SERICULTURE INDUSTRY

SERICULTURE, the technique of silk production, is an agro-industry, playing an eminent role in the rural economy of India. Silk-fibre is a protein produced from the silk-glands of silkworms.

Among the developing countries, India enjoys a very favourable position for doubling the present status of of silk porduction of 2,969 tonnes owing to the low cost of labour. sericulture is ideally suited for improving the rural economy of the country, as it is practised as a subsidiary industry to agriculture. Recent research has also shown that sericulture can be developed as a highly rewarding agro-industry.

Five varieties of silk worms are reared in India for producing this natural fibre. *Bombyx mori*, the silk worm, feeds on the leaves of *Morus* to produce the best quality of fibre among the different varieties of silk produced in the country. *Antherea assama* is confined to only Brahmaputra Valley of India in the world.It produces the famous *muga*silk.Tasar silk is a product of *Antherea mylitta*, which feeds on *Terminalia tomentosa* grown in the thick jungles of Bihar, Madhya Pradesh and Orissa. The recent introduction of *Antherea royeli* and *Antherea perniyi* has enabled the country to produce the oak tasar silk, *Phylosamia ricini*, the eri silkworm, which feeds on *Ricinus communis*, is raised in Assam and Orissa commercially.

Of the total production of 2,969 tonnes of silk in India, as much as 2,445 tonnes is produced by the mulberry silkworms,*Bombyx mori*.

Mulberry silk is produced extensively in the states of Karnataka, West Bengal and Jammu and Kashmir. About 85 per cent of the country's production is contributed by the Karnataka state by rearing multivoltine hybrids of silkworm and this activity enables the sericulturists to harvest five to six crops a year. Jammu and Kashmir, owing to its salubrious climate during autumn and spring, is producing silk by rearing univoltine silkworms. Other states, namely, Andhra pradesh, Assam, Tamil Nadu, Uttar Pradesh,Himachal Pradesh and Punjab, contribute roughly 1.8 percent to the total production of mulberry silk in India. Tasar silkworms are reared traditionally by the tribal people of Madhya Pradesh,Bihar, Orissa. These 3 states mainly contribute to the production of tasar silk in the country. The recent rearing of *Antherea royeli* & *Antherea perniyi* has enabled the country to produce the oak tasar silk in the sub-Himalayan belt & in Manipur. *Muga* silk is grown exclusively in Assam & it is still considered to be a ceremonial dress by the local population.
Assam produces as much as 90% of eri silk in the country by rearing eri silkworms on castor leaves.

MULBERRY SILK

The systematic cultivation of mulberry, the food plant of *Bombyx mori*, is the first step in the production of mulberry silk. The total area under mulberry in India is 1,20,567 hectares, of which only 28,781 hectares is irrigated Whereas, mulberry is raised as a bush plantation in Karnataka & West Bengal, it is grown as trees in Jammu & Kashmir. The propagation of mulberry in Karnataka & west Bengal is through vegetative propagation, whereas root-grafting & bud-grafting are practised in the hilly areas of Jammu & Kashmir & Uttar Pradesh. Considering the ecological conditions, such as rainfall & the nature of soil, different systems of plantations for raising mulberry are practised in India.In the rain-fed areas,mulberry is planted at a distance of 7.6*7.6 cm whereas under irrigation the spacing of 5 cm* 5cm & the row system (4 cm between rows & 15 cm between plants) are followed. In West Bengal, a modified system of row plantation, popularly called 'Malda System' is practised even under rainfed conditions, because of the rich soil & heavy rainfall.Recently, tree plantation have ben introduced into Jammu & Kashmir.

The cost of producing mulberry has a direct impact on the cost of producing cocoons, as nearly 605 of the total cost of production of cocoons goes to the production of mulberry leaves.

Experiments conducted in the moriculture divisions of the research institutions to evolve new varieties of mulberry & improved methods of cultivation have shown that over 30,000 kg of quality leaf can be produced per annum at competitive costs against 15,000 kg by adopting the traditional methods under irrigation. Many high-yielding varieties have been introduced into the country, & they not only double the leaf yield, but also maintain the succulence of the leaves, a factor which is very important under tropical conditions.

SILKWORM-REARING

In India(Karnataka state), where the temperature ranges from 16-31 degree centigrade, enjoys favorable climatic conditions for rearing the silkworm Bombyx mori throughout the year, whereas in West Bengal, the multivoltine silk-worm rearing is practiced even under adverse conditions of temperature. In Jammu & Kashmir, the rearing of silkworms is practiced once a year during May-June.

Of a life span of 50 days of B.mori, the egg stage lasts 10 days, the larval stage lasts longest-25-30 days. The pupa stage takes 10 days. The silkworm pass 4 moults during growth. The total quality of leaf required to raise a unit of 40,000 larvae(100 dfls) is 500-600 kg by using the traditional methods. The silkworms consume as much as 95% of the food after the third & fourth moults. At the end of the larval duration, the silkworm emits silk from its mouth & constructs a cocoon on a scaffolding. The cocoons produced by hybrids are used for extracting the silk fibre. For preparing the hybrid silkworm eggs, pure races of silkworms are raised in seperate areas. The cocoons are preserved properly in the egg-producing factories, popularly called silkworm grainages. the moths are allowed to emerge. The selected combination of moths are allowed to copulate for 4 hrs. The male after the first copulation is either rejected or used for copulating with another female. Later, the female is consigned to a dark plastic 'cellule'. She lays about 400 eggs in 24 hours. At the end of 24 hours, the female is crushed & examined for hereditary diseases. Only certified disease-free hybrid eggs are reared for industrial silk production.

Considering the various factors, such as the place of origin,voltinism, the colour of the cocoons, the larval markings, the colour ,shape & size of cocoons,the silkworms are classified into different breeds. The multivoltine races & their hybrids are reared in West Bengal & Karnataka. Owing to the non-diapausing of the eggs & the copious growth of the mulberry, these breeds can be reared six times & the cocoons are harvested after 2 months. These multivoltine hybrids have a short larval duration & are generally poor yielders of cocoons. Bivoltines, because of the interruption of diapause, can have only 2 life-cycles a year. However, its possible to break the diapause artificially by treating 1-day old eggs in Hydrochloric acid of 1.064 specific gravity at 46.1 degree centigrade. By adopting this technique, it is possible to take more than 4 crops in a year. Univoltines & bivoltines require more leaves than multivoltines. However, the yield & quality of the cocoons are superior to those of multivoltines. The multivoltine silkworms yield about 25 kg of cocoons per 40,000 eggs reared, whereas the bivoltines yield 40 kgs. The average annual yield of cocoons in India is as low as 150 kg under rainfed conditions, & under irrigated conditions, it is about 400 kg.

SILK-REELING

The cocoons are cooked in hot water & the silk fibre is unwound from the cocoons.This process is called 'reeling'.

The silk consists of two proteins, the inner core of fibroin & an outer cover of gum sericin. During reeling, the cocoons are processed in hot water at 95-97 degree centigrade for 10-15 minutes. This process is called cooking. This cooking will enable the sericin portion to get softened & make unwinding easy without breaks. The cocoons after cooking are reeled in hot water in different types of machines. In India, 61 percent of the silk amounting to 1,320 tonnes is reeled on the country-type *charka* numbering 6,656. The silk produced with the country charka is of very poor quality, as the thread is not uniform, as it carries many slubs etc. The improved cottage-type basins have been introduced recently into India. Provision for button-holes & a proper croisure system to maintain the thickness of the fibre, & to control the defects of neatness in the cottage basin have facilitated the production of better-quality silk. As much as 806 tonnes of silk is produced by 4000 cottage basins in the country.

Large-scale basins organised scientifically are arranged in filatures for the extraction of superior quality fibre. The silk produced by the filatures is superior because of the low level of defects of cleanliness & uniformity in the thickness of the fibre. Only 8% of the total production of silk in India is contributed by filatures.

The silk produced from the multivoltine races of silkworms is poor in quality & is known to have greater defects, such as lousiness, & defects in neatness & cleanliness & is of very poor quality in light of the international D grade. The silk produced by the bivoltine races of silkworms possesses superior neatness & cleanliness, is without lousiness & has high tensile strength & stands to the international A grade.

The new technology of handling silkworms in the country has shown that bivoltine silkworms, producing the international quality of silk, can be produced throughout the year in the Karnataka state in India. It has been shown that, on an average, 30-35 kg of cocoons, yielding 3-4 kg of high grade silk can be produced by rearing 40,000 eggs of bivoltines, as compared with 25 kg of cocoons & 1.4 kg of low-quality fibre from multivoltines.

BIVOLTINE COCOON HARVEST

Research observations have shown that the cocoon production can be increased significantly at economic costs.
It is programmed to produce 800 tonnes of bivoltine silk in Karnataka alone by 1980 & increase silk production from mulberry in India to 3,500 tonnes.

Non-mulberry silk industry

Tasar culture. Three species of *Antherea* are used for the extraction of tasar silk in India. They are *Antherea mylitta, A. perniyi* & *A. royeli*. In the case of the non-mulberry silk produced in India, 393 tonnes is produced from *Antherea mylitta* in Madhya Pradesh, Orissa & Bihar. This silkworm is reared on trees of *Terminalia tomentosa,Terminalia arjuna* found in the jungles of central & north-eastern parts of India. The tasar silkworms also exist in nature in jungles & are collected by the tribal people during certain seasons. The first crop, usually called the seed crop, is raised during May to July, whereas the commercial crop is raised during October-November.

Moths emerge from the cocoons of the November crop in June. The female moths are allowed to lay eggs after copulation in small baskets called *manias*. The eggs are collected & tied to the trees so that the hatched silkworms crawl up to reach the leaves of the food plants. Tasar silkworms are reared wild in nature & they survive exposed to the vagaries of nature & predators. They are uaually green. However, yellow, blue & white larvae are also reported. The larvae pass 4 moults before they complete their duration. At the end of the larval period, the larvae spin a ring-like structure around the twin & a long peduncle before it constructs the cocoon. The cocoons are large & brown or yellow. When the rearing is practised under cultivated conditions, the rearers protect the worms from pests & predators to harvest rich crops.

The cocoons are cooked in caustic potash & reeled to extract the fibre. They are also spun for manufacturing coarse fibre.

Tasar rearing. The recent introduction of *Antherea perniyi & A. royeli* on oak in Manipur has opened up new vistas for the production of superior quality tasar fibre in India. The cocoons spun by the *Antherea perniyi* can be easily reled & superior-quality fibre can be extracted. *Antherea royeli* is available in oak jungles of the sub-Himalayan belt. The cocoons are made up of 2 layers, an outer layer of thin floss & an inner thick shell of silk. The silk can be extracted only from the inner layer. Hybrids of *A. perniyi* & *A. royeli* are being exploited commercially for the production of quality tasar silk in India. A target of 650 tonnes of silk is proposed to be produced by the end of the Fifth Five-year Plan.

Muga culture. The golden-yellow silk produced by *Antherea assama* is found only in the Brahmaputra Valley of India. This species of silkworm is semi-domesticated in that the worms which crawl down at the end of their larval period are collected by the rearers. They are allowed to spin cocoons in the rearer's houses.

The worms are raised on *Som(Machilus bombycina) & soalu(Litsaea polyantha)* -trees.
A single female moth of muga lays 150-200 eggs after copulating with the male for 6-8 hrs. Usually, the female is tied to a 'kharika' for laying eggs. The larvae are reared, outdoors on trees of *som* or *soalu*.The young ones are yellowish with black markings on the body. They have the habit of crawling down the trees in groups when no leaves are left. During this time, the rearer transfers the worms to another tree. At the end of the larval period, when the worms are ready to spin the cocoons, they crawl down the tree in search of a suitable place for the construction of cocoons. Such worms are collected by the rearer & are allowed to spin the cocoons in 'jali', made of dried twigs.

The cocoon has a very weak peduncle & is golden-yellow. The cocoons are boiled in soap & soda aolution & are reeled on an appliance called "bhir". It is a tradition in Assam to raise *muga* silk. The total production of *muga* silk in India is 41 tonnes & is estimated that the country can produce 120 tonnes by 1980.

Eri culture. The silk produced by *Philosamia ricini* is called eri silk. It is grown in Assam & in the eastern parts of India. The heavy rainfall & humid atmosphere in these parts are suited to eri culture. The food plants for *Philosamia ricini* is castor.The alternative food plants are <I< sp.,Plumeria Ailanthus papaya, Carica utilissima, Manihot fragans,>but eri culture is mainly practised on castor.
This silk worm is multivoltine & is reared indoors. The eggs are white, hatch in ten days. The hatched larvae are mounted on castor leaves in the rearing-house & are allowed to grow by periodical feeding. The worms pass four moults during its larval period of 30-32 days. Eri silkworm is generally hardy & not easily susceptible to diseases. at the end of the larval period, the larvae crawl in search of a suitable place among castor leaves to spin the cocoons. The cocoons are usually white. However, brick red cocoons have also been observed. The cocoons of the eri silkworm cannot be reeled, as they are made up of uneven fibres. Usually, after the emergence of the moths, the cocoons are used for producing spun-yarn. Ninety-one tonnes of eri silk is produced in the country, & it is proposed to produce 375 tonnes by the end of the Fifth Plan.

Research findings have shown that under the existing acreage of food plants of silkworms, it is possible to increase the silk production 3-fold, in addition to increasing its quality. The introduction of new technology of handling *Bombyx mori* silkworms into the major sericultural tracts of the Karnataka state has enabled the state to produce a significant quality of bivoltine silk standing to the international grades. This silk was originally

imported. Its addition to the import substitution, the introduction of bivoltine silk production will enable the country to enter the export market of raw silk, opening a new directional approach to the development of sericulture in the country. It is proposed to produce over 800 tonnes of bivoltine silk by the end of the Fifth Five-Year Plan. The impact of bivoltine silkworm-rearing has already been felt by the sericulturists in Karnataka.

In addition to the higher returns of over Rs 10,000 per acre & the quality of cocoons, there is a significant improvement in the production of the existing multivoltine silk, as the bivoltine males are used for cross-breeding with the multivoltines. a significant break-through in controlling the diseases of silkworms & mulberry has ben achieved through the efforts of the research institutes in India. It has been shown that silk production in India can be increased from the present standard of 25kg per hectare to 140 kg under irrigated conditions & from 10 kg per hectare to 25 kg under rainfed conditions & the country's production can be increased 3-fold. These observations have a significant influence on the employment potential of the rural people increasing the employment potential from 30.37 lakhs of persons to 37.94 lakhs by 1980.

Recent findings relating to the rearing of tasar silkworms on oak plants in the sub-Himalayan range & in Manipur have placed the country in a new set-up of producing a significant quantity of quality tasar silk. It has also opened up new avenues for introducing & improving sericulture. It has also enhanced employment potential to the tribal & poorer sector in the hilly areas. Thus the country is poised for a white revolution leading to the production of international-quality silk, both in the mulberry & tasar sector & increasing the total silk production to 3500 tonnes providing employment potential for 37 lakhs of rural people in various fields of silk production.