
UNIT 1 IMPORTANCE OF SERICULTURE

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1.0 OBJECTIVES

After reading this unit, you will be able to:

- explain the potentialities of sericulture as a source of rural employment and as an export earning enterprise;
- differentiate different silkworms and their host plants;
- determine various support systems available to strengthen sericulture; and
- identify the organizations involved in sericulture training and skill upgradation.

1.1 INTRODUCTION

Sericulture plays a major role in rural employment, poverty alleviation and earning foreign exchange. A lot of entrepreneurial opportunities are available in various fields of sericulture. It is practised in various states *viz.*, Karnataka, Andhra Pradesh, Jammu & Kashmir, West Bengal and states like Madhya Pradesh and Maharashtra have also started practising Sericulture. The non-mulberry (also called Vanya silk) sericulture is practised in Assam, Jharkhand, Orissa and Madhya Pradesh. More than 6 million people are involved in sericulture activities. It is necessary to upgrade

the skills of the sericulturists to use the full potentialities of sericulture to produce qualitatively superior cocoons and to earn profitable income.

1.2 WHAT IS SERICULTURE?

Do you know what Sericulture is? Come, let us understand what we mean by sericulture.

Sericulture is an agro-based industry. It involves cultivation of host plants and rearing of silkworms for the production of cocoon to produce raw silk. 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 processing and weaving to produce the valuable products.

Now, let us know about the valuable fibre “silk”. Silk is called the “Queen of Textiles” and is known for its qualities like luxury, elegance, class and comfort. According to Chinese literature, the Chinese Empress Shiling Ti discovered it in her tea cup. It has overcome the challenges from other natural and artificial fibres and remained the undisputed “Queen of Textiles” for centuries.

Silk has been intermingled with the life and culture of the Indians. Though, India is producing all varieties of silk products such as dress materials, scarves/stoles, readymade garments, etc., the silk sarees are truly unique. It is the traditional costume of the Indian woman since time immemorial. There are innumerable references in Indian literature to this silk. Saree stands as a living example of the excellent craftsmanship of the weavers of the country. The saree is almost synonymous with the word silk.

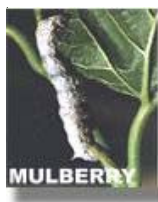
Chemically speaking, silk is made of proteins. The silkworms feed on the selected food plants and spin cocoons as a 'protective shell' with silk fibre. Silkworm has four stages in its life cycle viz., egg, caterpillar, pupa and moth. Man interferes in this life cycle at the cocoon stage to obtain the silk, used in weaving of the dream fabric.

1.3 TYPES OF SILKS

How many of us know that there are four types of silks produced in India? Do you want to know them? Come, we shall know some basic things about them.

India is blessed with cultivation of all the four commercial varieties of silks viz., mulberry, tasar, eri and muga and their food plants. India is the only country producing muga silk in the world and thus enjoys monopoly in its production.

i) MULBERRY



Mulberry silk is considered to be qualitatively superior. Mulberry is the food plant of mulberry silkworm, *Bombyx mori*. Bivoltine silk is qualitatively superior to multivoltine silk. India produces 90% of its silk in multivoltine form.

Fig. 1.1: Mulberry Silkworm

Mulberry silk is considered to be superior in quality as compared to other varieties. *Bombyx mori*, the mulberry silkworm feeds on mulberry leaves (Fig.1.1). About 92 per cent of the total production of the country consists of mulberry silk. Mulberry sericulture is practised in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra, West Bengal and Jammu & Kashmir.

ii) MUGA



Fig.1.2: Muga Silkworm

Muga silkworm, *Antheraea assama* is unique in secreting an unusual golden yellow coloured lustrous silk (Fig. 1.2). Muga production is the prerogative of India and the pride of Assam state. The popular name ‘Muga’ is an Assamese word which indicates the brown colour of the cocoon. The distribution extends from western Himalayas to Nagaland, Cachar district of Assam and South Tripura.

It is obtained from semi-domesticated multivoltine silkworm. These silkworms feed on the aromatic leaves of Som and Soalu plants and are reared on trees similar to those of tasar. The muga silk, is used in products like sarees, mekhalas, chaddars, etc., and is costly.

India is the only country that produces Muga silk. Muga contributes only 2% to the country’s total raw silk production. Muga worms are not reared in side rooms / houses like mulberry silkworm.

iii) ERI



Fig.1.3: Eri Silkworm

The name Eri is derived from the Assamese word ‘ERA’ meaning Castor oil plant, the main food of eri silkworm. It originated in India. This silkworm, *Philosamia ricini*, which feeds on the foliage of castor is also called *Erunda* or *Endi* (Fig.1.3).

Apart from the economic importance of Eri silk, the pupae are consumed. Ericulture is a household activity practised mainly for protein-rich pupae, a delicacy of the tribals. Eri is a multivoltine silk spun from open-ended cocoons, unlike other varieties of silk. Ericulture is mainly concentrated in areas of North Cachar, Mikir hills, Kamrup and eastern Goalpara in Assam, North Tripura, Muzaffarpur, Bhagalpur and Purnia in Bihar, Cooch Behar and Jalpaiguri in West Bengal and West Manipur. Now, it is being practised commercially in other parts of the country also. The silk is used indigenously for preparation of *chaddars* (wraps) for their own use by the tribals.

iv) TASAR



Fig.1.4: Tasar Silkworm

Tasar silkworms are reared in the tropical and temperate zones. Four species of the genus *Antheraea* are used in commercial production. The tropical silkworm - *A. mylitta* D. (India) and the temperate silkworms - *A. proyli* J. (India), *A. pernyi* G.M. (China and the USSR) and *A. yamamai* G.M. (Japan) are especially important in tasar production.

Tasar (Tussah) is copperish coloured, coarse silk mainly used for furnishings and interiors. It is less lustrous than mulberry silk, but has its own feel and appeal. Tasar silkworm, *Antheraea mylitta* (Fig.1.4) mainly thrives on the food plants Asan and Arjun. The rearings are conducted on the trees in the open. In India, tasar silk is mainly produced in the states of Jharkhand, Chattisgarh and Orissa, besides Maharashtra, West Bengal and Andhra Pradesh. Tasar culture is the mainstay for many a tribal community in India.

Check Your Progress 1

Note: a) Use the spaces given below for your answers.
b) Check your answer with those given at the end of the unit.

1) Which are the states practising Tasar Culture?

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2) Which are the states practising Mulberry Sericulture?

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3) Which are the states practising Eri Culture?

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4) Which are the states practising Muga Sericulture?

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1.4 IMPORTANCE OF SILK INDUSTRY

The practice of sericulture is beneficial to the rural population in many ways and its importance is explained in the following pages.

- **High Employment Potential :** It is a source of providing employment. It is astonishing to know that sericulture industry is providing gainful employment to 60 lakh persons every year in our country.

This sector employs one man throughout the year for producing every 3.07 kg of silk produced and used in handlooms. This potential is very high and no other industry generates this kind of employment, especially in rural areas. It is because of this reason that sericulture is practised as a tool for rural reconstruction.

Considering the employment potential, it occupies an important place in the five-year plans and in poverty alleviation programmes of the country. One acre of mulberry garden provides job to 2.1 persons round the year.

- **Important Agro-based Enterprise Adding Value in Villages:** About 57 % of the gross value of the final product in the industry (silk fabrics) flows back to the cocoon growers.

- **Low Gestation, Low Investment and High Returns :** Mulberry takes only six months to grow for commencement of silkworm rearing. An investment of only Rs.12,000 to 15,000 (excluding cost of land and silkworm rearing house) is sufficient to undertake mulberry cultivation and silkworm rearing in one acre of irrigated land. Mulberry once planted will support silkworm rearing for 15-20 years depending on inputs and management provided. Five crops can be taken in one year under tropical conditions. By adopting recommended package of practices, a farmer can attain net income levels up to Rs.30,000 per acre per annum.
- **Women Friendly Occupation :** Sericulture activities starting from mulberry garden management, leaf harvesting and silkworm rearing are more effectively taken up by women. Even the post-cocoon activities like silk reeling, twisting and weaving are largely supported by them. Thus, women constitute over 60% of those employed in sericulture industry.
- **Ideal Programme for Weaker Sections of the Society :** Sericulture can be practised even with very low land holding (0.75 acre of mulberry garden and silkworm rearing can support a family of three without hiring labour). Features such as low gestation and high returns make sericulture an ideal programme for weaker sections of the society.
- **Eco-friendly Activity :** As a perennial crop with good foliage and root-spread, mulberry provides green cover and contributes to soil conservation. Waste from silkworm rearing can be recycled as inputs to the mulberry garden. Being a labour intensive and predominantly agro-based activity, smoke-emitting machinery is not involved. Developmental programmes initiated for mulberry plantation are mainly in upland areas, vacant lands, hill slopes where un-used cultivable land is made productive and also in watershed areas due to its deep-rooted perennial nature.

One acre of mulberry cultivation generates employment for 5 people throughout the year. Wastes generated out of one hectare mulberry cultivation and silkworm rearing produces 5,000 kg of vermi-compost per year.

1.4.1 Why Sericulture?

In an agriculture-dominated country like India, it is quite important to know why sericulture is getting importance in the government plans. The next two paragraphs will let you know about the same.

The food plants of silkworms can grow in a wide variety of lands starting from plains to hilly areas with minimum rainfall. Sericulture assumed importance in the socio-economic structure of the developing countries as it could be practised during the free time of the farmer while raising other crops. Thus, it is more suitable to women who can rear silkworms in the house alongside their housework. Apart from the above, the following points throw some more light on the importance of sericulture **at the individual level.**

- Gives good returns at the family level.
- Could be started with low investment.
- Could be practised with minimum technical skills.

- Most of the silkworm rearing activities are not continuous and are confined to the indoors.
- Provides employment at the door step.
- Provides income at short intervals throughout the year.
- More suitable for small and marginal farm holdings.
- Short gestation period and longstanding crop.
- Involves family and unemployed youth.
- Existing market demand for the final product.

At national level, sericulture assumes importance because of the following points:

- Provides raw material for handlooms and power looms, thus supporting the weavers and other supporting sectors for their livelihood.
- Helps to earn foreign exchange and saves expenditure on imports.
- Supports rural development schemes as it employs rural labour.
- Prevents migration of working rural mass, thus minimizing the urbanization problems.
- Provides raw materials for other subsidiary enterprises.
- Has scope for by-products utilization for value addition.

With all the above inherent advantages, sericulture will improve the economic conditions of people, thus supporting the economic development of the nation.

Check Your Progress 2

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What are the important features of sericulture, which has led to its practice by a large group of people?

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1.5 SILKWORM AND THE FAMILY

Now, let us try to understand the silkworm, which produces this invaluable silk. Today, man has understood that there are many indigenous varieties of wild silk moths found in nature. The blind, flightless moth, *Bombyx mori*, lays 500 or more eggs in four to six days and dies soon after (Fig.1.5). The silk thread produced by *Bombyx mori* will be smooth, fine and round. Today, the moth of the silkworm *Bombyx mori* has lost its power to fly and is only capable of mating and producing eggs for the next generation of silk producers.



Fig.1.5: Silkworm eggs

1.5.1 The Life Cycle of Silkworm

It is interesting to know how the silkworm develops and when it starts spinning the silk thread. The silkworm passes through four stages in its life. After the silkworms hatch from the eggs, the baby worms feed day and night on fresh, hand-picked and succulent mulberry leaves until they pass second moult. A fixed temperature has to be maintained throughout. After the second moult, a whole branch of mulberry has to be fed to the worms on the shoot rearing racks. Thousands of feeding worms are kept on these racks till they complete all the four stages. The silkworm sheds its skin each time it passes from one stage to the other. The silkworm multiplies its size by 10,000 times within a month, changing colour and shedding its whitish-grey skin *four* times. The silkworms feed until they enter the cocoon (also called Pupal) stage. While spinning the cocoons, the worms produce a jelly-like substance in their silk glands, which hardens when it comes in contact with air and spin cocoons around them. After four to five days in a warm, dry place, the cocoons are ready to be unwound. The total life cycle of silkworm completes in about 25 to 35 days depending upon the race and climatic condition (Fig. 1.6).

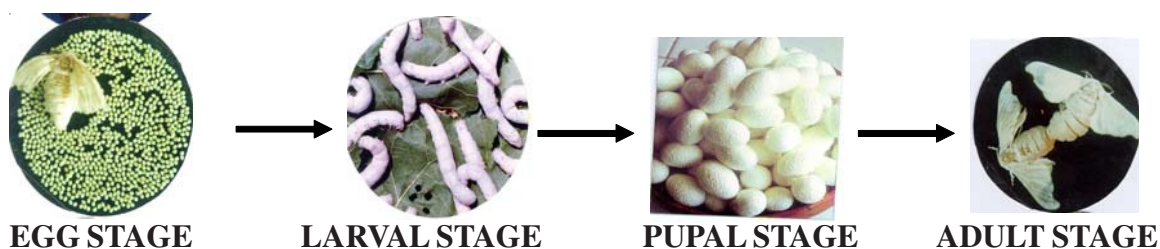


Fig.1.6: Different stages in the life cycle of Silkworm

Now, let us take a brief look at what happens after cocoon harvest.

First, the cocoons are baked to kill the pupae. The cocoons are then dipped into hot water to loosen the tightly woven filaments. These filaments are unwound onto a spool. Each cocoon is made up of a filament between 600 and 1,000 meters long. Five to eight of these super-fine filaments are twisted together to make one thread. Finally, the silk threads are woven into cloth or used for embroidery work. Clothes made from silk are not only beautiful and lightweight, they are also warm in cool weather and cool in hot weather. For detailed information on reeling and other post cocoon activities, Unit 2 of Block 2 may be referred.

Reeling silk and spinning were always considered household duties for women, while weaving and embroidery were carried out in workshops as well as at home. In every silk-producing area in the country, the women in sericulturists' families devote a large part of the year to the feeding, tending and supervision of silkworms and to the unravelling, spinning, weaving, dyeing and embroidering of silk.

1.6 DISTRIBUTION

Eventhough sericulture is practised in India since Vedic periods, do you know that it spread to India from China through Tibet during 140 BC? Shortly after 300 AD, sericulture travelled westward and the cultivation of the silkworm was established in India. It is also said that in 440 AD, a prince of Khotan (today's Hetian), a kingdom on the rim of Taklamakan desert - courted and won a Chinese princess. The princess smuggled out silkworm eggs by hiding them in her voluminous hairpiece.

By the fifth century BC, six Chinese provinces were producing silk. Each spring, the empress herself inaugurated the silk-raising season. Silk production was the work of women all over China. The technique and process of sericulture were guarded secrets and closely controlled by Chinese authorities. Anyone who revealed the secrets or smuggled the silkworm eggs or cocoons outside China would be punished by death.

Then, around 550 AD, two Nestorian monks appeared at the Byzantine Emperor Justinian's court with silkworm eggs hidden in their hollow bamboo staves. Under their supervision, the eggs hatched into worms, and the worms spun cocoons. Byzantium was in the silk business at last. The Byzantine church and state created imperial workshops, monopolizing production and kept the secret with them. Thus, silk industry was established in the Middle East, limiting the market for ordinary-grade Chinese silk. By the sixth century, the Persians too, had mastered the art of silk weaving, developing their own rich patterns and techniques. It was only in the 13th century that Italy began silk production with the introduction of 2,000 skilled silk weavers from Constantinople. Eventually, silk production became widespread in Europe. The practice of different types of silks in various parts of the country is indicated in Fig 1. 7.

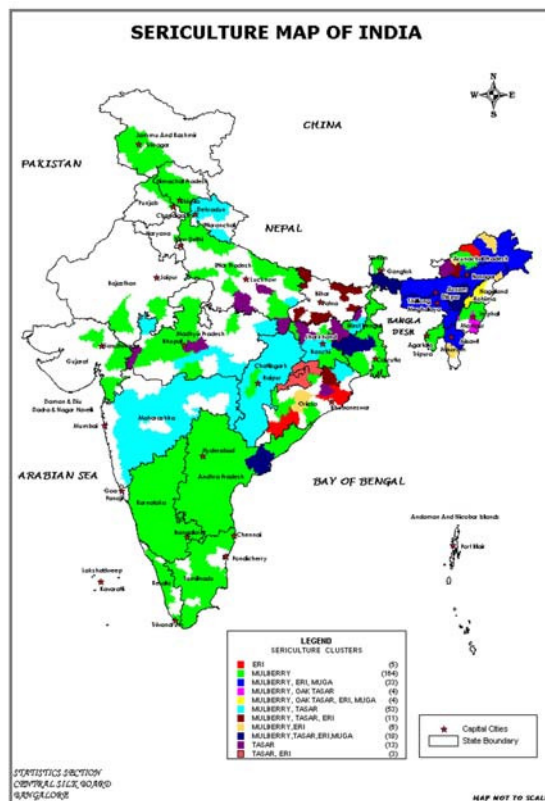


Fig.1.7: Distribution of different types of silk produced in India

1.6.1 Silk and Its Trade

Some important facts about silk development in the ancient period are indicated below:

- Silk trade started before the second century BC.
- Later, ambassadors of the Chinese emperor, Han Wu Di travelled towards Persia and Mesopotamia, with gifts including silks.
- It reached Baghdad in 97AD, and important finds of silks have been made.
- The Greeks and Romans began talking of Seres, the Kingdom of Silk during 400 BC.
- The Roman Emperor Heliogabalus (218 – 222 AD) wore silk.
- By 380AD, Marcellinus Ammianus reported, "The use of silk which was once confined to the nobility has now spread to all classes without distinction, even to the lowest." The craving of silk continued to increase over the centuries.

1.7 CONSTRAINTS OF SERICULTURE INDUSTRY IN INDIA

Though, India has achieved a significant leap in silk production and productivity, Indian sericulture industry is facing certain problems. Some of them are:

- Bulk of the silk produced in the country is got from the cross-breed of multivoltine and bivoltine breeds, which is low in quality by international silk standards and cannot be used in high-speed looms.
- Though, attempts were made to introduce sericulture in many states in a big way through World Bank aided National Sericulture Project (NSP) during the 1990s, sericulture production is still limited to the traditional silk producing states.
- The cost of production of silk in India is much higher than that of China. Hence, imported Chinese silk is available at a cheaper price to Indian weavers.
- The production system of China is far superior to that of India. Thus, there is a scope for a lot of improvement in the production system to improve the quality and productivity of Indian silk.
- There is a sharp decline in mulberry area due to uprooting of mulberry and urbanization.
- The reeling sector is unorganized in India. Sixty per cent of Indian raw silk is produced by age-old charka technology and 35 % of the production is in cottage basin and only 5 % is in filature.
- The current production of silk in the country cannot cater to the demand for silk in the country. Hence, India has to import raw silk.

This clearly indicates that there is a scope to improve the productivity and quality of silk in the country.

Trade liberalization due to implementation of WTO agreement poses a threat to sericulture industry due to high cost and low quality of Indian silk.

Check Your Progress 3

- Note:** a) Use the spaces given below for your answers.
b) Check your answer with those given at the end of the unit.

- 1) What are the different stages in the life cycle of silkworms?
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- 2) List five important constraints faced by the silk industry in India.
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1.8 SERICULTURE ECONOMICS

After learning about the types of silkworms, distribution, production and advantages, it is relevant for us to know the cost and returns in sericulture. Sericulture is suitable to small, medium and large-scale farmers. As such, the economics of sericulture will also vary.

Now, we all know that mulberry can be cultivated in a wide range of agro-climatic conditions and both in rainfed and irrigated areas. But, the latest research development indicates that mulberry can also be cultivated as intercrop with some plantation crops without reducing the income. Similarly, silkworm rearing can be conducted at different scales in wide range of climatic and seasonal conditions throughout the year.

Sericulture is highly suitable to small and marginal farmers, because of its capacity to generate a high income with comparatively less investment. A survey conducted with the sericulture farmers under tropical conditions by Central Sericultural Research and Training Institute (CSRTI), Mysore revealed that small farmers earned a net income of Rs. 46,339 from one acre of irrigated land and Rs. 7,800 from one acre of rain-fed land from sericulture in one year.

Under assured irrigated condition, a farmer can take up silkworm crops five times in a year at 70 days interval. Further, sericulture helps to shift the income from affluent urban societies to rural people, as silk is a high value commodity and consumed more by rich people.

With better planning and management, 10 crops per year can also be taken instead of 5 crops. This system enables the efficient use of the resources such as land, labour and capital. This leads to higher profits.

Sericulture provides employment for 506.20 man-days per annum per acre. The participation of women in sericultural activities is quite high. The contribution of women manpower in sericultural activities was 56.70%. Further, the seasonal unemployment created in agriculture for labourers can be effectively utilized in sericulture.

You will learn about the economics of sericulture in detail in Block 3 of Course 3.

Sericulture also helps the country to earn valuable foreign exchange. India earns Rs. 1,500 crores annually through the export of silk goods.

1.9 QUALITY CONCEPT OF RAW COCOON AND SILK

In the context of globalization, quality plays an important role globally and this is true for sericulture also. Hence, the stakeholders of the sericulture industry should focus more on production of quality products. In this regard, it is essential for us to know about the quality parameters of cocoons and raw silk.

What is meant by quality cocoon?

Quality cocoon means the production of cocoons with uniform shape, size, less defective cocoon percentage and good reelability. These parameters could be obtained by the proper usage of technologies and packages recommended in mulberry leaf production and silkworm rearing.

Visual examination of a cocoon lot for some of the defective cocoons may be made for identifying the percentage of following types of cocoons:

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| 1) Melted cocoons | 2) Double cocoons | 3) Pierced cocoons |
| 4) Stained cocoons | 5) Thin-end cocoons | 6) Flimsy cocoons |
| 7) Malformed cocoons | | |

The quality parameters of silk are as follows:

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| 1) Non-breakable filament length | 2) Uniform denier | 3) Cohesion |
| 4) Cleanliness | 5) Evenness | 6) Neatness |
| | | 7) Elongation |

For detailed information on quality parameters, you can refer Unit 2 of Block 2.

1.9.1 Support Systems Functioning for Strengthening Sericulture

The support system in sericulture consists of the research system which includes all those who involve in new technology output; the extension system, which takes the technology from the research system and disseminates to the needy clients so that farmers understand and accept the new technology; the farmers system, which consists of all types and categories of farmers who utilize the new research outcomes for their economic well being. The extension system after disseminating technology to the needy farmers collects the opinion of the farmers about the suitability of new technology and in turn passes it on to the research system. This feedback will be utilized by the research system to formulate new research programmes or for modifying the technology that is already in use by the farmers (Fig.1.8)

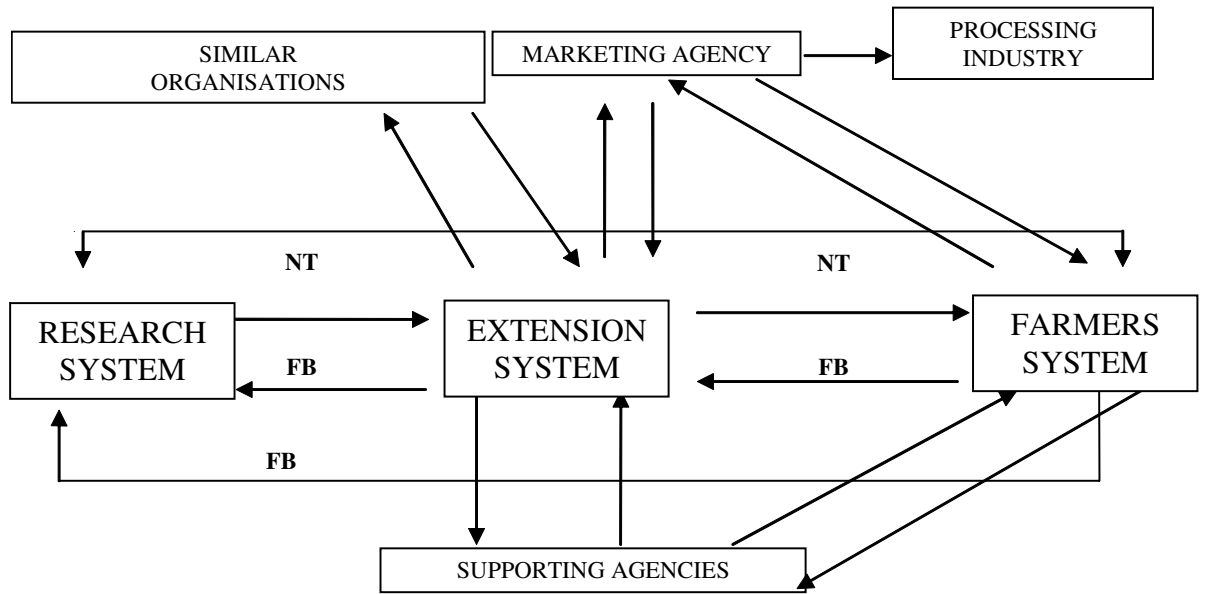


Fig. 1.8: Diagrammatic working & linkage in sericulture

Check Your Progress 4

Note: a) Use the spaces given below for your answers.
 b) Check your answer with those given at the end of the unit.

- 1) Define 'quality cocoons'.

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- 2) Enlist the different defective cocoon types.

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1.10 LET US SUM UP

Sericulture, being an agro-based commercial enterprise involves cultivation of food plants and rearing of silkworms. There are different types of silkworms producing different types of silks. India is the only country that produces muga silk in the world. Sericulture originated in China and was distributed to different parts of the world through the “silk route”. Silkworm passes through different stages in its life cycle, like egg, larva, pupa and adult. Sericulture is an eco-friendly enterprise generating sufficient income and employment to the farmer’s family. It also earns foreign exchange for the country by way of exporting silk and fabric to different countries. The silk is graded internationally for quality, based on several cocoon and raw silk characters. Shell ratio and denier are the important quality parameters that are looked into while grading the silk. Quality is also determined by the race of

silkworm and leaf quality. The farmers are linked with research institutes for addressing their problems and ensuring the transfer of technology.

1.11 GLOSSARY

Bivoltine	: is a type of silkworm which completes two life cycles per year in natural conditions.
Feedback	: refers to the opinion of the farmers about the new technologies popularized among them. This will help the researchers in formulating research proposals, modifying the existing technology or withdrawing the technology.
Indigenous	: Native to a particular country.
Man-Day	: refers to eight hours of work done by an average adult.
Monopoly	: refers to a single producer of a particular product. Eg: Railways in India, Muga production in the world is monopolized by India etc.
Muga Silk	: Muga silkworm is a unique insect secreting an unusual golden yellow coloured lustrous silk. The popular name 'Muga' is an assamese word which indicates the brown colour of the cocoon.
Multivoltine	: is a type of silkworm which completes more than three life cycles per year in natural conditions.
National Sericulture Project	: A project funded and popularized by the government of India for the development of sericulture in the country.
Research System	: refers to the organizations involved in the technology generation.
Sericulture	: refers to the cultivation of mulberry and rearing of silkworms to produce cocoons.
Silk	: is made of proteins secreted in the fluid state by a caterpillar, popularly known as 'silkworm'.
Similar Organizations	: refers to the organizations whose nature of work is same.
Skill	: refers to the correct way of doing a particular activity. Eg: Mixing water with acid, preparation of disinfectant solution, deflossing of cocoons by using deflossing machine etc.

1.12 SUGGESTED FURTHER READING

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1.14 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) In India, tasar silk is mainly produced in the states of Jharkhand, Chattisgarh and Orissa, besides Maharashtra, West Bengal and Andhra Pradesh.
- 2) Mulberry sericulture is practised in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra, West Bengal and Jammu & Kashmir.
- 3) Ericulture is mainly concentrated in Assam, Tripura, Bihar, West Bengal and West Manipur. Now, it is being practised commercially in other parts of the country.
- 4) Muga sericulture is practised in Nagaland, Assam and South Tripura.

Check Your Progress 2

- 1) Main reasons for practising sericulture are:
 - High employment potential.
 - Important agro-based enterprise adding value in villages.
 - Low gestation, low investment and high returns.
 - Women friendly occupation.
 - Ideal programme for weaker sections of the society.
 - Eco-friendly activity.

Check Your Progress 3

- 1) Silkworm undergoes four stages in its life cycle namely egg, larva, pupa and adult / moth stage.
- 2) Important constraints faced by the silk industry in India are:
 - The silk produced in India is mainly of the cross-breed variety which is low in quality by international silk standards and cannot be used in high-speed looms.
 - Chinese silk is available at a cheaper price as compared to Indian varieties due to its low cost of production.
 - There has been a sharp decline in mulberry area due to uprooting of mulberry trees and urbanization.
 - The reeling sector is unorganized in India and majority still follow old technology.
 - Indigenous demand for silk is more than the production.

Thus, there is a scope for improvement in the production system.

Check Your Progress 4

- 1) Quality cocoon means the production of cocoons with uniform shape, size, less defective cocoon percentage and good reelability.
- 2) The different defective cocoons are:
 - 1) Melted cocoons 2) Double cocoons 3) Pierced cocoons
 - 4) Stained cocoons 5) Thin end cocoons 6) Flimsy cocoons
 - 7) Malformed cocoons