CHAPTER – 1

Fiscal and Environmental Barriers in Silk Reeling and Wet Processing Sectors
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1.1 INTRODUCTION

The silk Industry, one of the productive cottage sectors in India is developing rapidly and lucratively over the past years.

Clothing is the second important need and the factors like comfort, material, cost, quality, design, and fashion appeal play a significant role during cloth selection. Among the natural fibres - silk, cotton and wool, silk is known as the queen of fibres.

Irrespective of age, sex, income status and the geographical location, everybody seems to adore silk fabrics and silk-related products, including sarees, bridal wear, hand bags, rugs, sox etc.

In addition, silk products come in different price ranges and are considered as exclusive and luxurious as gems and jewels. Therefore, silk products enjoy the support from the upper economic strata as well as from the middle class Indian society. Further, being a natural fibre, silk is acceptable in both domestic and export markets.

Despite India being the second largest producer of silk in the world behind China, the annual silk consumption exceeds the production in India. For example, while the production is about 18,000 MT, the consumption is 26,000 MT. India has a share of approximately 13.4% in the global raw silk production and hence the western countries believe that the Indian silk industry is a viable alternative to that of Chinese silk. Accordingly, the foreign exchange earnings from silk exports have been over Rs.3000 crores [1].

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Pre-cocoon and post-cocoon are the two major areas in the silk industry.

The pre-cocoon sector, called farm or sericulture sector, is connected with larval stage to cocoon production stage. The characteristics of pre-cocoon observed during the larval stage are hatching percentage, total larval period and pupation. Cocoon-yield depends on the quality of cocoons. Depending on the number of generations per year, the silkworms are classified into univoltine, bivoltine or multivoltine breeds. Univoltine and bivoltines breeds are specific for temperate areas whereas multivoltines are for tropical areas [2].

Most of the farmers in Andhra Pradesh state produce bivotine and multivoltine breeds. They bring these cocoons to the nearest cocoon market daily, for sale. The silk reelers purchase these cocoons through auction. The cocoon markets are run by the department of sericulture, government of Andhra Pradesh.

The post-cocoon process involves reeling, twisting, dyeing, designing, weaving and trading, which help in the production of silk apparel. The process by which silk cocoon is reeled into raw silk (on silk reeling machines) is called reeling. During twisting, reeled yarn is twisted to provide strength to the yarn. Twisting is followed by dyeing, in which the raw silk is dyed with diverse colours/dyes, to bring splendors to the silk yarn.

Subsequently, in the designing sector, designers create a variety of fabulous designs that are later woven on the sarees/fabrics by the
weavers. These processes occur gradually for the production of silk fabrics. Finally, the finished product is made available to the traders for sale.

1.2 PROBLEM STATEMENT

Considering the industry as a whole, the entire process of silk manufacturing is profitable. However, as far as individual process is concerned, several constraints are involved. For instance, in our problem statement of the reeling and dyeing sectors, we find that the entrepreneurs face several problems starting from the purchase of cocoons to the production of the raw silk and dyeing of the yarn. The limitations are discussed in detail below:

1. First, after transporting the cocoons from the cocoon market, reelers must stifle (cocoon drying) the cocoons either by steam or hot air to kill the pupae, otherwise the pupae will pierce the cocoons or come out of the shells, which makes the shells useless.

   If reelers choose steam stifling, cocoons must be reeled within two or three days, otherwise the cocoons become vulnerable to fungal infections, rendering them futile. The cocoons which are dried through hot air dryers can be stored for a longer period [2].

   The following two hot air drying options are available for reelers: i) Ushnakoti and ii) Electrical [2]. Both methods have their own advantages and disadvantages. Ushnakoti requires firewood to generate adequate hot air for drying, in contrast, although electrical
hot air dryers offer an advantage over Ushnakoti, the expenditure associated with electrical energy can be a limiting factor.

Hence, in both cases, reelers have no other option but meet the expenses on cocoon stifling.

2. Second limitation is noticed while cocoon cooking. Hot water in two to three pans with different temperatures, between 70°C and 98°C is essential for cooking the cocoons [2]. Thus, reelers are dependent on the firewood boilers to generate the steam for obtaining required temperatures in the cooking pans.

![Fig. 1.1 Cocoon cooking](image)

Fig. 1.1 shows cooking process in a reeling unit, for softening the cocoons for better silk reeling. Cooking pans, cocoons, arrangement for cold water and steam pipe valves are also seen.

3. Third obstacle is observed during reeling. While reeling, hot water between 35°C and 45°C must be maintained in reeling basins of the Multi-End Silk Reeling machine [2], for which enough steam must be generated for about 8 hours through firewood boilers.

Therefore, huge expenditure on firewood is inevitable for reeling.
A Multi-end Reeling Machine, with reeling basins, reel batons (bobbins) and mechanism are seen in Fig. 1.2.

4. Fourth limitation is observed during drying of the yarn. Unwinding of silk yarn from the small reels has to occur in moist conditions for optimal unwinding on re-reeling machines.

   Ineffective removal of moisture results in matting or plastering of yarns. This leads to the hard gum spots, especially at the reel batons and at yarn contact points, which is a serious defect in the winding process. Consequently, the silk yarn will be dried through indirect drying method, by passing the steam through steam pipes, inside the re-reeling machine window. The temperature in the steam pipes is maintained between 40°C and 45°C (preferably 41°C) by regulating the steam in the pipes, so that the yarn is not over dried [2].

   Unfortunately, 30% to 40% of the steam generated through the boiler is consumed for yarn drying. Therefore, consumption of steam for drying the yarn in re-reeling machines is also unavoidable.
5. Similar to the expenditure incurred on the firewood by the reeling sector, the dyeing sector too utilizes boilers to generate steam to maintain 85°C to 95 °C temperatures in the dyeing vats/baths.

Therefore, the frequent expenditure incurred by both reeling and dyeing sectors on firewood to generate the steam is inevitable and increasing at an alarming rate.

Fig. 1.3 Silk yarn dyeing and boiler for steam generation

Fig. 1.3 shows dyeing process in a dyeing unit, where the cold water in the dyeing tubs is heated up by the steam that is generated by the firewood boiler.

6. Another fundamental issue that requires significant consideration in silk dyeing sector is the disruption of ecosystem by untreated dye effluents.

The dyeing/wet processing sector of the silk industry is contributing to the disruption of the ecosystem by releasing huge amounts of untreated dye effluents, consisting of toxic chemicals, into the drainage system. The effluents from the drainage seep to
contaminate the ground water. Hence, the silk dyeing sector is a significant contributor of pollutants, together with other industries in India.

7. Another significant limitation is observed during waste pupae drying.

In conventional method, after reeling process is completed, the left over silkworm pupae, a silk by-product are dried by open sun-drying method for one or two days. As the pupae are dried in open area, the inhabitants feel discomfort due to the extremely bad odor and the obnoxious gases released from the pupae.

Also, the open sun-drying system invites microbes, rodents, dogs, pigs, monkeys, crows, eagles and vultures for pupae feast. Moreover, the present method of drying provides poor and objectionable working conditions, including environmental problems, which is a significant health hazard to the employees and neighboring communities.

1.3 DISCUSSION

Steam generation for cooking, reeling, re-reeling and for the dyeing processes is inevitable and requires a boiler with appropriate capacity. Generally, boilers of 100 kg to 200 kg capacity (100 kg or 200 kg steam is generated per hour) are used to generate steam for reeling and dyeing units. Depending upon the size of a reeling or a dyeing unit, sufficient quantity of firewood should be readily available for the boilers.
Therefore, by using the boilers there are a few drawbacks involved:

i. Significant investment by silk industry entrepreneurs on firewood

ii. Deforestation and

iii. Environment pollution through emission of Carbon Dioxide (CO₂), Carbon Monoxide (CO), Methane (CH₄) - a strong greenhouse gas, Nitrous Oxide (N₂O) etc.

Although, the expenditure incurred on firewood falls on the entrepreneurs of reeling and dyeing sectors, the long-term effects of burning firewood burdens the whole earth. Therefore, steam generation in both reeling and dyeing sectors for various purposes has become a major issue. Similarly, cocoon stifling, disruption of eco system through effluents and drying of silkworm pupae are also major constraints to look into.

Thus, it is essential to probe alternate solutions for the following.

- Hot air generation for –
  - Cocoon Stifling
  - Yarn Drying

- Acquiring hot water with different temperatures for different purposes in both reeling and dyeing sectors

- Diminishing the effect of toxic effluents generated from dyeing sectors and
Drying of silkworm pupae

Preliminary theoretical and practical studies encountering major problems, including hot water generation, effluent treatment and pupae dying through solar energy have yielded positive results.

The renewable solar energy can be an alternative to run both reeling and dyeing sectors in a most economical and environment friendly manner, as the solar energy is inexhaustible, cost-effective and pollution free.

1.4 PRELIMINARY COMPONENTS OF THE STUDY

i. Collection of data i.e. baseline survey on present conventional methods, fuel consumption and cost for steam and hot air generation.

ii. Analysis of the data.

iii. Study of literature, pertaining to the silk reeling, dyeing and solar systems from various sources.


v. Arrangement for project execution.

The main objective of the study was to verify the relevance, effectiveness, and efficiency of the solar system for the silk reeling and dyeing sectors, besides identifying constraints/bottlenecks and inherent problems during implementation.
This study also had to assess the actual benefits accrued to the beneficiaries in the silk industry and to provide an idea whether the intended Non-Conventional approach will be beneficial.

![Diagram showing various applications of solar energy in silk industry](image)

**Fig. 1.4 Various applications of solar energy in silk industry**

This thesis, after studying the setbacks of the conventional methods used in the 21st century by the silk industry, it suggests alternative approaches such as the Non-Conventional Solar Energy Systems for implementation, to bring out remarkable changes in the silk industry.

**1.5 CONCLUSION**

The use of Non-conventional energy i.e. Solar Energy appears to be, by far, the best alternative solution to run both silk reeling and dyeing sectors in a most economical way, as the geographical location (Tropical zone) of India allows almost year round sunshine. In addition, the effective use of solar energy addresses global issues such
as prevention of deforestation, reduction of carbon emission, and control over discharge of unprocessed effluents.

If the people concerned with the silk industry and governments ruminate over the issue of effective prevention of deforestation and pollution and adopt the solar energy for various purposes as discussed, it is possible to overcome the financial barriers apart from making the silk industry eco friendly.