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"PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"

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PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH

EXECUTIVE SUMMARY

The art of silk production is called sericulture that comprises cultivation of mulberry, silkworm rearing and post cocoon activities leading to production of silk yarn. Silk, a highly priced agricultural commodity, accounts for about 0.2% of the total world production of textile fiber. Sericulture is an agro-based industry that 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 comprise 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. Domesticated silkworm (Bombyx mori) are raised for the purpose of production of cocoons.

Apart from silk, there are several other by-products from sericulture. The mulberry fruits are rich in minerals and vitamins and from the roots, barks and mulberry leaves several ayurvedic and herbal medicines are prepared. Some of the woody mulberry trees provide timber which are resistant to termites and the timber is used for making sports items, toys etc. The mulberry branches after silkworm feeding are generally dried and used as fuel particularly in the villages. The foliage of mulberry is used as a fodder for cattle. The silkworm pupae are rich in oil content and pupal oil is used in cosmetic industry and the remaining pupal cake is a rich source of protein suitable for poultry and fisheries.

Sericulture is one of the major agro-based activities which can provide gainful self-employment for poor families in rural areas on their own land. It is an enterprise with a very short gestation period, having the potential to generate adequate returns from a very small piece of land. The pursuit of sericulture offers gainful employment to the rural masses. Being a labour intensive rural based industry it offers a qualitative and quantitative change in the poverty alleviation with a chain creation of employment from unskilled farm labourers to skill artisans to all sections in rural areas. The silk industry encompasses different on-farm and non-farm activities, with diversified nature of skills, involving a heterogeneous group of people, bringing people of various walks of life together work for the production of silk. Sericulture is a continuous activity and employment is available throughout the year.

The major silk producing countries in the world are; China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran, etc. Few other countries are also engaged in the production of cocoons and raw silk in negligible quantities; Kenya,

Botswana, Nigeria, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Japan, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania, Bolivia, etc. The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, Viet Nam, etc. the major producers are in Asia (90% of mulberry production and almost 100% of non-mulberry silk).

India occupies a predominant position in the world in silk production and India is the second largest producer of silk in the World (35,261 tonnes), next to China (1,20,000 tonnes), with 16.14% share in global raw silk production. India is also the largest consumer of silk in the world. Among the four varieties of silk produced in 2018-19, Mulberry accounts for 71.50 per cent (25,213 tonnes), Tassar 8.44 per cent (2,977 tonnes), Eri 19.40 per cent (6,839 tonnes) and Muga 0.66 per cent (232 tonnes) of the total raw silk production of 35,261 tonnes. (CSB, 2016). Though, Indian breeds/hybrids have the potential to produce the same quality, our system of sericulture practices is entirely different from that of China. The strict maintenance of discipline and better linkage from farmers to weavers, large-scale operation of egg production, reeling and weaving using modern machineries, strict control measures for diseases, uniform adoption of new technologies, supply of required quantity of quality eggs in time to avoid the chances of contamination of young silkworm etc. make the Chinese sericulture more vibrant economically sound and sustainable. Another area of difference is that the entire production is state controlled with no open marketing/auction systems for silk cocoons and yarns.

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 has witnessed a quantum jump in raw silk productivity. The average yield of 25 kg of cocoons/ 100 DFLS in the recent past has increased and currently the average yields are in the range of 60 – 65 kg/ 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.

India’s dependence on China for the import of high-quality silk is likely to come down in the next 3-4 years, with the country striving to become self-sufficient in silk production by 2022. In 2016-17, India imported close to 3,700 tonnes of high-quality silk from China, compared to close to 7,000 tonnes in 2013-14. The decrease in import volumes has been primarily on the back of an increase in production of the ‘better quality’ bivoltine silk.

There is an urgent need to bring in a holistic approach, i.e., from leaf to fabric production and marketing and ancillary units of the industry to produce the best at the lowest possible cost so that the country could benefit and rely less on the imported silk in view of the present global scenario. The challenges ahead and strategies required to face the challenges are many:

- Production of silk in India has been rationally driven by domestic demand mainly for heavier handloom-based fabrics like sarees. Silk in India is produced from the hardier and indigenous variety of multivoltine silkworms, the silk produced from these silkworm strains is not gradable. The changing consumer tastes in the domestic market as well as export market from the traditional heavy handloom fabrics like sarees to lighter materials, are sending signals to the industry to reorient its production plans to match the changing demand patterns, by developing the bivoltine silk sector.
- The Indian reeling sector is mainly cottage based and highly decentralized; employing a variety of reeling devices and producing low to medium quality of silk in limited quantities. The equipment used in the silk industry are simple, conventional and less capital intensive. This leads to low value addition, heavy dependence on manual skill and attention and scale and scope economies being negligible. Much needs to be done in the silk machines manufacturing sector to make the industry highly competitive. Unless adequate infrastructure and capabilities are built within the country, it will be difficult to be competitive. There are certain gaps and links that are amiss. Fragmented and very small units would not have the strength to upgrade or understand and react to the market forces. In this context systematic and organized restructuring of the silk industry to emphasize and enhance the production of high quality raw silk on a commercial scale, so as to facilitate export of Indian raw silk and lowering of imports is an essential component in global perspective.
- The pre-requisites for a progressive silk industry would be the availability of raw silk of the right quality in adequate quantities at competitive prices consistently. The present-day problem is that the raw silk lots are quite small and the cocoon prices are quite high (for the quality levels anywhere in the world) and as a consequence the demand for good quality raw silk in bulk quantity at a competitive price is not being met.
- The multi-end reeling technology designed and developed by the Central Silk Technological Institute, Bangalore addressing the quality and productivity issues provides the advantages of pollution free working conditions, reduced health hazards and discourages child labour.
- There is a strong domestic market for silk in India which is expected to continue for a long period. However, the domestic production of raw silk is not sufficient to meet the rising domestic and export requirements. Hence the country is dependent

upon imports to fill the demand and supply gap, mostly from China. Import of raw silk and silk fibre to India negatively affects the domestic producers and forces the Indian government to impose antidumping duty for imports. Self-sufficiency in domestic production of raw silk and suitable business protection for domestic producers of silk may be a solution. The past trends show that the demand supply gap will reduce gradually probably due to improvement in domestic raw silk production and its quality.

- India has a number of distinct silk weaving clusters that are known for unique designs, weaves, colours, patterns, traditional knowledge (TK) and processes that are specific to a geographical region and are guarded for centuries. Over the period, these products have become a brand by themselves and recognized by their place of origin. Muga silks of Assam, Mysore silks of Mysore (Karnataka), Kanchipuram silks of Kanchi (Tamil Nadu), Brocades of Banaras (Uttar Pradesh), Pochampalli saris, Gadwal silks (Andhra Pradesh) are just to cite a few. The globalization has brought about enormous challenges to the trade and industry. The GI Act stipulates protection of the market of the producers and safeguards the interests of the consumers of these unique products through registration and taking infringement action against the infringers. It is believed, that the IPR Protection of unique textile products of the country with a predetermined market linkage strategy would help in brand building of the product, providing market linkages, generating more employment opportunities and enhanced income to the stakeholders. It is hoped that all traditional silks will get the protection under the GI registry umbrella to avoid the exploitation especially in view of globalization.
- With the cheaper silk-like imitations, the consumers are easily being drawn away from silk. They are trying to derive a pseudo satisfaction of wearing a fabric with designs and colours hitherto available only on silk and the feel and appearance with a resemblance of silk. In the market there are numerous other textile materials sold in the name of silk i.e., Art silk, artificial silk and other glamorous names. It is time to educate consumers about the virtues of silk that makes it worthy of possession and drive home the fact that only silk is silk. The emotional chord, luxury image, status and eco-friendly nature of silk is to be brought to focus and this can happen with a strategy for generic promotion of silk. In view of this SILK MARK was launched on 17th June 2004 as an initiative of Central Silk Board, Ministry of textiles, Government of India with major objectives such as protecting the interests of the consumer, protecting the interest of genuine traders and manufacturers of Silk, Generic Promotion of Natural Silk.
- Efforts for quality improvement should necessarily include quality-based pricing of cocoons prior to transaction. Quality standards for seed cocoons, commercial eggs, reeling cocoons and raw silk is of utmost importance to build quality at all stages. Create a brand image for silks from India and build quality into the products, blending heritage with the market requirements.

- One of the serious problems for the sericulture industry is the wide fluctuations in cocoon prices. Unless steps are taken to have efficient and effective marketing organization to prevent wide fluctuations in the prices of cocoons, farmers will not have assured income and also new farmers may hesitate to take up this vocation. Hence, efficient marketing conditions will go a long way in bettering the conditions of sericulturists.
- Sericulture with its unique features plays an important role in upgrading the socio-economic conditions of the rural folk and with employment opportunities to the educated rural youth and women. Therefore, there is a need to provide appropriate forward and backward linkages with necessary technical backup will provide a gateway to the future prosperity of the industry.
- There are five major types of silk of commercial importance obtained from different species of silkworms. These are Mulberry, Oak Tasar & Tropical Tasar, Muga and Eri. Except for mulberry, other non-mulberry varieties of silks are wild silks, known as vanya silks. India has the unique distinction of producing all these commercial varieties of silk. The Vanya silks have more potentialities to grow as ''Very Indian Silk'' in the global market. Being treated as tribal crafts of the hill folks, these silks have great commercial importance because of huge demand in Indian as well as foreign markets. This is one of a huge area to be focused.

Understanding the various stages of growth of silkworms and techniques to be followed for successful rearing of silkworms is essential for farmers to make the activity a viable one.

Economics is an important criterion to evaluate, acceptance and wider adoption of any technology which is economically sound and that can be accepted by the sericulture farming community. Among different indicators of economic efficiency in sericulture, net returns have greater impact on the practical utility and acceptance of the production technology by the farmers. Identification of suitable reasons and management of economic problems to increase the productivity in sericulture is the key for success crop potential (Vinayak Hosmani et al., 2020).

In addition to the understanding of the technology of silkworm rearing, the farmers face several other problems that limit realization of optimum returns. The scarcity of labour with high wage rate is a major problem. Skilled labour is required for planting of mulberry cuttings and other operations. Costly inputs such as cost of fertilizers, growth regulators, irrigation water and labour requirement are prominent problems. Other problems like non-availability of good quality mulberry cuttings followed by unsuitable soil type, and un-favourable climate are affecting quality of mulberry bio-mass production. High temperature during summer is the major constraint in case of cocoon production. It affects the health of silkworms there by the yield of cocoons. Difficulty in obtaining disease

free layings, high incidence of uji fly were other problems faced and volatility of cocoon price, less number of reeler's participation in the auction, lack of local market facility are the major constraints in marketing of cocoon (G. N. Anil Kumar et al., 2019).

There has not been adequate thrust on quality due to the absence of quality-based price fixation. Absence of quality-based pricing has been a major deterrent factor in the pursuit for quality improvement. The seasonality associated with cocoon quality, cocoon supply and price as also the raw silk price almost always determine the fate of reeling activity.

Reeling sector is a vital component of sericulture linking the agriculture-based activity of cocoon production with the industrial activity of fabric production.

Keeping the above in view, the project, "**PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"** was taken up by University of Agricultural Sciences, Bengaluru with Rashtriya Krishi Vikas Yojana funding. The project was implemented from 2012-13 to 2015-16. The details of the project are as under:

1.	**Title of Project**	**:**	"**PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"**
2.	**Nodal officer and Principal Investigator**	**:**	**DR. S. CHANDRASHEKHAR** Professor of Sericulture, College of Sericulture, Chintamani, UAS, GKVK, Bengaluru
3.	**Implementing Institution (S) and other collaborating Institution (s)**	**:**	College of Sericulture, Chintamani
4.	**Date of commencement of Project**	**:**	2012-13
5.	**Approved date of completion**	**:**	2015-16
6.	**Actual date of completion**	**:**	2015-16
7.	**Project cost**	**:**	Rs. 125 lakhs

The objectives of the project are as follows:

1. To promote community cluster approach in silkworm rearing to produce uniform quality cocoons and to encourage rearing of bivoltine breeds.
2. To encourage farmers in clusters to effectively utilize sericulture byproducts to increase the returns per unit area from sericulture enterprise.
3. To design and install efficient silk reeling units to produce high quality raw silk.

4. To establish appropriate power loom to convert high quality raw silk into a standard fabric.

The focus of Evaluation is:

i. To evaluate the impact of community cluster approach in silkworm rearing to produce uniform quality cocoons and to encourage rearing of bivoltine breeds.
ii. To evaluate the efficiency of encouraging farmers in clusters to effectively utilize sericulture byproducts to increase the returns per unit area from sericulture enterprise.
iii. To evaluate the impact of designing and installing efficient silk reeling units and establishing appropriate power loom in producing high quality raw silk and converting it into a standard fabric.

A cluster approach for development of sericulture in Chintamani taluk was adopted. Two villages, viz., Kathriguppe and Lakshmidevakote were selected as there was concentration of sericulturists in these villages. A group of 30 farmers with 32 acres under mulberry in Kathriguppe and group of 16 farmers with 26 acres under mulberry in Lakshmidevakote were selected for the project. Participatory Technology Development (PTD) was adopted in the project area. The farmers were motivated to take up bivoltine silkworm rearing by emphasising on the economic and quality aspects of bivoltine silk.

Two village level societies, i.e., Kathriguppe Bivoltine Reshme Belegarar Sangha and Manjunatha Swamy Reshme Belegara Sangha were formed and registered and provided all inputs required for improving mulberry garden and to popularize the bivoltine cocoon production. By laws were framed to fix the responsibility of different stake holders.

Kolar and Chikkaballapur district sericulturists are traditional multivoltine rearers and the selected villages had no bivoltine rearing exposure in the past. The farmers were motivated to take-up Bivoltine silkworm rearing. Totally 11 OFDs and 33 FFS were conducted to educate the farmers on various aspects of sericulture. By participating in FFS, farmers got season long educational activity. Farmers were empowered to solve the sericultural problems by interaction, joint decision making and self-confidence. All the technologies were provided through training programmes and practical demonstrations to transfer the appropriate technologies to the farmers. Selected farmers were given technical guidance through crop inspections to produce quality Bivoltine cocoons and to enhance productivity per unit land value so that their economic uplifting is achieved. Totally 494 farmers were trained on advanced bivoltine sericulture technologies and they were considered for biovoltine rearing. The farmers were trained on aspects related to identification of the diseases, integrated management practices, method of secondary level multiplication of bio control agents and their application. were trained in seven

batches through demonstrations at the Karnataka State Sericulture Research and Development Institute on integrated nutrient and Root Disease Management in mulberry.

The members of the groups were trained on integrated approaches in mulberry production, chawki rearing, silkworm rearing house management, silkworm rearing, grading, packing, etc. They were provided mulberry garden management technologies and critical inputs including chemical fertilizers (Urea, Single Super Phosphate, Muriate Of Potash). Rearing inputs like minimal modification of rearing houses (inputs for Rearing house alterations, i.e., PVC Pipes, mesh and gunny sacks for micro environment improvement) were also supplied. The disinfectants (Seriswach, Sanitech super, Bleaching powder & Decol), bed disinfectants (Vijetha supplement & Vijetha green) and Chawki reared worms were supplied at their door step at free of cost. Inspections were carried out at timely interval and members were provided technical guidance on age and stage of development on day to day basis by the project supervisory staff housed in the village. In addition, common facilities such as power sprayer, brush cutter, plastic montages and mulberry leaf chopping machine were supplied to the society to use on hired basis. Uniform brushing of silkworm breed/ hybrid, management of rearing, harvesting and grading of cocoons were also promoted. Further, they were encouraged for the effective utilization of by products to generate value added products viz., compost/vermicompost, silage, energy cakes, bio gas bio-crafts from defective cocoons, etc. The uniform quality cocoons produced by the group were utilized within the project for its conversion as quality raw silk by using Multi end reeling machine installed at Sericulture College, Chintamani. Standardized the reeling practices for effective conversion of graded cocoons for quality raw silk production and initiated the silk production process. The quality raw silk produced was converted into standard silk fabrics using design. Power loom unit was established at Sericulture College, Chintamani. Studies were initiated to standardize the procedures for effective utilization of reeling waste water as per emerging needs.

Impact

All the farmers were rearing cross breeds with low yield potential prior to the project period. The mulberry gardens were not maintained properly. The average cocoon yield was about 55 kg/ 100dfls and the annual cocoon production from the entire village was about 14000 kg and approximate returns of Rs. 25,20,000 with an average cocoon price of Rs.180/ kg.

The farmers started rearing Bivoltine hybrids after effecting modifications in the mulberry gardens and silkworm rearing houses. The modifications in mulberry gardens were mainly broader rows at 6 feet apart, soil test based application of fertilizers, spraying of plant protection chemicals and following package of practices as guided by the project supervisors. Appropriate production, grading, packing and marketing technologies were adopted by all the members. The average cocoon yield increased to 70.00 kg/ 100dfls and

the total cocoon production in 10 months-time was about 25000 kg with an approximate returns of Rs. 57,50,000 (more than doubled) at average price of Rs.230/ kg for the better quality cocoons.

About 55000 kg high quality cocoons were produced by the cluster farmers every year for the next two years. It amounts to 20 per cent increase in yield and production of 150 ton of quality compost using sericultural wastes.

In Lakshmidevakote cluster, significantly higher yield (30%) was obtained by the farmers compared to the taluk average yield in the preceding years. The average Bivoltine cocoon yield recorded was 79.25 kg/ 100 dfl and the price obtained was Rs.300-375.

The results confirm that under handholding technology adoption and timely technical guidance the traditional multivoltine farmers learnt about Bivoltine rearing technologies and produced an appreciable uniform quality cocoon crop and got an annual return of Rs. 2 lakhs acre/ year.

The feedback received from the farmers who participated in the project include the following:

1. There was continuous guidance from the project supervisors in crop cultivation and silkworm rearing.
2. There used to be some crop failures before the project period. After the training and guidance from the project supervisors, no farmer faced crop failure problems.
3. Most farmers were rearing multivoltine cross breds before the project and shifted to Bivoltine cross breeds during the project period and got better yield and income from better cocoon quality and rates.
4. The farmers faced marketing problems as they had to go to only Ramanagar cocoon market to sell the bivoltine cocoons.
5. The farmers found that bivoltine hybrids are good only during rainy season and shifted to multivoltine races during summer.
6. Farmers were happy with the folding model/ rotary mountages used for bivoltine breed worms.
7. There was increase in area under mulberry by 10 to 15 acres as other farmers in the area took up sericulture.
8. The good results enthused farmers from neighbouring villages, viz., Kundagurki and Donnahalli to take up sericulture activity.
9. Most farmers discontinued the Bivoltine rearing during summer due to high temperature, water scarcity. They took up Bivoltine during winter and rainy seasons. Farmers also experienced marketing problem.
10. There was no increase in area under sericulture in Lakshmidevakote as farmers faced water shortage.

The multi end reeling machine in Sericulture College, Chintamani was installed after studying the design and making suitable modifications, especially in the design of the basin. The machine was tested using the bivoltine cocoons produced by the farmers in Kathriguppe and Lakshmidevakote. The uniform quality cocoons produced by the group were utilized for conversion as quality raw silk.

Power loom was also installed in Sericulture College, Chintamani for the conversion of quality raw silk produced into standard silk fabrics using pre-assigned designs. The multiend reeling machine and hand loom are used extensively for demonstration purposes involving farmers and students in quality silk and fabric production.

The project implementation functionaries have methodically and systematically taken up the task of identifying sericulture clusters, educating the farmers to take up rearing of bivoltine breed through training, exposure visits, demonstrations and hand holding, introducing the farmers to latest technological innovations in mulberry growing and silkworm rearing, providing subsidized inputs and guiding the farmers in taking up successful rearing of bivoltine breeds.

The trainings, exposure visits and demonstrations have been exclusively used to educate the farmers in latest technological innovations in mulberry growing and silkworm rearing. The farmers have adopted the modifications suggested like broader row spacing of 6 feet in mulberry planting, drip irrigation, soil test based application of fertilizers in mulberry growing, providing adequate ventilation and aeration in rearing houses, frequent disinfection, using folding model/ rotary mountages, uniform harvest of cocoons, grading of cocoons in silkworm rearing.

The forming of growers' co-operative societies by the farmers has also helped the farmers in taking up group activities like cocoon grading, group marketing etc.

The impact of introduction of technological innovations like broader row spacing of 6 feet in mulberry planting, drip irrigation, soil test based application of fertilizers in mulberry growing on the yield, quality and economics of mulberry production has not been studied. This could have made the farmers to understand the importance of the technology introduced and given impetus to adoption by other farmers.

Similarly, the effect of providing adequate ventilation and aeration in rearing houses, frequent disinfection, using folding model/ rotary mountages on the microclimate in the rearing house, bacterial counts and quality of cocoons in terms of reeling efficiency, renditta, floss density, filament strength could have given a better picture of the improvements made.

The farmers in the clusters used the third instar silkworms purchased from chawki centres. There is need to encourage the farmers to take up chawki rearing also.

The supply of subsidized inputs appears to have had a negative impact on the project as it was observed that the farmers discontinued the technological innovations suggested once the supply of subsidized inputs was stopped after the project was concluded.

The farmers have stopped rearing of bivoltine breed after the project period mainly due to marketing problems. The bivoltine cocoons had to be marketed only in Ramanagar cocoon market. This aspects should have been considered during the project period and suitable steps should have been taken to ensure smooth marketing avenues for the cocoons.

Although, vermicompost and compost units were established for utilization of sericulture waste for production of compost and vermicompost and mulberry twigs were used for making pallettes after chopping, no specific strategy was put in place for improving the use of sericulture waste like uneaten mulberry leaves, floss etc. There does not seem to be any appreciable effort made to make use of the sericulture wastes in preparing by-products to augment the income of farmers.

The establishment of multi end reeling unit and power looms in sericulture College, Chintamani does not appear to have been optimally utilized in the project as no comprehensive and discernible efforts are found to improve the quality of post cocoon processing. However, the multiend reeling machine and hand loom are used extensively for demonstration purposes involving farmers and students in quality silk and fabric production.

REFLECTIONS AND CONCLUSIONS

1. The project has been well planned, efficiently executed and commendable impact has been observed in improvement of income of stake holders in the clusters formed.
2. The identification and formation of clusters have been done meticulously.
3. The introduction of technological innovations in the clusters has been well thought out and executed systematically.
4. The farmers have adopted the technological innovations in right earnest. This is clearly seen more in mulberry cultivation where broader row plantations, drip irrigation, soil test based application of fertilizers are practiced. The farmers have also adopted the improvements suggested in silkworm rearing like providing better ventilation and aeration, frequent disinfection and grading of cocoons.

5. The farmers experienced difficulty in marketing their produce as they had to go to Ramanagar cocoon market only.
6. The impact of technological innovations on the yield, quality and economics of mulberry production could have made the farmers to understand the importance of the technology introduced and given impetus to adoption by other farmers.
7. The effect of providing adequate ventilation and aeration in rearing houses, frequent disinfection, using folding model/ rotary mountages on the microclimate in the rearing house, bacterial counts and quality of cocoons in terms of reeling efficiency, renditta, floss density, filament strength could have given a better picture of the improvements made.
8. The supply of subsidized inputs appears to have had a negative impact on the project as it was observed that the farmers discontinued the technological innovations suggested once the supply of subsidized inputs was stopped after the project was concluded.
9. The farmers have stopped rearing of bivoltine breed after the project period mainly due to marketing problems. This aspect should have been considered during the project period and suitable steps should have been taken to ensure smooth marketing avenues for the cocoons.
10. There does not seem to be any appreciable efforts made to make use of the sericulture wastes in preparing by-products to augment the income of farmers.
11. The establishment of multi end reeling unit and power looms in sericulture College, Chintamani does not appear to have been optimally utilized in the project as no comprehensive and discernible efforts are found to improve the quality of post cocoon processing.
12. The involvement of line departments was not seen except in sanction of subsidy for drip irrigation and a few extension activities for technology dissemination.
13. Criteria for selection of farmers has not been detailed in the project and needs to be spelt out/ brought out.
14. Impact assessment of the technology developed in improving the productivity and quality of cocoon and silk needs to be brought out.
15. Impact of training modules adopted needs to be brought out.

ACTION POINTS

1. The planning and implementation of the project have been meticulous and are praiseworthy. The project is suitable for replication in other sericulture areas of the state.
2. The convergence of line departments is necessary for better implementation of similar projects.

3. Policy issues like online marketing and establishment of post cocoon processing units nearer to sericulture clusters need to be resolved to facilitate and encourage farmers to shift to rearing of bivoltine breeds.
4. The problems associated with rearing of bivoltine breeds during summer months need to be studied and suitable solutions found for successful rearing of bivoltine breeds during summer months.
5. The technological innovations adopted in mulberry cultivation and silkworm rearing should be evaluated and adopted as recommended package of practices.
6. The success stories should be circulated among the sericulture villages in the state to encourage other farmers to adopt the practices.
7. There is need to take a holistic view of the activity from seed to fibre so that the seemless transformation is achieved.
8. There is need to devise methods and systems to make use of the sericulture wastes in preparing by-products to augment the income of farmers.
9. The multi end reeling unit and power loom established in sericulture College, Chintamani should be utilized better to study the problems associated with reeling, rereeling and manufacture of fabrics.

RESEARCHABLE ISSUES

1. Development of package of practices for mulberry cultivation for seed cocoon in seed areas.
2. Documentation of Indigenous Technology Knowledges (ITKs) and their integration in crop husbandry and non-cash inputs in sericulture activities is needed.

PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH

INTRODUCTION

The art of silk production is called sericulture that comprises cultivation of mulberry, silkworm rearing and post cocoon activities leading to production of silk yarn. Silk, a highly priced agricultural commodity, accounts for about 0.2% of the total world production of textile fiber. Sericulture is an agro-based industry that 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 comprise 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. Domesticated silkworm (Bombyx mori) are raised for the purpose of production of cocoons. Sericulture provides gainful employment, economic development and improvement in the quality of life to the people in rural area and therefore it plays an important role in anti-poverty programme and prevents migration of rural people to urban area in search of employment. Mulberry sericulture is a labour intensive industry in all its phases, namely, cultivation of silkworm food plants, silkworm rearing, silk reeling and other post cocoon processes such as twisting, dyeing, weaving, printing and finishing (Lakshmanan 2007).

Hence several developing countries like China, India, Brazil, Thailand, Vietnam, Indonesia, Egypt, Iran, Sri Lanka, Philippines, Bangladesh, Nepal, Myanmar, Turkey, Papua New Guinea, Mexico, Uzbekistan and some of the African and Latin American countries have taken up sericulture to provide employment to the people in rural area.

Apart from silk, there are several other by-products from sericulture. The mulberry fruits are rich in minerals and vitamins and from the roots, barks and mulberry leaves several ayurvedic and herbal medicines are prepared. Some of the woody mulberry trees provide timber which are resistant to termites and the timber is used for making sports items, toys etc. The mulberry branches after silkworm feeding are generally dried and used as fuel particularly in the villages. The foliage of mulberry is used as a fodder for cattle. The mulberry trees are also planted in the embarkment area for protection of the soil to prevent soil erosion, and mulberry trees are planted as avenue trees. The silkworm pupae are rich in oil content and pupal oil is used in cosmetic industry and the remaining pupal cake is a rich source of protein suitable for poultry and fisheries. In some tribal population, the people eat eri pupa as a source of protein and nourishment. The silkworm litter is used for bio-gas production and used as a fuel for cooking in the rural area. Thus, sericulture not

only provides silk for fashionable clothings, it also provides several very useful by-products to the human society. Therefore, sericulture development provides opportunities to improve the living standards of people in the rural area in developing countries.

Sericulture is one of the major agro-based activities which can provide gainful self-employment for poor families in rural areas on their own land. It is an enterprise with a very short gestation period, having the potential to generate adequate returns from a very small piece of land. The pursuit of sericulture offers gainful employment to the rural masses. Being a labour intensive rural based industry it offers a qualitative and quantitative change in the poverty alleviation with a chain creation of employment from unskilled farm labourers to skill artisans to all sections in rural areas. The silk industry encompasses different on-farm and non-farm activities, with diversified nature of skills, involving a heterogeneous group of people, bringing people of various walks of life together work for the production of silk. Sericulture is a continuous activity and employment is available throughout the year.

Micro level studies reveal (Lakshmanan and Geetha Devi, 2000, 2005) that one acre of mulberry sericulture generated around 506.20 man days from leaf to cocoon production for one year period and assured periodical income throughout the year. 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. In China 20 million farmers and 5 lakh people are occupied by sericulture and silk processing industry (Vishakanta, 2018). Out of the 6,38,588 villages in India, sericulture is practiced in about 52,360 villages providing employment to about 7.52 million people. Women are engaged about 60% (about 57% in 1st year and about 64% from 2nd year onwards) work in various sector in Sericulture i.e., from Mulberry cultivation to Silk weaving etc. and women are doing their works successfully in every sector (Kunal Sarkar et al., 2017).Sericulture is providing livelihood for 9,47,631 families (G. Savithri et al., 2013). Sericulture is an activity where about 57 per cent of the gross value of final product flows back to the cocoon growers with share of income to different groups. It should be noted that, about 56.8 per cent income goes to cocoon growers, 6.8 per cent to the reelers, 9.1 per cent to the twisters, 10.7 per cent to the weavers and 16.6 per cent to the traders. Thus, large chunk of income goes back to the villages from the cities (Krishnakumare et al., 2017).

Sericulture is labour-intensive. About 1 million workers are employed in the silk sector in China. Silk Industry provides employment to 7.9 million people in India, and 20,000 weaving families in Thailand. China is the world's single biggest producer and chief supplier of silk to the world markets. India is the world's second largest producer. Sericulture can help keeping the rural population employed and to prevent migration to big cities and securing remunerative employment; it requires small investments while providing raw material for textile industries.

The major silk producing countries in the world are; China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran, etc. Few other countries are also engaged in the production of cocoons and raw silk in negligible quantities; Kenya, Botswana, Nigeria, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Japan, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania, Bolivia, etc. The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, Viet Nam, etc.

Even though silk has a small percentage of the global textile market - less than 0.2% (the precise global value is difficult to assess, since reliable data on finished silk products is lacking in most importing countries) - its production base is spread over 60 countries in the world. While the major producers are in Asia (90% of mulberry production and almost 100% of non-mulberry silk), sericulture industries have been lately established in Brazil, Bulgaria, Egypt and Madagascar as well. Brazil, Thailand Uzbekistan and Vietnam are also producing silk around 3,092 tonnes in a year.

Table: Global Silk Production (in metric tonnes)

#	Countries	2014	2015	2016	2017	2018
1	Bangladesh	44.5	44	44	41	41
2	Brazil	560	600	650	600	650
3	Bulgaria	8	8	9	10	10
4	China	1,46,000	1,70,000	1,58,400	1,42,000	1,20,000
5	Colombia	0.5	0.5	-	-	-
6	Egypt	0.8	0.8	1.2	1.1	1.25
7	India	28,708	28,523	30,348	31,906	35,261
8	Indonesia	10	8	4	2.5	2.5
9	Iran	110	120	125	120	110
10	Japan	30	30	32	20	20
11	North Korea	320	350	365	365	350
12	South Korea	1.2	1	1	1	1
13	Philippines	1.1	1.2	1.82	1.5	2
14	Syria	0.5	0.3	0.25	0.25	0.25
15	Thailand	692	698	712	680	680
16	Tunisia	4	3	2	2	2
17	Turkey	32	30	32	30	30
18	Uzbekistan	1,100	1,200	1,256	1,200	1,800
19	Vietnam	420	450	523	520	680
20	Madagascar	15	5	6	7	7
	Total	**178057.62**	**202072.83**	**192512.27**	**177507.35**	**159648.00**

Source: International Sericulture Commission, 2020

In India, sericulture is one of the most important agro and forest-based cottage industry, earning a foreign exchange of Rs. 400 corers / annum and providing gainful employment to over six million people. Technically sericulture is rearing of silkworms either on mulberry or non-mulberry plants for production of silk.

India occupies a predominant position in the world in silk production and India is the second largest producer of silk in the World (35,261 tonnes), next to China (1,20,000 tonnes), with 16.14% share in global raw silk production. India is also the largest consumer of silk in the world. Among the four varieties of silk produced in 2018-19, Mulberry accounts for 71.50 per cent (25,213 tonnes), Tassar 8.44 per cent (2,977 tonnes), Eri 19.40 per cent (6,839 tonnes) and Muga 0.66 per cent (232 tonnes) of the total raw silk production of 35,261 tonnes. (CSB, 2016). Though, Indian breeds/hybrids have the potential to produce the same quality, our system of sericulture practices is entirely different from that of China. The strict maintenance of discipline and better linkage from farmers to weavers, large-scale operation of egg production, reeling and weaving using modern machineries, strict control measures for diseases, uniform adoption of new technologies, supply of required quantity of quality eggs in time to avoid the chances of contamination of young silkworm etc. make the Chinese sericulture more vibrant economically sound and sustainable. Another area of difference is that the entire production is state controlled with no open marketing/auction systems for silk cocoons and yarns.

Exports of silk and silk products from India reached US$ 291.36 million in 2018-19 and US$ 116.88 million in 2019-20 (till July 2019). The silk products exported include natural silk yarns, fabrics, made-ups, readymade garments, silk carpets and silk waste. Readymade garments of silk formed the largest share in exports between 2018-19 at US$ 189 million, followed by fabrics and made ups at US$ 57.72 million and silk waste at US$ 18.56 million. Other products made up rest of the export earnings. During April-September 2019, the export of the readymade garments of silk stood at US$ 68.45 million, followed by silk carpet at US$ 11.32 million, silk waste at US$ 7.55 million and fabrics and made ups at US$ 3.08 million.

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 has witnessed a quantum jump in raw silk productivity. The average yield of 25 kg of cocoons/ 100 DFLS in the recent past has increased and currently the average yields are in the range of 60 – 65 kg/ 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.

India's dependence on China for the import of high-quality silk is likely to come down in the next 3-4 years, with the country striving to become self-sufficient in silk production by 2022. In 2016-17, India imported close to 3,700 tonnes of high-quality silk from China, compared to close to 7,000 tonnes in 2013-14. The decrease in import volumes has been primarily on the back of an increase in production of the 'better quality' bivoltine silk.

While the total production of raw silk recorded an annual growth rate of around 5 per cent, that of bivoltine silk [which is considered to be superior quality] has grown by 12-13 per cent. With the production of indigenous high-quality silk increasing, our imports are likely to come down. The production of bivoltine, which is also an import-substitute-quality silk, increased from 2,559 tonnes in 2013-14 to 5,266 tonnes in 2016-17. Bivoltine production is likely to touch 6,200 tonnes in 2017-18. Once the production touches the targeted 12,000 tonnes by 2022, the country would no longer need to import Chinese silk. The country's total raw silk production increased to 30,348 tonnes in 2016-17 and 35,261 tonnes in 2019 from 26,480 tonnes in 2013-14. Central Silk Board estimates total production of raw silk to touch 45,000 tonnes in 2022 when India is expected to be self-sufficient.

HISTORICAL PERSPECTIVE OF SERICULTURE IN INDIA

The silk trade flourished in India during the medieval period. Under the Moughals, silks from Kashmir and Bengal were exported mainly by the Moors, who during the 14th and 15th centuries transmitted it to Europe (Nanavaty, 1990). The British had identified the qualitative shortcoming with Indian silk and tried to improve it by bringing experts to modernize the rearing and reeling techniques. In 1771, the 'China worm' was introduced with the idea of improving cocoon quality. The government promoted the extension of land under sericulture. Rent was slashed by half for those lands, and that too was exempt for the first two years of cultivation. The government also promoted a higher wage structure for processing raw silk (Ray Indrajit, 2005). Technology was substantially improved in conformity with the European knowhow and practices so that British weavers accepted raw silk of Bengal. In fact, the overseas market responded very favorably to the first consignment of the new technology in 1772 (Ray Indrajit, 2005). The government was also successful in diffusing Chinese worms in sericulture. Another breakthrough was achieved in the sphere of the production system. The government successfully organized sericulture as a cottage industry. The industry's technology and organization were thus thoroughly reformed by the close of the eighteenth century in tandem with the requirements of the European market. Consequent to the abolition of British East India Company's monopoly on private trade the company wound up its silk trade in 1833, leaving

it to private entrepreneurs. During the last quarter of 19th century Bengal silk began to decline due to lack of proper organization, husbanding authority and the absence of technical knowhow (Ray Indrajit, 2005).

Hanumappa and Erappa (1988) cites sericulture development in the princely state of Mysore as an example of the crucial role the state can play in augmenting the sources of rural income. Sericulture flourished in Mysore during the 18th century under Tipu Sultan. The technology was transferred from Bengal. Japanese and Italian silkworm strains were imported and experts hired from these countries (Nanavaty, 1990). Spread of diseases during 1866 and the world depression in 1929 along with competition from imported silk and rayon lead to downfall of Indian silk industry on the eve of World War II. A tariff protection commenced from 1934 to save the industry from cheap imports of silk (National Commission of Agriculture, 1976). During the World War II, the Indian silk industry again surged, mainly due to demand from the Allies for silk for manufacture of parachutes.

Recommendations by a Silk Panel in 1946 lead to the formation of the Central Silk Board in 1949. Central Silk Board (CSB) is a statutory body, under the administrative control of the Ministry of Textiles, Government of India. One of the earliest commodity boards to be constituted by the Government of India, the Board coordinates the development of sericulture and advises the Government on policies governing export and import. It has the responsibility for pre-shipment inspection of silk goods exported from the country. The Board is also responsible for organizing sericultural research, training, basic seed (egg) production and collection of statistics pertaining to sericulture and silk industry (National Commission of Agriculture, 1976 and Gopalachar, 1978).

The Central Silk Board (CSB) established a number of sericulture research institutions in 1960s. With systematic efforts, it became possible in 1970s to develop a technology suitable for tropics. New mulberry varieties coupled with agronomical practices were made available to the farmers. Packages of practice were developed for silkworm rearing, besides realizing new bivoltine races. Popularization of the bivoltine hybrids was given priority. Since seed preparers started using bivoltine as a male parent for the preparation of cross breeds, the traditional poor yield crosses have been replaced to the extent of 85%. Consequent to this, mulberry sericulture was spread to nontraditional states like Kerala, Maharashtra, Rajasthan and Gujarat in the 1980s. While other crops (grains) perish due to very little precipitation, mulberry survives such acute situation where ground water is also not available for raising the crops, thus providing subsistence to a large number of farmers (National Commission of Agriculture, 1976).

Mulberry sericulture is practiced mainly in five states namely, Karnataka (42.24%), Andhra Pradesh (30.71%), West Bengal (11.67%), Tamil Nadu (8.99%) and Jammu and

Kashmir (4.43%), which collectively account for about 98 per cent of the total mulberry silk production in the country. Among the traditional sericulture states, Karnataka ranked first with its total raw silk yarn production (9571 tonnes) followed by Andhra Pradesh (5974 tonnes) and Assam (3811 tonnes) wherein, mulberry is the major contributor among all other sources. Whereas, in the case of Vanya Silks, Eri the highest contributor (5629 tonnes) followed by Tasar (3259 tonnes) and Muga (171 tonnes). As regards to Eri silk, Assam is the highest producer (2,612 tonnes) followed by Meghalaya (614 tonnes) and Nagaland (597 tonnes). Similarly, Jharkhand (1088 tonnes) is a major producer of Tasar silk followed by Chhattisgarh (385 tonnes) and Odisha (45 tonnes) in India. Although, the contribution of Muga silk is very less in the country, its major production takes place from North Eastern States, in which Assam solely produces around 126 tonnes.

The area under mulberry in Karnataka during 2017-18 accounted for 98,135 hectares with production of 66,833 tonnes of silk cocoons. Further, more than 1.26 lakh families are depending on sericulture and more than 7430 reeling families converts the cocoons in to silk yarn (9571 tonnes). In the past remunerative prices for silk cocoons gave an impetus and farmers who had uprooted mulberry also returned to replant mulberry many times.

STRENGTHS OF SERICULTURE INDUSTRY IN INDIA

- Silk is a way of life in India, occupies a prime position and carries an aura of royalty. It has a sacred place in the cultural heritage of Indians and it has merited mention in the epic scriptures. It has also become the religious tradition and indispensable for the Indian brides to wear silk saree in the marriage ceremony. Truly, silk has a fine blend with the cultural heritage of the Indians.
- Traditionally, Indian economy is largely dependent on the success of agriculture and allied farm activities as more than 70 percent of the people's livelihood security is depending on this sector. Sericulture as an agro-based is an economically rewarding enterprise consisting of several sets of activities and plays a predominant role in shaping the economic destiny of the rural people.
- India being blessed with prevalence of favourable climatic conditions, mulberry is cultivated in almost all states although the crux of the India silk industry lies with the Indian traditional states of Karnataka, Andhra Pradesh, Tamil Nadu, Jammu & Kashmir and West Bengal. These five states collectively account for 95% of the total area under mulberry cultivation and 92% of raw silk production in the country. Now, as a result of growing realization, sericulture is gaining ground in non-traditional areas too.
- Sericulture is best suited to a country like India, where manpower and land resources are in surplus and sericulture has potential to provide employment at home for the entire family members by way of chawki rearing, cocoon production,

silk reeling, hand spinning etc. and it is woman friendly, domestic chores can be attended conveniently combined with productive work.

- India enjoys the distinction of being the only country producing all the five known commercially exploited silks, i.e., mulberry, tropical tasar, temperate tasar, eri and muga. The golden yellow muga silk is exclusive to India and the pride of the Nation. Vanya silks are the products of rich salubrious climate and nourishing vegetation. Therefore, Vanya sericulture offers protection to the forest wealth and providing livelihood for the tribals. Indian vanya silks enjoy a niche market the world over.
- The silk production in India is 35,261 (2018) metric tonnes, but the actual consumption of the country is around 45,000 metric tonnes. Hence it is obvious that India's requirement of silk is much higher than its current production. Therefore, there is a lot of scope for the expansion of the industry. In addition to the domestic market there is huge export potential for Indian silks.
- Mulberry, the sole food plant of silkworm is perennial and drought resistant which could be grown on a variety of soils both under irrigated and rainfed conditions. When most of the agricultural crops do not revive even after a few showers mulberry being a perennial crop will sprout and yield leaves for silkworm rearing. Once mulberry garden is established it will give consistent yield for 15-20 years with minimum expenditure for maintenance.
- Sericulture is highly suitable to small and marginal farmers, as sericulture involves simple technology and requires low investment. It is the only cash crop which provides frequent attractive returns with minimum investment and low gestation period. Sericulture farmer can have ten to twelve crops per annum.

CHALLENGES AND STRATEGIES

There is an urgent need to bring in a holistic approach, i.e., from leaf to fabric production and marketing and ancillary units of the industry to produce the best at the lowest possible cost so that the country could benefit and rely less on the imported silk in view of the present global scenario. The challenges ahead and strategies required to face the challenges are many:

- Production of silk in India has been rationally driven by domestic demand mainly for heavier handloom-based fabrics like sarees. Silk in India is produced from the hardier and indigenous variety of multivoltine silkworms, the silk produced from these silkworm strains is not gradable. The changing consumer tastes in the domestic market as well as export market from the traditional heavy handloom fabrics like sarees to lighter materials, are sending signals to the industry to reorient its production plans to match the changing demand patterns, by developing the bivoltine silk sector.
- The Indian reeling sector is mainly cottage based and highly decentralized; employing a variety of reeling devices and producing low to medium quality of silk

in limited quantities. The equipment used in the silk industry are simple, conventional and less capital intensive. This leads to low value addition, heavy dependence on manual skill and attention and scale and scope economies being negligible. Much needs to be done in the silk machines manufacturing sector to make the industry highly competitive. Unless adequate infrastructure and capabilities are built within the country, it will be difficult to be competitive. There are certain gaps and links that are amiss. Fragmented and very small units would not have the strength to upgrade or understand and react to the market forces. In this context systematic and organized restructuring of the silk industry to emphasize and enhance the production of high quality raw silk on a commercial scale, so as to facilitate export of Indian raw silk and lowering of imports is an essential component in global perspective.

- The pre-requisites for a progressive silk industry would be the availability of raw silk of the right quality in adequate quantities at competitive prices consistently. The present-day problem is that the raw silk lots are quite small and the cocoon prices are quite high (for the quality levels anywhere in the world) and as a consequence the demand for good quality raw silk in bulk quantity at a competitive price is not being met.
- The multi-end reeling technology designed and developed by the Central Silk Technological Institute, Bangalore addressing the quality and productivity issues provides the advantages of pollution free working conditions, reduced health hazards and discourages child labour.
- There is a strong domestic market for silk in India which is expected to continue for a long period. However, the domestic production of raw silk is not sufficient to meet the rising domestic and export requirements. Hence the country is dependent upon imports to fill the demand and supply gap, mostly from China. Import of raw silk and silk fibre to India negatively affects the domestic producers and forces the Indian government to impose antidumping duty for imports. Self-sufficiency in domestic production of raw silk and suitable business protection for domestic producers of silk may be a solution. The past trends show that the demand supply gap will reduce gradually probably due to improvement in domestic raw silk production and its quality.
- India has a number of distinct silk weaving clusters that are known for unique designs, weaves, colours, patterns, traditional knowledge (TK) and processes that are specific to a geographical region and are guarded for centuries. Over the period, these products have become a brand by themselves and recognized by their place of origin. Muga silks of Assam, Mysore silks of Mysore (Karnataka), Kanchipuram silks of Kanchi (Tamil Nadu), Brocades of Banaras (Uttar Pradesh), Pochampalli saris, Gadwal silks (Andhra Pradesh) are just to cite a few. The globalization has brought about enormous challenges to the trade and industry. The GI Act stipulates protection of the market of the producers and safeguards the interests of the

consumers of these unique products through registration and taking infringement action against the infringers. It is believed, that the IPR Protection of unique textile products of the country with a predetermined market linkage strategy would help in brand building of the product, providing market linkages, generating more employment opportunities and enhanced income to the stakeholders. It is hoped that all traditional silks will get the protection under the GI registry umbrella to avoid the exploitation especially in view of globalization.

- With the cheaper silk-like imitations, the consumers are easily being drawn away from silk. They are trying to derive a pseudo satisfaction of wearing a fabric with designs and colours hitherto available only on silk and the feel and appearance with a resemblance of silk. In the market there are numerous other textile materials sold in the name of silk i.e., Art silk, artificial silk and other glamorous names. It is time to educate consumers about the virtues of silk that makes it worthy of possession and drive home the fact that only silk is silk. The emotional chord, luxury image, status and eco-friendly nature of silk is to be brought to focus and this can happen with a strategy for generic promotion of silk. In view of this SILK MARK was launched on 17th June 2004 as an initiative of Central Silk Board, Ministry of textiles, Government of India with major objectives such as protecting the interests of the consumer, protecting the interest of genuine traders and manufacturers of Silk, Generic Promotion of Natural Silk.
- Efforts for quality improvement should necessarily include quality-based pricing of cocoons prior to transaction. Quality standards for seed cocoons, commercial eggs, reeling cocoons and raw silk is of utmost importance to build quality at all stages. Create a brand image for silks from India and build quality into the products, blending heritage with the market requirements.
- One of the serious problems for the sericulture industry is the wide fluctuations in cocoon prices. Unless steps are taken to have efficient and effective marketing organization to prevent wide fluctuations in the prices of cocoons, farmers will not have assured income and also new farmers may hesitate to take up this vocation. Hence, efficient marketing conditions will go a long way in bettering the conditions of sericulturists.
- Sericulture with its unique features plays an important role in upgrading the socio-economic conditions of the rural folk and with employment opportunities to the educated rural youth and women. Therefore, there is a need to provide appropriate forward and backward linkages with necessary technical backup will provide a gateway to the future prosperity of the industry.
- There are five major types of silk of commercial importance obtained from different species of silkworms. These are Mulberry, Oak Tasar & Tropical Tasar, Muga and Eri. Except for mulberry, other non-mulberry varieties of silks are wild silks, known as vanya silks. India has the unique distinction of producing all these commercial

varieties of silk. The Vanya silks have more potentialities to grow as ''Very Indian Silk'' in the global market. Being treated as tribal crafts of the hill folks, these silks have great commercial importance because of huge demand in Indian as well as foreign markets. This is one of a huge area to be focused.

- The Government of India has allocated ₹2161.68 crores for three years, i.e., 2017-2020 to its Central Sector Scheme 'Silk Samagra' for the development of sericulture in the country.

Silkworm lifecycle

The life cycle of silk moth starts when a female silk moth lays eggs. Copulation between silkworm moths lasts for several hours. After mating, the female silkworm moth lays her tiny eggs on mulberry leaves. Silkworm moths do not eat or drink in the final stage of their life cycle, they mate; the female lays her eggs and the adult moths die. In areas where the seasons change, silkworm moths reproduce only once each year. In areas where the climate is always warm, the moth's life cycle is ongoing. Based on number of reproductions, the silkworms are classified as univoltine, bivoltine and multivoltine. The univoltine type is generally linked with the geographical area within greater Europe where the seasons change, the female silkworm moth lays her eggs at the end of summer, and the eggs do not hatch until spring. The eggs of this type hibernate during winter due to the cold climate, and cross-fertilize only by spring, generating silk only once annually. The second type is called bivoltine and is normally found in China, Japan, and Korea. The breeding process of this type takes place twice annually, a feat made possible through the slightly warmer climates and the resulting two life cycles. The poly or multivoltine type of mulberry silkworm can only be found in the tropics where the climate is continually warm. The eggs are laid by female moths and hatch within nine to 12 days, so the resulting type can have up to eight separate life cycles throughout the year.

The caterpillar or larvae are hatched from the eggs of the silk moth. In the larva stage, or caterpillar stage, the silkworm will go through four molts before going into pupa. Just before its first molt, the head of the worm will turn a bit darker than the rest of its body. Each time it molts, it sheds the old skin and grows a larger one. The first molt takes away the young silkworm's hair and leaves it as a white, smooth and soft caterpillar for the remainder of its days as a silkworm. The larva of silkworm also develops a horn at the back of its body following the first molt. The periods between molts are called silkworm instars. The larva stage lasts between 24 and 33 days. Following the worm's fourth molt, the silkworm will appear slightly yellow, and its skin will appear tighter than it did in other stages. The silkworm spins itself in a silk cocoon, made of one single thread that may be nearly a mile long, about the size of a cotton ball. Within the cocoon, if the process is allowed to complete itself, the worm is changing into a moth and will emerge as an adult one to two weeks after entering the cocoon. The silkworms feed on mulberry leaves and give rise to pupa. In pupa stage, a weave is netted around by the silkworm to hold itself.

After that it swings its head, spinning a fiber made of a protein and becomes a silk fiber. The silk thread (yarn) is obtained from the silk moth's cocoon.

Stage 1: Egg

An egg is the first stage of the life cycle of silkworm. The egg is laid by a female moth which is mostly the size of small dots. A female moth lays more than 350 eggs at a time.in the springtime, the eggs hatch due to the warmth in the air. This procedure happens once in every year.

Stage 2: Silkworm

A hairy silkworm arises after the eggs crack. In this stage of silkworms, the growth happens. they feed on mulberry leaves and consume a large amount of these leaves for around 30 days before going to the next stage.

Stage 3: Cocoon

In this stage, silkworms spin a protective cocoon around itself. It is the size of a small cotton ball and is made of a single thread of silk.

Stage 4: Pupa

Pupa stage is a motionless stage. In this stage, people kill the pupa by plunging the cocoon into boiling water and unwind the silk thread.

Stage 5: Moth

In this stage, the pupa changes into an adult moth. The female moth lays eggs after mating and thus the life cycle of silkworm begins again.

Understanding the various stages of growth of silkworms and techniques to be followed for successful rearing of silkworms is essential for farmers to make the activity a viable one.

Economics is an important criterion to evaluate, acceptance and wider adoption of any technology which is economically sound and that can be accepted by the sericulture farming community. Among different indicators of economic efficiency in sericulture, net returns have greater impact on the practical utility and acceptance of the production technology by the farmers. Identification of suitable reasons and management of economic problems to increase the productivity in sericulture is the key for success crop potential (Vinayak Hosmani et al., 2020).

It is observed that the yield gap of mulberry was found to be higher (21.98%) in small farm holdings as compared to other farm size groups. This may be due to resource constraints and low adoption of recommended technologies by them. In cocoon yield also,

higher level of difference between the potential farm yield and yields obtained by the farmers was observed. It is estimated that the gap between the potential yield and the farmers yield for all groups together was to the extent of 37.24 %. The yield gap was high at 43.43% in small holdings, which much higher than all other groups. This may be due to the low adoption of technologies and poor resources of the small farmers in rearing of silkworm practices (Srinivasa and Hiriyanna, 2014).

Lakshmanan et al. (2000) compared economic benefit over investment in rearing bivoltine and crossbred cocoons in their study on economics of bivoltine versus cross breed cocoon production in K. R. Nagar taluk of Mysore district. The study revealed that bivoltine rearing earns higher net returns than crossbred production owing to climatic suitability, skilled manpower and technical guidance received from developmental agencies.

In study conducted by Vishakanta (2018) in Kanakapura and Ramanagar taluks, it was found that Biovoltine silk rearing gives relatively higher income as compared to Multivoltine silk rearing. Hence, it is advisable for the farmers to switch over to Biovoltine silk rearing system of mulberry cultivation.

In addition to the understanding of the technology of silkworm rearing, the farmers face several other problems that limit realization of optimum returns. The scarcity of labour with high wage rate is a major problem. Skilled labour is required for planting of mulberry cuttings and other operations. Costly inputs such as cost of fertilizers, growth regulators, irrigation water and labour requirement are prominent problems. Other problems like non-availability of good quality mulberry cuttings followed by unsuitable soil type, and un-favourable climate are affecting quality of mulberry bio-mass production. High temperature during summer is the major constraint in case of cocoon production. It affects the health of silkworms there by the yield of cocoons. Difficulty in obtaining disease free layings, high incidence of uji fly were other problems faced and volatility of cocoon price, less number of reeler's participation in the auction, lack of local market facility are the major constraints in marketing of cocoon (G. N. Anil Kumar et al., 2019).

Srinivas Reddy et al., 2019 observed that electricity problem, lack of knowledge on correct dose of NPK, scarcity of labourers, shortage of irrigation water, lack of knowledge on pests and diseases in mulberry were the constraints as perceived by the farmers in mulberry cultivation. High transportation cost, lack of knowledge on the deflossing and sorting of cocoons, lack of information on market prices, lack of knowledge on diseases control, lack knowledge on uniform silkworm maturity hormone, lack knowledge on uzifly control in silk worm and low price for cocoons were the constraints as perceived by the farmers in silkworm rearing practices.

However, there has not been adequate thrust on quality due to the absence of quality-based price fixation. Absence of quality-based pricing has been a major deterrent factor in the pursuit for quality improvement. The seasonality associated with cocoon quality, cocoon supply and price as also the raw silk price almost always determine the fate of reeling activity.

Reeling sector is a vital component of sericulture linking the agriculture-based activity of cocoon production with the industrial activity of fabric production. Reeling converts the cocoons into raw silk yam. Silk reeling sector, though provides a vital transformation, appear to be the weakest link owing to its innumerable problems and the limited value addition that takes place. Problems are associated with raw material availability, working capital constraints, marketing and quality related aspects. Reeling sector is input dependent activity and its operations are influenced heavily by three factors viz., cocoon quality, cocoon price and cocoon supply.

Major problem faced by charka reelers is the multi end reelers will get 300 to 400 rupees more per kg when compared to charka and filature silk because quality of multi end is better than Charka and Filature. Multi-end reeling process requires minimum space of 30 feet x 40 feet land accommodation. which is not available to many reelers. Ready market for the charka and filature silk is not available regularly. Charka and Filature reelers are facing financial problems, labour problems, market problem for sale of their silk manufactured due to competition from multi - end reelers. More capital is required the manage the Multiend reeling machinery and majority of the medium and small size reelers cannot afford such an investment (Syed Yaseen, 2013).

Keeping the above in view, the project, "**PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"** was taken up by University of Agricultural Sciences, Bengaluru with Rashtriya Krishi Vikas Yojana funding. The project was implemented from 2012-13 to 2015-16. The details of the project are as under:

1.	**Title of Project**	**:**	**"PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"**
2.	**Nodal officer and Principal Investigator**	**:**	**DR. S. CHANDRASHEKHAR** Professor of Sericulture, College of Sericulture, Chintamani, UAS, GKVK, Bengaluru
3.	**Implementing Institution (S) and other collaborating Institution (s)**	**:**	College of Sericulture, Chintamani

4.	**Date of commencement of Project**	**:**	2012-13
5.	**Approved date of completion**	**:**	2015-16
6.	**Actual date of completion**	**:**	2015-16
7.	**Project cost**	**:**	Rs. 125 lakhs

The objectives of the project are as follows:

1. To promote community cluster approach in silkworm rearing to produce uniform quality cocoons and to encourage rearing of bivoltine breeds.
2. To encourage farmers in clusters to effectively utilize sericulture byproducts to increase the returns per unit area from sericulture enterprise.
3. To design and install efficient silk reeling units to produce high quality raw silk.
4. To establish appropriate power loom to convert high quality raw silk into a standard fabric.

HYPOTHESIS

The context of the evaluation arises from the following facts:

1. India occupies a predominant position in the world in silk production and India is the second largest producer of silk in the World (35,261 tonnes), next to China (1,20,000 tonnes).
2. The actual consumption of the country is around 45,000 metric tonnes. Hence it is obvious that India's requirement of silk is much higher than its current production. Hence the country is dependent upon imports to fill the demand and supply gap, mostly from China. Import of raw silk and silk fibre to India negatively affects the domestic producers and forces the Indian government to impose antidumping duty for imports. Self-sufficiency in domestic production of raw silk and suitable business protection for domestic producers of silk may be a solution. The past trends show that the demand supply gap will reduce gradually probably due to improvement in domestic raw silk production and its quality. Therefore, there is a lot of scope for the expansion of the industry. In addition to the domestic market there is huge export potential for Indian silks.
3. Sericulture is one of the major agro-based activities which can provide gainful self-employment for poor families in rural areas on their own land. It is an enterprise with a very short gestation period, having the potential to generate adequate returns from a very small piece of land. The pursuit of sericulture offers gainful employment to the rural masses. Being a labour intensive rural based industry it offers a qualitative and quantitative change in the poverty alleviation with a chain creation of employment from unskilled farm labourers to skill artisans to all sections in rural areas.

4. Economics is an important criterion to evaluate, acceptance and wider adoption of any technology which is economically sound and that can be accepted by the sericulture farming community. Among different indicators of economic efficiency in sericulture, net returns have greater impact on the practical utility and acceptance of the production technology by the farmers. Identification of suitable reasons and management of economic problems to increase the productivity in sericulture is the key for success crop potential (Vinayak Hosmani et al., 2020).
5. Studies have revealed that bivoltine rearing earns higher net returns than crossbred production owing to climatic suitability, skilled manpower and technical guidance received from developmental agencies. Hence, it is advisable for the farmers to switch over to Biovoltine silk rearing system of mulberry cultivation.
6. In addition to the understanding of the technology of silkworm rearing, the farmers face several other problems that limit realization of optimum returns. The scarcity of labour with high wage rate is a major problem. Skilled labour is required for planting of mulberry cuttings and other operations. Costly inputs such as cost of fertilizers, growth regulators, irrigation water and labour requirement are prominent problems. Other problems like non-availability of good quality mulberry cuttings followed by unsuitable soil type, and un-favourable climate are affecting quality of mulberry bio-mass production. High temperature during summer is the major constraint in case of cocoon production. It affects the health of silkworms there by the yield of cocoons. Difficulty in obtaining disease free layings, high incidence of uji fly were other problems faced and volatility of cocoon price, less number of reeler's participation in the auction, lack of local market facility are the major constraints in marketing of cocoon (G. N. Anil Kumar et al., 2019).

OBJECTIVES AND ISSUES FOR EVALUATION

The scope of evaluation is to study the impact of scheme, "**PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"** implemented by University of Agricultural Sciences, Bengaluru from 2012-13 to 2015-16.

1. Stake Holders

a) University of Agricultural Sciences, Bengaluru – Sponsorer
b) Rashtriya Krishi Vikas Yojane – as Monitoring Authority
c) Institution of Agriculture Technologists – as Consultant
d) Farmers / beneficiaries as target group of evaluation

2. Purpose of Evaluation

Evaluation Framework

The focus of Evaluation is:

i. To evaluate the impact of community cluster approach in silkworm rearing to produce uniform quality cocoons and to encourage rearing of bivoltine breeds.
ii. To evaluate the efficiency of encouraging farmers in clusters to effectively utilize sericulture byproducts to increase the returns per unit area from sericulture enterprise.
iii. To evaluate the impact of designing and installing efficient silk reeling units and establishing appropriate power loom in producing high quality raw silk and converting it into a standard fabric.

LOG FRAME/THEORY OF CHANGE/PROGRAM THEORY

The intention of the project is to develop, evaluate and demonstrate the use of various renewable sources of energy in operation of equipment used in crop production. The various operations studied included pre-planting operations, sowing, irrigation, intercultural operations and post-harvest management.

EVALUATION DESIGN

Evaluation design has a rationale of requirement of field level data (primary) that is required to study evaluation objective with respect to beneficiary farmers on one part and the projects taken up for study per se on the other part. The evaluation requires analysis of administration obligations under the two heads and hence a secondary data analysis becomes important and accordingly formats were designed to procure secondary data. The third obligation under evaluation is opinion of stake holders with respect to improvement of the schemes, which require group discussions and exchange of views both in the form of a format, as well as group discussions with the stake holders. The entire evaluation process required a central administration of all activities.

A core team of experts at the Institution level considered three methods to bring a meaningful evaluation of the subject, keeping in mind the scope, evaluation questions and sub-questions duly keeping its focus on the purpose of evaluation. The three methods are:

a. Accessing and analysis of secondary data from the implementing department.
b. Interaction with Principal Investigator and his team.
c. Actual visit to the project site to study and obtain necessary information to elicit answers to the evaluation questions.

DATA COLLECTION AND ANALYSIS

Evaluation of the impact of community cluster approach in silkworm rearing to produce uniform quality cocoons and to encourage rearing of bivoltine breeds

Clustering as an approach to economic development has developed as a formal discipline over the last 2-3 decades. Clusters are differentiated by their specialization in a particular stage of their field's value chain, by their focus on specific geographic areas, or by targeting selected customer needs or market segments (Ketels, C.H.M 2003).

A cluster is a group of industries whose linkages mutually reinforce and enhance their competitive advantage. They can be each other's customers, competitors, partners, suppliers or research and development sources. Partners in a cluster continue to compete, but they also begin to share the benefits of innovative ideas and practices that each contributes. This makes them more competitive. The cluster approach is not simply about strengthening or developing individual companies or organisations within a particular industry – it is about building that industry as a whole so that it is stronger and fitter and ready to take advantage of what the future brings. This is done through building on links between the component parts of the sector. By developing an agreed strategy for development, the whole sector will be better placed to identify and take advantage of the opportunities that co-operation can bring. The existing research shows that the evolution of clusters can take many years, often decades. Many clusters have developed without the presence of any dedicated efforts to upgrade them. The inherent economics of proximity have been enough to over time attract increasing numbers of companies and other institutions, leading to a self-reinforcing cycle that was often started by a chance event. But other clusters have developed much faster because of the determined action of regional leaders that had spotted the potential of their region for the cluster (Porter, M.E. 1998).

Hence, a cluster approach for development of sericulture in Chintamani taluk was adopted. Two villages, viz., Kathriguppe and Lakshmidevakote were selected as there was concentration of sericulturists in these villages. A group of 30 farmers with 32 acres under mulberry in Kathriguppe and group of 16 farmers with 26 acres under mulberry in Lakshmidevakote were selected for the project. Participatory Technology Development (PTD) was adopted in the project area. The farmers were motivated to take up bivoltine silkworm rearing by emphasising on the economic and quality aspects of bivoltine silk.

Two village level societies, i.e., Kathriguppe Bivoltine Reshme Belegarar Sangha and Manjunatha Swamy Reshme Belegara Sangha were formed and registered and provided all inputs required for improving mulberry garden and to popularize the bivoltine cocoon production. By laws were framed to fix the responsibility of different stake holders.

Kolar and Chikkaballapur district sericulturists are traditional multivoltine rearers and the selected villages had no bivoltine rearing exposure in the past. The farmers were motivated to take-up Bivoltine silkworm rearing. Totally 11 OFDs and 33 FFS were conducted to educate the farmers on various aspects of sericulture. By participating in FFS, farmers got season long educational activity. Farmers were empowered to solve the sericultural problems by interaction, joint decision making and self-confidence. All the technologies were provided through training programmes and practical demonstrations to transfer the appropriate technologies to the farmers. Selected farmers were given technical guidance through crop inspections to produce quality Bivoltine cocoons and to enhance productivity per unit land value so that their economic uplifting is achieved. Totally 494 farmers were trained on advanced bivoltine sericulture technologies and they were considered for biovoltine rearing. The farmers were trained on aspects related to identification of the diseases, integrated management practices, method of secondary level multiplication of bio control agents and their application. were trained in seven batches through demonstrations at the Karnataka State Sericulture Research and Development Institute on integrated nutrient and Root Disease Management in mulberry.

The members of the groups were trained on integrated approaches in mulberry production, chawki rearing, silkworm rearing house management, silkworm rearing, grading, packing, etc. They were provided mulberry garden management technologies and critical inputs including chemical fertilizers (Urea, Single Super Phosphate, Muriate Of Potash). Rearing inputs like minimal modification of rearing houses (inputs for Rearing house alterations, i.e., PVC Pipes, mesh and gunny sacks for micro environment improvement) were also supplied. The disinfectants (Seriswach, Sanitech super, Bleaching powder & Decol), bed disinfectants (Vijetha supplement & Vijetha green) and Chawki reared worms were supplied at their door step at free of cost. Inspections were carried out at timely interval and members were provided technical guidance on age and stage of development on day to day basis by the project supervisory staff housed in the village. In addition, common facilities such as power sprayer, brush cutter, plastic montages and mulberry leaf chopping machine were supplied to the society to use on hired basis. Uniform brushing of silkworm breed/ hybrid, management of rearing, harvesting and grading of cocoons were also promoted. Further, they were encouraged for the effective utilization of by products to generate value added products viz., compost/vermicompost, silage, energy cakes, bio gas bio-crafts from defective cocoons, etc. The uniform quality cocoons produced by the group were utilized within the project for its conversion as quality raw silk by using Multi end reeling machine installed at Sericulture College, Chintamani. Standardized the reeling practices for effective conversion of graded cocoons for quality raw silk production and initiated the silk production process. The quality raw silk produced was converted into standard silk fabrics using design. Power loom unit was established at Sericulture College, Chintamani. Studies were initiated to standardize the procedures for effective utilization of reeling waste water as per emerging needs.

Impact

All the farmers were rearing cross breeds with low yield potential prior to the project period. The mulberry gardens were not maintained properly. The average cocoon yield was about 55 kg/ 100dfls and the annual cocoon production from the entire village was about 14000 kg and approximate returns of Rs. 25,20,000 with an average cocoon price of Rs.180/ kg.

The farmers started rearing Bivoltine hybrids after effecting modifications in the mulberry gardens and silkworm rearing houses. The modifications in mulberry gardens were mainly broader rows at 6 feet apart, soil test based application of fertilizers, spraying of plant protection chemicals and following package of practices as guided by the project supervisors. Appropriate production, grading, packing and marketing technologies were adopted by all the members. The average cocoon yield increased to 70.00 kg/ 100dfls and the total cocoon production in 10 months-time was about 25000 kg with an approximate returns of Rs. 57,50,000 (more than doubled) at average price of Rs.230/ kg for the better quality cocoons.

About 55000 kg high quality cocoons were produced by the cluster farmers every year for the next two years. It amounts to 20 per cent increase in yield and production of 150 ton of quality compost using sericultural wastes.

In Lakshmidevakote cluster, significantly higher yield (30%) was obtained by the farmers compared to the taluk average yield in the preceding years. The average Bivoltine cocoon yield recorded was 79.25 kg/ 100 dfl and the price obtained was Rs.300-375.

The results confirm that under handholding technology adoption and timely technical guidance the traditional multivoltine farmers learnt about Bivoltine rearing technologies and produced an appreciable uniform quality cocoon crop and got an annual return of Rs. 2 lakhs acre/ year.

The feedback received from the farmers who participated in the project include the following:

1. There was continuous guidance from the project supervisors in crop cultivation and silkworm rearing.
2. There used to be some crop failures before the project period. After the training and guidance from the project supervisors, no farmer faced crop failure problems.
3. Most farmers were rearing multivoltine cross breds before the project and shifted to Bivoltine cross breeds during the project period and got better yield and income from better cocoon quality and rates.

4. The farmers faced marketing problems as they had to go to only Ramanagar cocoon market to sell the bivoltine cocoons.
5. The farmers found that bivoltine hybrids are good only during rainy season and shifted to multivoltine races during summer.
6. Farmers were happy with the folding model/ rotary mountages used for bivoltine breed worms.
7. There was increase in area under mulberry by 10 to 15 acres as other farmers in the area took up sericulture.
8. The good results enthused farmers from neighbouring villages, viz., Kundagurki and Donnahalli to take up sericulture activity.
9. Most farmers discontinued the Bivoltine rearing during summer due to high temperature, water scarcity. They took up Bivoltine during winter and rainy seasons. Farmers also experienced marketing problem.
10. There was no increase in area under sericulture in Lakshmidevakote as farmers faced water shortage.

Evaluation of the efficiency of encouraging farmers in clusters to effectively utilize sericulture by-products to increase the returns per unit area from sericulture enterprise.

Although, vermicompost and compost units were established for utilization of sericulture waste for production of compost and vermicompost and mulberry twigs were used for making pallettes after chopping, no specific strategy was put in place for improving the use of sericulture waste like uneaten mulberry leaves, floss etc. The farmers were already following composting of uneaten mulberry leaves and twigs. About 150 tonnes of quality compost was produced by the farmers in Kathriguppe using sericultural wastes.

Evaluation of the impact of designing and installing efficient silk reeling units and establishing appropriate power loom in producing high quality raw silk and converting it into a standard fabric

The process of drawing silk fibre from the cocoon is called 'reeling'. The cocoons are cooked in hot water and the silk fibre is unwound from the cocoons. The silk consists of two proteins, the inner core of fibroin and an outer cover of gum sericin. During reeling, the cocoons are processed in hot water at 95-97^{0}C for 10-15 minutes. This process is called cooking. This cooking will enable the sericin portion to get softened and make unwinding easy without breaks.

Silk reeling is the process by which a number of cocoon baves are reeled together to produce a single thread. This is achieved by unwinding filaments collectively from a group of cooked cocoons at one end in a warm water bath and winding the resultant thread onto a fast moving reel. Raw silk reeling may be classified by direct reeling method on a standard sized reel, indirect method of reeling on small reels, and the transfer of

reeled silk from small reels onto standard sized reels on a re-reeling machine. The last technique is primarily applied in modern silk reeling processes. In India, 61% of the silk is reeled on the country-type charka (spinning-wheel). The silk produced with the country charka is of very poor quality, as the thread is not uniform and it carries many slubs etc. The improved cottage-type basins have been introduced recently into India. Provision for button-holes and a proper croisure system to maintain the thickness of the fibre and to control the defects of neatness in the cottage basin have facilitated the production of better-quality silk. There are as many as 4,000 cottage basins in the country. Large-scale basins organized 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, cleanliness and 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 multivoltine races of silk worms is poor in quality and is known to have greater defects, such as lousiness, and defects in neatness and cleanliness and is of very poor quality conforming to the international D grade. The silk produced by the bivoltine races of silkworms possesses superior neatness and cleanliness, is without lousiness and has high tensile strength and stands to the international A grade.

Reeling process is an important activity. Depending upon the required thickness (denier) of silk thread filaments from number of cocoons are combined together and reeled. An efficient reeler will maintain the fixed number of cocoons per end to produce uniform denier silk. Reeling is carried out by distinctive methods. The quality of silk fabric mainly depends on the efficiency of reeling units.

The multi end reeling machine has a number of reeling thread ends per basin and reducing the reeling speed. The operator must stand when running this machine as the number of reeling threads per basin increases by twenty-fold. The Multi-ends reeling machine is composed of driving part, groping ends, picking ends, standby bath, reeling part, jetboute, stop motion, traverse guider, small reels, steam heating pipes and clutches.

The cooked cocoons contained in the tubs are carried into the groping ends portion of the reeling machine. From there, cocoons are moved into the picking ends apparatus. After correctly processing, the cocoons go to the standby bath for cocoon feeding. They are picked up by the reeler and fed to the reeling thread. During this step a number of cocoons will be dropped thus reducing the ratio of reeling cocoons per thread. The normal speed of cocoon feeding by a skilled reeler is around 16 times per minute. The reeling thread passes through the jetboute, silk button, first guider, second guider, third guider, fourth guider, traverse guider, in that order and then is wound onto the small reels. The cocoons dropped during the reeling process are gathered and reprocessed starting from the groping end section. The croissure of reeling thread is made between second guider

and third guider, and the length of croissure is not for twisting of thread but for cohesion of thread by rubbing of composed filament. Typically, one set of Multi-ends reeling machine consists of ten basins with each basin having twenty ends or reels.

Basin: The basin is rectangular with well-rounded corners and edges. It is only 10 to 12 cm deep. It is commonly made of dark coloured porcelain. The basin is subdivided into sections, each intended for a specific job such as brushing, end gathering of baves, stocks in reserve and waste collection.

Reels: The reels of the Multi-ends reeling machine have a circumference of 75 cm. The frame of the reel is made of light metal or plastic. The reels are fitted into reel carriers and driven by a transmission shaft by connecting gears.

Traverse guider: To ensure narrow and long web on the hank of the reel, a cam type traverse assembly has been fixed. This will make a convex surface in the hank, which is wound on the reel. The centre part of the hank is higher than the two axis.

Thread button: Porcelain button thread-guiders are used for removing any dirt adhering to the thread passing through the tiny aperture in the button.

The multi end reeling machine in Sericulture College, Chintamani was installed after studying the design and making suitable modifications, especially in the design of the basin. The machine was tested using the bivoltine cocoons produced by the farmers in Kathriguppe and Lakshmidevakote. The uniform quality cocoons produced by the group were utilized for conversion as quality raw silk.

Power loom was also installed in Sericulture College, Chintamani for the conversion of quality raw silk produced into standard silk fabrics using pre-assigned designs.

The multiend reeling machine and hand loom are used extensively for demonstration purposes involving farmers and students in quality silk and fabric production.

FINDINGS AND DISCUSSION

The project implementation functionaries have methodically and systematically taken up the task of identifying sericulture clusters, educating the farmers to take up rearing of bivoltine breed through training, exposure visits, demonstrations and hand holding, introducing the farmers to latest technological innovations in mulberry growing and silkworm rearing, providing subsidized inputs and guiding the farmers in taking up successful rearing of bivoltine breeds.

The trainings, exposure visits and demonstrations have been exclusively used to educate the farmers in latest technological innovations in mulberry growing and silkworm rearing. The farmers have adopted the modifications suggested like broader row spacing of 6 feet in mulberry planting, drip irrigation, soil test based application of fertilizers in mulberry growing, providing adequate ventilation and aeration in rearing houses, frequent disinfection, using folding model/ rotary mountages, uniform harvest of cocoons, grading of cocoons in silkworm rearing.

The forming of growers' co-operative societies by the farmers has also helped the farmers in taking up group activities like cocoon grading, group marketing etc.

The impact of introduction of technological innovations like broader row spacing of 6 feet in mulberry planting, drip irrigation, soil test based application of fertilizers in mulberry growing on the yield, quality and economics of mulberry production has not been studied. This could have made the farmers to understand the importance of the technology introduced and given impetus to adoption by other farmers.

Similarly, the effect of providing adequate ventilation and aeration in rearing houses, frequent disinfection, using folding model/ rotary mountages on the microclimate in the rearing house, bacterial counts and quality of cocoons in terms of reeling efficiency, renditta, floss density, filament strength could have given a better picture of the improvements made.

The farmers in the clusters used the third instar silkworms purchased from chawki centres. There is need to encourage the farmers to take up chawki rearing also.

The supply of subsidized inputs appears to have had a negative impact on the project as it was observed that the farmers discontinued the technological innovations suggested once the supply of subsidized inputs was stopped after the project was concluded.

The farmers have stopped rearing of bivoltine breed after the project period mainly due to marketing problems. The bivoltine cocoons had to be marketed only in Ramanagar cocoon market. This aspects should have been considered during the project period and suitable steps should have been taken to ensure smooth marketing avenues for the cocoons.

There does not seem to be any appreciable efforts made to make use of the sericulture wastes in preparing by-products to augment the income of farmers.

The establishment of multi end reeling unit and power looms in sericulture College, Chintamani does not appear to have been optimally utilized in the project as no comprehensive and discernible efforts are found to improve the quality of post cocoon processing. However, the multiend reeling machine and hand loom are used extensively for demonstration purposes involving farmers and students in quality silk and fabric production.

BUDGET ALLOCATION AND UTILIZATION

SUMMARY

Year	Funds released	Utilized
2011-12	1,25,00,000.00	17,16,992.00
2012-13	----	60,72,318.00
2013-14	----	12,14,789.00
2014-15	----	2,95,213.00
2015-16	----	71,445.00

YEAR-WISE BUDGET UTILIZED

Budget allotted and utilization for 2011-12

Sl. No.	Particulars	Budget allotted for 2011-12	Expenditure for 2011-12	Balance revalidated for 2012-13
1.	Salary: JRF (3 Nos.)	6,00,000.00	2,12,026.00	3,87,974.00
2.	Subject Matter Specialist- Silk reeling & weaving			
3.	Secretarial Assistant/Typist			
4.	Field Assistants	2,00,000.00	57,467.00	1,42,533.00
5.	TA & DA	50,000.00	Nil	50,000.00
6.	Contingencies	13,00,000.00	89,684.00	13,10,316.00
7.	Stationary	2,00,000.00	37,261.00	1,62,739.00
8.	Vehicle hire charges	3,00,000.00	1,33,800.00	1,66,200.00
9.	Critical inputs on farm and beneficiaries/ purchase of cocoons from farmers for silk reeling training	13,00,000.00	5,41,569.00	7,58,431.00
10.	Capacity building of stake holders	5,00,000.00	2,21,800.00	2,78,200.00
11.	Publicity material	3,00,000.00	----	3,00,000.00
12.	Printing & publication	1,50,000.00	----	1,50,000.00
13.	Skilled labourer	3,00,000.00	53,515.00	2,46,485.00
14.	Chawki, Silkworm rearing, silk reeling & weaving unit equipment	3,000,000.00	119,385.00	2,880,615.00
15.	Establishment of Silk reeling and weaving unit civil works	4,200,000.00	250,485.00	3,949,515.00
	Total	**1,25,00,000.00**	**17,16,992.00**	**1,07,83,008.00**

Budget allotted and utilization for 2012-13

Sl. No.	Particulars	Budget allotted for 2012-13	Expenditure for 2012-13	Balance revalidated for 2013-14
1.	Salary: JRF (3 Nos.)	4,39,562.00	3,76,365.00	63,197.00
2.	Subject Matter Specialist- Silk reeling & weaving			
3.	Secretarial Assistant/Typist			
4.	Field Assistants	1,35,533.00	91,608.00	43,925.00
5.	TA & DA	50,000.00	Nil	50,000.00
6.	Contingencies	7,60,316.00	6,74,215.00	86,101.00
7.	Stationary	1,62,739.00	5,742.00	1,56,992.00
8.	Vehicle hire charges	1,66,200.00	1,63,674.00	2,526.00
9.	Critical inputs on farm and beneficiaries/purchase of cocoons from farmers for silk reeling training	5,58,431.00	5,34,670.00	23,761.00
10.	Capacity building of stake holders	78,200.00	--	78,200.00
11.	Publicity material	50,000.00	Nil	50,000.00
12.	Printing & publication	50,000.00	--	50,000.00
13.	Skilled labourer	2,46,485.00	1,07,340.00	1,39,145.00
14.	Chawki/Silkworm rearing /silk reeling and weaving unit equipment	37,80,615.00	34,19,189.00	3,61,426.00
15.	Establishment of Silk reeling and weaving unit civil works	6,99,515.00	6,99,515.00	Nil
	Total	**71,77,596.00**	**60,72,318.00**	**11,05,278.00**

Budget allotted and utilization for 2013-14

Sl. No.	**Particulars**	**Budget allotted for 2013-14**	**Expenditure 2013-14**	**Budget Revalidated for 2014-15**
1.	Salary: JRF (3 Nos.)	1,76,367.00	1,64,710.00	11,657.00
2.	Subject Matter Specialist- Silk reeling & weaving			
3.	Secretarial Assistant/Typist			
4.	Field Assistants	Nil	Nil	Nil
5.	TA & DA	25,000.00	Nil	25,000.00
6.	Contingencies	3,18,131.00	2,88,655.00	29,476.00

7.	Stationary	25,000.00	160.00	24,840.00
8.	Vehicle hire charges	2,526.00	Nil	2,526.00
9.	Critical inputs on farm and beneficiaries/ purchase of cocoons from farmers for silk reeling training	1,52,042.00	1,01,180.00	50,862.00
10.	Capacity building of stake holders	Nil	Nil	Nil
11.	Publicity material	25,000.00	Nil	25,000.00
12.	Printing & publication	50,000.00	Nil	50,000.00
13.	Skilled labourer	2,32,169.00	1,32,800.00	99,369.00
14.	Chawki, Silkworm rearing, silk reeling and weaving unit equipment	2,61,426.00	2,53,100.00	8,326.00
15.	Establishment of Silk reeling and weaving unit civil works	3,00,000.00	2,74,184.00	25,816.00
	Total	**15,67,661.00**	**12,14,789.00**	**3,52,872.00**

Budget allotted and utilization for 2014-15

Sl. No.	***Particulars***	***Budget Allotted for 2014-15***	**Actual expenditure 2014-15**	**Budget available for 2015-16**
1.	Salary: JRF (3 Nos.)	0.00	0.00	0.00
2.	Subject matter specialist & silk reeling & weaving (Contractual Staff)			
3.	Secretarial Assistant/Typist			
4.	Field Assistants	0.00	0.00	0.00
5	TA & DA	0.00	0.00	0.00
6	Contingencies	84,791.00	84,709.00	71,527.00
7	Stationery	24,840.00	4,959.00	19,881.00
8	Vehicle hire charges	12,800.00	0.00	12,800.00
9	Critical inputs on farm & beneficiaries	50,000.00	50,000.00	0.00
10	Printing and Publications	20,000.00	0.00	20,000.00
11	Skilled labourer	86,000.00	86,000.00	0.00
12	Chawki/Silkworms rearing/ Silk reeling and weaving unit equipment	58,779.00	40,500.00	18,279.00
13	Establishment of silk reeling and weaving unit-civil works	29,448.00	29,045.00	403.00
	Total	**3,66,658.00**	**2,95,213.00**	**71,445.00**

REFLECTIONS AND CONCLUSIONS

i. The project has been well planned, efficiently executed and commendable impact has been observed in improvement of income of stake holders in the clusters formed.

ii. The identification and formation of clusters have been done meticulously.

iii. The introduction of technological innovations in the clusters has been well thought out and executed systematically.

iv. The farmers have adopted the technological innovations in right earnest. This is clearly seen more in mulberry cultivation where broader row plantations, drip irrigation, soil test based application of fertilizers are practiced. The farmers have also adopted the improvements suggested in silkworm rearing like providing better ventilation and aeration, frequent disinfection and grading of cocoons.

v. The farmers experienced difficulty in marketing their produce as they had to go to Ramanagar cocoon market only.

vi. The impact of technological innovations on the yield, quality and economics of mulberry production could have made the farmers to understand the importance of the technology introduced and given impetus to adoption by other farmers.

vii. The effect of providing adequate ventilation and aeration in rearing houses, frequent disinfection, using folding model/ rotary mountages on the microclimate in the rearing house, bacterial counts and quality of cocoons in terms of reeling efficiency, renditta, floss density, filament strength could have given a better picture of the improvements made.

viii. The supply of subsidized inputs appears to have had a negative impact on the project as it was observed that the farmers discontinued the technological innovations suggested once the supply of subsidized inputs was stopped after the project was concluded.

ix. The farmers have stopped rearing of bivoltine breed after the project period mainly due to marketing problems. This aspect should have been considered during the project period and suitable steps should have been taken to ensure smooth marketing avenues for the cocoons.

x. There does not seem to be any appreciable efforts made to make use of the sericulture wastes in preparing by-products to augment the income of farmers.

xi. The establishment of multi end reeling unit and power looms in sericulture College, Chintamani does not appear to have been optimally utilized in the project as no comprehensive and discernible efforts are found to improve the quality of post cocoon processing. However, the multiend reeling machine and hand loom are used extensively for demonstration purposes involving farmers and students in quality silk and fabric production.

xii. The involvement of line departments was not seen except in sanction of subsidy for drip irrigation and a few extension activities for technology dissemination.

xiii. Criteria for selection of farmers has not been detailed in the project and needs to be spelt out/ brought out.

xiv. Impact assessment of the technology developed in improving the productivity and quality of cocoon and silk needs to be brought out.

xv. Impact of training modules adopted needs to be brought out.

ACTION POINTS

1. The planning and implementation of the project have been meticulous and are praiseworthy. The project is suitable for replication in other sericulture areas of the state.
2. The convergence of line departments is necessary for better implementation of similar projects.
3. Policy issues like online marketing and establishment of post cocoon processing units nearer to sericulture clusters need to be resolved to facilitate and encourage farmers to shift to rearing of bivoltine breeds.
4. The problems associated with rearing of bivoltine breeds during summer months need to be studied and suitable solutions found for successful rearing of bivoltine breeds during summer months.
5. The technological innovations adopted in mulberry cultivation and silkworm rearing should be evaluated and adopted as recommended package of practices.
6. The success stories should be circulated among the sericulture villages in the state to encourage other farmers to adopt the practices.
7. There is need to take a holistic view of the activity from seed to fibre so that the seemless transformation is achieved.
8. There is need to devise methods and systems to make use of the sericulture wastes in preparing by-products to augment the income of farmers.
9. The multi end reeling unit and power loom established in sericulture College, Chintamani should be utilized better to study the problems associated with reeling, rereeling and manufacture of fabrics.

RESEARCHABLE ISSUES

1. Development of package of practices for mulberry cultivation for seed cocoon in seed areas.
2. Documentation of Indigenous Technology Knowledges (ITKs) and their integration in crop husbandry and non-cash inputs in sericulture activities is needed.

Participatory approach and training

Training programme conducted

Demonstration of soil sampling

	
Demonstration of mechanised inter-cultivation in mulberry	Inspection and technical guidance

Training programme conducted under RKVY project

Field inspection

Field inspection

Soil sampling

Distribution of kits to farmers

Harvesting of cocoons

Cocoon storage prior to marketing

Uniform quality cocoons of cluster village

Packing of cocoons

SILK REELING, TWISTING AND WEAVING UNIT UNDER RKVY PROJECT AT SERICULTURE COLLEGE CAMPUS, CHINTAMANI

<table>
<tr>
<td> 
Silk reeling, twisting and weaving complex</td>
<td> 
Steam boiler room</td>
</tr>
<tr>
<td> 
USHNAKOTI</td>
<td> 
Hot air drier</td>
</tr>
<tr>
<td> 
Two pan cocoon cooking unit</td>
<td> 
Centralised pressurised cocoon cooking unit</td>
</tr>
</table>

Vacuum permeation chamber

Multi-end reeling machine

Silk reeling activity at the unit

Re-reeling machine

Raw silk produced at the unit

Silk winding, doubling and twisting machine

Silk winding

Silk doubling

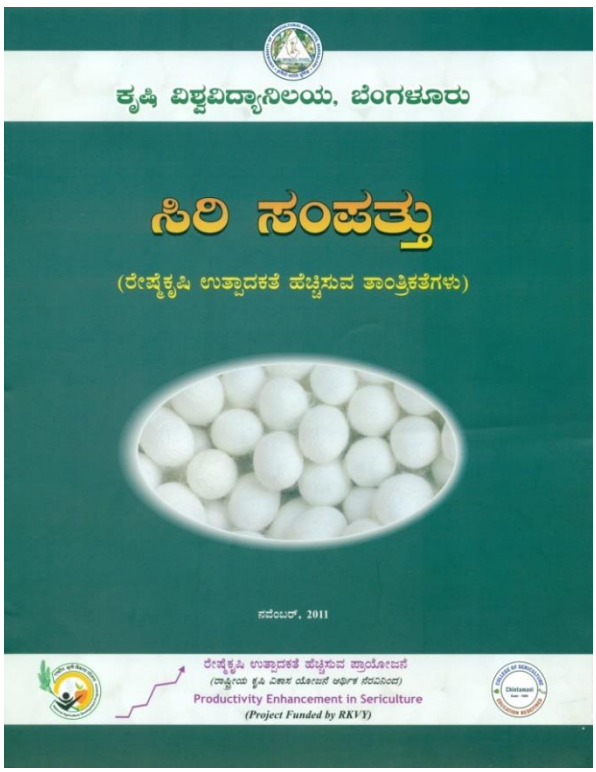
Electronic Jacquard power loom

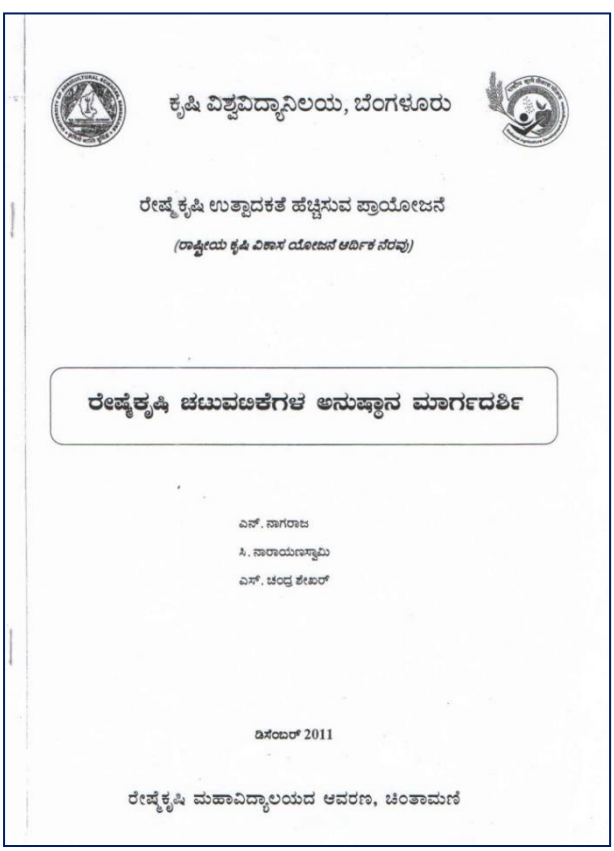
Dobby power loom

Plain fabrics weaving

Silk saree and shirt produced in the unit

Literature Developed





VISIT OF EVALUATION TEAM TO VILLAGES AND SERICULTURE COLLEGE, CHINTAMANI

Different types of silks manufactured in India

State	Type of silk sarees
Andhra Pradesh and Telangana	Dharmavaram, Pochampalli, Venkatagiri, Narainpet
Assam	Sualkuchi
Bihar	Bhagalpur
Gujarat	Surat, Cambay
Jammu and Kashmir	Srinagar
Karnataka	Anekal, Bangalore, Ilkal, Molakalmur, Melkote, Kollegal, Doddaballapur
Chattisgarh	Champa, Chanderi, Raigarh
Maharastra	Paithan
Tamil Nadu	Kanchipuram, Arni, Salem, Kumbhakonam, Tanjavur
Uttar Pradesh	Varanasi (Benaras)
West Bengal	Bishnupur, Mushirabad, Birbhum

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TERMS OF REFERENCE

FOR THE RKVY PROJECT ENTITLED "PRODUCTIVITY ENHANCEMENT IN SERICULTURE THROUGH COMMUNITY CLUSTER APPROACH"

1. Title of the study

Productivity Enhancement in Sericulture through Community Cluster Approach

2. Department/Agency implementing the Scheme:

College of Sericulture, Chintamani, University of Agricultural Sciences, Bangalore

3. Background and the context

Karnataka is a leading sericultural state in the country and the sericulture enterprise is steadily progressing in the state. The cocoon yield per 100 Disease Free Layings (DFLs) was about 25 kg in 1980's against the present yield of 60 kg. Similarly, the raw silk production per hectare was about 25 kg and now it is 90 kg. Correspondingly, the renditta (number of kg cocoons required to produce one kg raw silk) has declined from 11 to 7. These significant achievements were due to the contribution of research in sericulture. Some of the significant improvements were evolving high yielding mulberry varieties, technology packages for better management of mulberry gardens, improved water use efficiency, integrated approaches in pest management in mulberry, improvements in rearing house, evolving high yielding bivoltine breeds and their hybrids, integrated approaches in rearing house management, disease and pest management in silkworms, management of ripe worms, etc.

In spite of these improvements, the quality raw silk now produced in the country/ state is not comparable to the quality of silk produced by sericulturally advanced countries like China. The silk produced in China will have uniform size over a long stretch of yarn besides lower cost of production. Hence, the fabric manufacturers using power looms prefer such quality raw silk. Important reasons for getting uniform size raw silk are homogeneity in cocoon lots, large scale convertors of cocoon to raw silk and integrated approaches to recycle the sericulture byproducts, thereby reducing the cost of cocoon and raw silk production.

Though, sporadic attempts were made in India to improve the quality of raw silk, a comprehensive approach like integrating large scale uniform cocoon production, large scale conversion of cocoon to quality raw silk and silk fabric manufacturing has not been tried. But, there is a scope to improve the yield levels and quality of raw silk to remain competitive in the free trade era.

Intermittent attempts were under progress to improve the quality of raw silk, a comprehensive approach for large scale quality cocoon production and conversion to quality raw silk and silk fabric has not been tried. With an attempt to improve the yield levels and quality of raw silk production in large scale this project has been designed got approved on 28.09.2012 and launched during October 2012 by selecting sericulture potential village Kathriguppe of Chintamani Taluk, covering about 32 acres of mulberry area with 40 farmers. This was the first identified cluster.

The selected farmers of the cluster has been trained on integrated approaches in mulberry production, chawki rearing, silkworm rearing house management, silkworm rearing, gardening, packing, etc., through group discussions and interactions. This farmer group was technically and financially supported to take up improved technological practices to produce quality cocoon by rearing bivoltine crop. Group brushing of same silkworm hybrids were organized to supervise, guide and manage the transfer of technology of rearing, harvesting and grading of cocoons before marketing. An attempt was made by educating the farmer groups to effective utilization of by-products and generate value added products viz., compost/vermicompost production, silage, energy cakes, bio-gas production, bio-crafts from defective cocoons, etc. The uniform quality cocoons produced by the group was utilized within the project for its conversing as quality raw silk.

The fabricated multi end reeling machine was installed in the Sericultural College Chintamani. By utilizing this machine converted the produce into quality silk and improved the reeling practices for effective conversion of graded cocoons for quality raw silk production, standardize the silk production process by utilizing the uniform quality cocoons produce by the community cluster.

Formed the village level committee comprising of sericulture farmers at cluster level. Bylaws have been framed to fix the responsibility of different stakeholders and the society has been registered to strengthen them. Constituted the committee at college level with due representation of all the stakeholders to manage the whole process in the cluster and to supervise the progress and to guide the famers. The identified farmers have been trained and capacity building on quality aspects of different activities such as, mulberry production, rearing house management, chawki handling, silkworm rearing, compost production, harvesting and grading of cocoons has been carried out on handholding skill up gradation techniques. All the interested farmers of the cluster group have been provided common technologies to mulberry garden management and critical inputs (chemical fertilizers).

4. Out Come of the Project

The results obtained under the RKVY project from Kathriguppe cluster was 70.00 kg cocoon 100 dfls and the price obtained per kg ranging from 240-300/kg. Lakshmidevakote cluster during the project period was significantly higher, 30 percent above the average mean yield of the taluk for the preceding years. The Bivoltine cocoon yield per 100 dfls was recorded 78.33 kg and the price obtained per kg ranging from Rs.300-375. Thus confirming that, under handholding technology adoption and timely technical guidance the traditional multivoltine farmers who had no Bivoltine exposure can learn Bivoltine rearing technologies and produce an appreciable uniform quality cocoon crop and get an annual returns/ acre/ year above 2lakhs.

To convert the Bivoltine cocoons into quality raw silk a composite silk reeling and weaving unit with machineries like multi-end silk reeling machine, silk doubling, twisting machine and appropriate power looms have been installed and the uniform quality cocoons produced by the cluster farmers has been converted into quality fabrics.

About 60 sericulturists in a cluster covering an area of 20ha of mulberry uniformly adopted improved technology packages for effective management of mulberry gardens and silkworm rearing to produce uniform cocoon lots.

All the sericulturists were rearing cross breeds (less yield potential) and the mulberry gardens were not maintained properly. The average cocoon yield was about 55kg/100dfls and the annual cocoon production from the entire village was about 14000kg with an average cocoon price of 180/kg (approximate returns of Rs.2520000).

As RKVY project intervention, firstly a sangha was formed and registered as Kathariguppe Bivoltine Reshme Belegarara Sangha at Kathariguppe and Sri Manjunatha swamy Reshme Belegarara sangha at Lakshmidevakote involving all the sericulturists in the village. Secondly, the members of the Sangha were given technical and financial support required for Bivoltine silk production. An amount of Rs.10 lakhs was spent from the project to modify the mulberry gardens, silkworm rearing houses, equipment for scientific rearing (given to Sangha).

All the members of the Sangha started rearing Bivoltine hybrids after affecting modifications to the mulberry gardens and silkworm rearing houses. Appropriate production, grading, packing and marketing technologies are being adopted by all the members of Sangha. The average cocoon yield is 70.00 kg/100dfls and the total cocoon production in 10 months time is about 25000kg with an average price of Rs.230/kg (Approximate returns of Rs.5750000).

Neighboring village sericulture farmers those who do not come under the project also got motivated and adopted the technologies like integrated nutrient management in the mulberry garden, integrated pest management techniques, through disinfection of rearing house,

Bivoltine silkworm rearing, maintenance of hygiene during silkworm rearing, improved rearing practices, silkworm disease management, sorting and packing of cocoons by seeking the support from the project beneficiaries.

About 55000kg high quality cocoons were produced by the cluster farmers every year. Amounts to 20 per cent increase in yield. 150 ton of quality compost was produced using sericultural wastes. About 7500kg higher quality raw silk was produced and the same was converted to quality fabrics.

The cluster farmers have derived more returns per unit area from the sericulture enterprise

5. Objectives

i. To promote community cluster approach in silkworm rearing to produce uniform quality cocoons and to encourage rearing of bivoltine breeds.

ii. To encourage farmers in clusters to effectively utilize sericulture byproducts to increase the returns per unit area from sericulture enterprise.

iii. To design and install efficient silk reeling units to produce high quality raw silk.

iv. To establish appropriate power loom to convert high quality raw silk into a standard fabric.

6. Evaluation questions a minimum expectations (including not exhaustive)

1. Whether the plan prepared at village, block and district levels are used to bridge the gaps between potential and actual yields while preparing the annual plans? If yes, to what extent and if not, why?

2. Illustrate few best examples where in convergence of implementing agency is done in implementing the project demonstrations. Annual work plans for filling the gap between potential and actual yields.

3. Whether the prescribed process has been followed in preparation of village action plan, district action plan?

4. How many village level societies have been formed under RKVY project as a part of social mobilization group approach?

5. Whether the physical and financial targets set and approved by the university level for each of the activities? If yes, to what extent? If not, why not?

6. Whether the process prescribed has been followed in implementation? If not, what are the reasons?

7. What is the average delay in starting implementation and average time over run in completing implementation?
8. How many farmers groups have been beneficial under the project, the category of farmers benefitted viz., SC/ST/OBC/small farmers/marginal farmers/large farmers and women
9. The additional income generated by the farmers benefitted as a result of implemented activities may be estimated/computed and detailed?
10. What is the extent of awareness created by the three implementing agencies? Is it enough? If not, what needs to be done for increasing awareness?
11. Whether the resource allocation percentages for activities like training, exposure visits, demonstrations, input distributions, research activities, capacity building of farmers groups as fixed in the guidelines have been followed? If not, where are and what are the reasons for deviations?
12. Whether the resources for different activities as prescribed in the guidelines under district level activities for
a. Farmers oriented activities
b. Farm information dissemination
c. Technical retirement, validation and adoption
d. Administration expenses
13. Please assess the extent of the project impact on the following lines / points.
A. Project impact in respect of
a. No. of farmers benefitted
b. No. of women SC/ST/OBC farmers benefitted
c. Introduction of bivoltine races / new farm activities and adoption of new / and or sustainable technologies
d. Assistance in marketing of bivoltine cocoons.
B. Project impact in reframing the extension system in respect of the following processes;
a. Formation of village level societies
b. Farmers field school
c. On farm demonstrations
d. Exposure visits
14. What has been the level of involvement of different line departments and research organizations in implementing the scheme? Can some suggestions be made for improving the week areas, if found.
15. Whether the grants are released in time to implementing agencies? If not, why not?
16. Has the audit of RKVY project accounts been completed for the year 2014-15 by chartered accountants and the same is sent to government of Karnataka? If not, reasons there of?
17. How many success stories under the project activities have been submitted to Government of Karnataka as per the project guidelines? How many success stories have been published?

18. Whether the farmers group discussion meetings have been conducted as per guidelines? If not, reasons there of.
19. Is there any duplication of effort and work or linkages in case of Central Silk Board, Extension activities of OS Karnataka and the RKVY project? If yes what suggestions are there to set right the duplication and strengthen the linkages?
20. Suggestions for overall improvement of the scheme.

7. Evaluation methodology and sampling;
a. The field work should cover villages of Kolar and Chikkaballapur districts.
b. At least one taluk should be selected by simple random sampling method as sample taluk in each district out of three implementing agencies
c. In the selected taluks, at least one sub technology each from out of different technologies should be covered for field visits, personal interviews and focused group discussions
d. All the predominant sericulture activities in the district should be covered.
e. One of the village adjacent to the selected taluk in each of the selected districts where none of the scheme activities have been implemented will be selected as a control village.

8. Deliverables time schedule
An inception report containing a list of documents reviewed, persons contacted/consulted, list of sampling details, proposed data collection, evaluation questions and sub questions and processing methods should be submitted.

The College of Sericulture, Chintamani, University of Agricultural Sciences, Bangalore will assist the evaluator in obtaining requisite information from the offices concerned in the Project.

8. Duration and time schedule for the study
The total duration of the concurrent evaluation study is about 5 month's time.
a. Draft monitoring and evaluation report should be delivered with adequate time to allow the UAS (B) for consultation and findings and recommendations.
b. Final report should contain front matter, programme description, evaluation purpose, methodology, findings, executive summary, recommendations and related Annexure.
c. A meeting with presentation of the key findings at each level before proceeding to the next level shall be organized and any clarification/changes in methodology followed by awardees is made as per the requirement of the client.
d. Work plan submission: One month after signing the agreement.
e. Field Data Collection: Two months from date of work plan approval
f. Draft report Submission: One month after field data collection.
g. Final Report Submission: One month from draft report submission.

h. Total duration: 5 months.

9. Qualification of Consultant

Consultants should have and provide details of evaluation team members having technical qualifications/capability as below.

i. A Masters in Agriculture/Sericulture having knowledge of Agricultural Extension and Rural Development with ability to design and lead the concurrent evaluation with minimum 5 years' experience

ii. Research Assistants with good data processing skills.

And in such numbers that the evaluation is completed within the scheduled time prescribed by the ToR. Consultants not having these number and kind of personnel will not be considered as competent for evaluation.

10. Qualities Expected from the Evaluation Report :

The following are the points, only inclusive and not exhaustive, which need to be mandatorily followed in the preparation of evaluation report:-

a) By the very look of the evaluation report it should be evident that the study is that of University of Agricultural Sciences, Bangalore and Karnataka Evaluation Authority (KEA) which has been done by the Consultant. It should not intend to convey that the study was the initiative and work of the Request for Proposals for Selection of Consultant Evaluation Organization for the Evaluation of "Improving Productivity Enhancement in Sericulture through Community Cluster Approach" Project Consultant, merely financed by the RKVY and Karnataka Evaluation Authority (KEA).

b) Evaluation is a serious professional task and its presentation should exhibit it accordingly. Please refrain from using glossy, super smooth paper for the entire volume overloaded with photographs, graphics and data in multicolor fancy fonts and styles.

c) The Terms of Reference (ToR) of the study should form the first Appendix or Addenda of the report.

d) The results should first correspond to the ToR. In the results chapter, each question of the ToR should be answered, and if possible, put up in a match the pair's kind of table, or equivalent. It is only after all questions framed in the ToR that is answered, that results over and above these be detailed.

e) In the matter of recommendations, the number of recommendations is no measure of the quality of evaluation. Evaluation has to be done with a purpose to be practicable to implement the recommendations. The practicable recommendations should not be lost in the population maze of general recommendations. It is desirable to make recommendations in the report as follows:-

(A) Short Term practicable recommendations

These may not be more than five in number. These should be such that it can be acted upon without major policy changes and expenditure, and within say a year or so.

(B) Long Term practicable recommendations

There may not be more than ten in number. These should be such that can be implemented in the next four to five financial years, or with sizeable expenditure, or both but does not involve policy changes.

(C) Recommendations requiring change in policy

There are those which will need lot of time, resources and procedure to implement.

11. Cost and Schedule of Budget release

Output based budget release will be as follows Request for Proposals for Selection of Consultant Evaluation Organization for the Evaluation of RKVY Project entitled "Productivity Enhancement in Sericulture through Community Cluster Approach" as per the terms and conditions of Karnataka Evaluation Authority, Govt. of Karnataka, Bangalore.

a. The First instalment of Consultation fee amounting to 30% of the total fee shall be payable as advance to the Consultant after the approval of the inception report, but only on execution of a bank guarantee of a scheduled nationalized bank valid for a period of at least 12 months from the date of issuance of advance.

b. The Second instalment of Consultation fee amounting to 50% of the total fee shall be payable to the Consultant after the approval of the Draft report.

c. The Third and final instalment of Consultation fee amounting to 20% of the total fee shall be payable to the Consultant after the receipt of the hard and soft copies of the final report in such format and number as prescribed in the agreement, along with all original documents containing primary and secondary data, processed data outputs, study report and soft copies of all literature used to the final report. Tax will be deducted from each payment as per rates in force. In addition, the evaluator is expected to pay statutory taxes at their end.

12. Agency for evaluation:

The evaluating agency should be finalized as over provision of the Karnataka Transparency in Public Procurement Act and Rules, but without compromising on the quality

13. Contact person to get further details about the study:

a. S. Chandrashekhar, Principal Investigator & Professor of Sericulture, RKVY Project, College of Sericulture, Chintamani-563125.

Phone No : 9880325001/8762675849

b. Prof. M. Vijayendra, Co-Principal Investigator, RKVY Project, College of Sericulture, Chintamani-563125.

Phone No : 9448750892 / 9448713604

The entire process of evaluation shall be subject to and confirm to the letter and spirit of the contents of the Government of Karnataka order no. PD/8/EVN(2)/2011 dated 11th July 2011 and orders made there under.

EVALUATION TEAM MEMBERS

Sl. No.	Name	Designation
1	Dr. M. A. Shankar	Principal Investigator
2	Dr. B. C. Suryanarayana	Associate Investigator
3	Sri. Siddaraju	Associate Investigator

Dr. M. A. Shankar is a doctorate in Agriculture with specialization in Agronomy. He is former Director of Research, University of Agricultural Sciences, Bengaluru and presently the Executive Member of Institution of Agricultural Technologists, Bengaluru and Co-Chairman of Agribusiness Consultancy Subcommittee. He has implemented 51 research projects for the University funded by International organizations, Central and State governments, Private firms. He has guided 6 Ph. D. students and 15 M. Sc., (Agri) students. As Dean of College of Agriculture, Hassan, he has, with his administrative skills, streamlined accounting, financial, academic and administrative issues. He has been involved in review and evaluation of Technical Reports of 32 All India Co-ordinated Research Projects (AICRP) spread all over India. He has also evaluated 11 operational research projects for the technical feasibility and implementation. He has published 173 peer reviewed research papers. He has also penned 54 booklets and books for the University. He has vast experience in evaluation studies of projects.

Dr.Suryanarayana, B.C. is a doctorate in Agriculture with specialization in Agronomy and is a Certified Associate of Indian Institute of Banking (CAIIB), Fellow of Indian Institute of Valuers. He worked in State Bank of India from the year 1981 to 2014 as a Technical Officer and retired as Asst. General Manager (Rural Development). He is a practicing consultant in the field of Agriculture, Horticulture, poultry, dairy, fisheries and plant tissue culture and covered cultivation. He has about 35 years of experience in the field and has prepared several project reports for financial institution, written books in vanilla cultivation, anthurium, medicinal and aromatic crops, minor irrigation, poultry and dairy farming. He has appraised more than 6,000 proposals in agriculture and related fields for funding by the Bank and has also been involved in many studies relating to development of Agriculture and allied activities. He has served as a General Manager in a bio-fertilizer, bio-pesticides and organic manures manufacturing company and is also a Technical Director in a company involved in manufacture of agricultural implements and equipment.

Sri. Siddaraju is a Graduate in Agriculture with more than 35 experience in the field of Agriculture. He has served in the Karnataka State Department of Agriculture (KSDA) as Asst. Agricultural Officer in Farmers' Training and Education Centre, Soil Testing laboratory and as Subject Matter Specialist. He was Deputy Director of Agriculture (Commercial Crops) for 6 years, District Watershed Development Officer for 2 years. He has also been Joint Director of Agriculture (Inputs) for 5 years. He was involved in preparation of Annual Programme Planning booklets pertaining to Agricultural Inputs in Department of Agriculture. After retirement, he is serving as Chairman, Agriculture Consultancy Subcommittee, Institution of Agricultural Technologists, Bengaluru and has been actively involved in evaluation studies of projects.