Impact of Japan International Cooperation Agency (JICA) Extension Project on Quality Silk Production – a Case Study

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Introduction

Sericulture, as an agro-based enterprise, occupies an important position in Indian economy due to its high employment potential, low capital intensive and remunerative nature of the production that churns out value added products of economic importance. India is the second largest producer of raw silk, next only to China accounting for more than 13 per cent of the global silk production. The total annual production of raw silk in India was 18.48 thousand MT, of which mulberry raw silk output aggregated to about 16.53 thousand MT during 2006-07. However, the major concern of the Indian silk industry is the low level of quality and productivity as compared to other major silk producing countries such as China and Brazil. The major reason for the above problem is that the silk is produced by the use of crossbreed cocoons for reeling raw silk. The silk reeled out of these crossbreed cocoons produced in India reaches a maximum grade of C by the international standards. This silk is not preferred in the high-speed looms and mill sectors due to less uniformity, short filament length, more winding breaks and high degumming losses as compared to imported silk (Naik and Babu, 1992).

Bivoltine silk, which is mostly produced in countries having temperate climate, excels in quality and productivity. The bivoltine silk production, however, constitutes hardly 7 per cent of the total mulberry silk production in the country. As there is a significant gap between demand and supply for raw silk on one hand and sufficient quantity of bivoltine silk is not produced in India on the other hand, India imports a large quantity of bivoltine silk and has emerged as the largest importer of raw silk.

To address the above issue, the Central Silk Board obtained technical cooperation from Japanese Experts through Japan International Cooperation Agency (JICA) in three phases, from 1989 to 2007, to develop and test bivoltine sericulture technologies suitable for Indian conditions and then to strengthen the extension system for popularization

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of bivoltine sericulture technologies in India. The country's success in the production of bivoltine silk in a large quantity in the long run to meet its domestic demand as well as the export requirements depends on sustainability and replication of the success obtained in the JICA project. The past experience shows that farmers revert back to old technologies after the withdrawal of the programme in a particular area. In this context, an impact analysis of the JICA project on the yield and income level of the farmers would throw light on the technical and economic viability of the bivoltine sericulture in the Indian context. The prime objective of the present study is to analyze productivity and profitability improvements in bivoltine cocoon production under JICA project.

Methodology

The study was conducted in Karnataka state, which accounts for 47.70 per cent of total mulberry silk production in the country. Kolar district was selected purposively, being the largest producer of mulberry raw silk accounting for 38.37 per cent of the production in the state. Two Technical Service Centres (TSC) namely, Kolar and Bangarpet in Kolar district were selected for the study since the JICA project was implemented in these two TSCs covering 502 farmers. The data were collected from 60 randomly selected bivoltine rearers under the project in TSC, Kolar and Bangarpet with a pre-tested interview schedule. For comparison purpose, the data were also collected from 60 crossbreed rearers, who live adjacent to the bivoltine rearers.

Result and Discussion

Performance of bivoltine cocoon production

The performance of the bivoltine rearings conducted under the JICA Project is given in Table 1. A total of 502 farmers were involved in the project in the study area and 8.37 lakh dfls were chawki reared and distributed to the farmers under the project. The farmers could harvest 66.09 Kg/100 dfls as against the district average of 46.94 Kg/100 dfls during 2005-06. The average price realized by the JICA farmers was Rs. 163.28/ Kg cocoon. The defective cocoon percentage was just 4.57 per cent that is below the benchmark of 5.00 per cent. The reeling tests conducted at Central Silk Technological Research Institute, Bangalore indicated that the silk produced out of the cocoons grown in these two TSCs under JICA could fetch 2A-3A grades, which is internationally superior raw silk grade. The JICA Project has demonstrated that sustainable production of good quality bivoltine cocoons is possible through proper adoption of technologies. The farmers have a scope to achieve a potential yield of 66.09 Kg/100 dfls as obtained in the JICA Project.

Table 1: Performance of Bivoltine Cocoon production under JICA in TSC, Kolar and Bangarpet

Sl. No.	Particulars	TSC		Total/Average
		Bangarpet	Kolar	
1	No of farmers	252	250	502
2	No of Dfls (in Lakhs)	5.20	3.17	8.37
3	Hatching %	91.95	92.43	92.19
4	Actual yield (MT)	346.06	207.11	553.17
5	Yield/100 dfls (Kg)	66.54	65.36	66.09
6	Shell ratio (%)	22.29	22.66	22.48
7	Defective cocoons (%)	4.72	4.41	4.57
8	Rate/Kg (Rs.)	162.01	165.40	163.28

Extent of Adoption of Technologies

Though the crossbreed and bivoltine hybrids are different races, the basic rearing practices are the same for both. The adoption of improved technologies ensures more crop stability, higher crop yields and good returns. However, owing to various technical, personal and socio-economic reasons, the adoption rate of the improved technologies is generally less with the farmers. The extent of adoption of improved package of practices for mulberry cultivation and silkworm rearing was therefore analyzed between JICA and non-JICA farmers and the results are presented in Table 2.

As bivoltine silkworms are highly susceptible to diseases compared to crossbreed, it is essential to maintain good hygienic practices during silkworm rearing. Further, as bivoltine silkworms are highly productive, they require more quantity of quality feed and bed spacing compared to that of crossbreed (Kawakami, 1999).

In view of these prerequisites, bivoltine silkworm rearing requires certain basic facilities such as mulberry gardens with improved mulberry varieties, wider plant spacing and assured irrigation, separate rearing house and shoot rearing system for silkworm rearing. Hence, only the farmers who possess the required facilities were adopted for bivoltine rearing under the project. Hence, the mean percent score (MPS) of a separate rearing house and shoot rearing was 100 with the JICA farmers. On the other hand, only 30.00 per cent of the respondents of non-JICA farmers possessed separate rearing house and 43.33 per cent of them adopted shoot rearing method. V1 mulberry variety is the highest leaf yielding variety in India. About 76.76 per cent of JICA farmers had V1 mulberry variety. The remaining JICA farmers used other high yielding varieties such as S36, K2 etc for producing feed for silkworm. Only 46.67 per cent of the non-JICA respondents planted V1 variety of mulberry.

Table 2: Extent of Adoption of Improved Package of Practices

Sl. No.	Practices	Mean percent score (MPS)	
		JICA farmers	Non-JICA farmers
I	**Mulberry cultivation**		
1	V1 variety	76.67	46.67
2	Wider plantation system	96.67	58.33
3	FYM/ fertilizer application	70.00	8.33
4	Plant protection	40.00	20.00
II	**Silkworm rearing**		
1	Separate rearing houses	100.00	30.00
2	Bivoltine silkworm rearing	93.33	0.00
3	Disinfection of rearing house and rearing appliances	86.67	33.33
4	Shoot rearing	100.00	43.33
5	Purchase of chawki reared worms	100.00	30.00
6	Use of bed disinfectants	96.67	40.00
7	Mounting methods and usage of mountages	75.00	68.33
8	Time of cocoon harvesting and deflossing	76.67	58.33

The wider plantation system of 3′ x 3′ or paired row method (5′ x (3′+2′)) was followed by 96.67 per cent of the JICA farmers, whereas only 58.33 per cent of non-JICA farmers adopted wider plantation system for mulberry. Only 70 per cent of the JICA farmers applied right doses of farmyard manure and fertilizers for mulberry garden. The remaining farmers applied less than the recommended quantity of FYM and chemical fertilizers. The adoption rate of application of right doses of plant nutrients was very less (8.33) with non-JICA farmers. As the mulberry leaves are fed to silkworm, the farmers give the least importance to spraying of chemicals for controlling insect pests or diseases of mulberry. Hence, the adoption rate was very less in plant protection in both the categories of farmers.

Protection of silkworm against diseases is very important for ensuring crop stability and realizing higher yields. For this, disinfection of rearing house and rearing apparatus with chemicals and use of bed disinfectants at the time of silkworm rearing are recommended. As bivoltine silkworms are highly susceptible to diseases, high priority was given for disinfection in bivoltine rearing and the regular supply of disinfectants at subsidized cost was ensured under JICA project. Hence, the adoption rate was very high in use of disinfectants with the JICA farmers. Though the non-JICA farmers used

disinfectants, the adoption was partial in terms of use of non-recommended chemicals, application of chemicals in sub-optimal quantity or improper application of chemicals.

As the supply of chawki reared silkworms was made compulsory under JICA project, all the JICA farmers purchased young aged silkworms from Chawki Rearing Centres (CRCs), whereas only 30 per cent of the non-JICA farmers gave importance to the purchase of chawki worms from CRCs. The remaining farmers purchased silkworm eggs and reared young age worms by themselves. Most of the silkworm rearers in Kolar district do not possess their own mounting devices, as the mountages are used for only a few days in each rearing. They usually hire the devices for mounting silkworm from certain farmers, who own the mountages. As the availability of mountages is based on demand and supply situation in the villages, proper care could not be given by the farmers for the quality, number of mountages used for mounting and time of harvest of cocoons from mountages. Therefore, the adoption rates for mounting and harvest of cocoons were comparatively less for both the JICA as well as non-JICA farmers.

Profitability in Bivoltine Cocoon Production

The productivity differences between JICA and non-JICA farmers are furnished in Table 3. The JICA farmers brushed more quantity of silkworm seeds (1027 dfls/acre/year) compared to the non-JICA farmers (823 dfls/acre/year) due to higher production of mulberry leaf by adoption of improved technologies popularized under JICA project. The JICA farmers obtained higher cocoon yield of 71.20 Kg/100 dfls against 61.39 Kg/100 dfls achieved by their counterparts. As the JICA farmers brushed more quantity of silkworm layings and obtained better cocoon yield, more quantity of cocoons (731.22 Kg/acre/year) was produced by the JICA farmers compared to the non-JICA farmers (505.24 Kg/acre/year). As the JICA farmers produced high quality bivoltine cocoons, they realized a better cocoon price of Rs.129.86/Kg compared to Rs. 119.57 obtained by non-JICA farmers. The JICA farmers could obtain better yields and fetch higher prices, as they produced bivoltine cocoons by adopting improved sericulture technologies.

Table 3: Productivity differences in cocoon production between JICA and non-JICA farmers

Sl. No.	Items	JICA farmers	Non-JICA farmers
1	Number of dfls/acre/year	1027	823
2	Cocoon yield (Kg/100 dfls)	71.20	61.39
3	Cocoon production (Kg)/acre/year	731.22	505.24
4	Cocoon price (Rs./Kg)	129.86	119.57

The cost and returns in bivoltine cocoon production were worked out as against crossbreed cocoon production by comparing the cost and return structures in cocoon production of both JICA and non-JICA farmers. It can be inferred from Table 4 that mulberry leaf was the major input used in silkworm rearing accounting for Rs. 26,341.53/acre/year with JICA farmers and Rs.18,560.95/acre/year with non-JICA farmers. As the JICA farmers used more inputs compared to non-JICA farmers, the mulberry leaf production costs were higher for the JICA farmers. The cost of human labour in silkworm rearing was estimated to Rs. 13,971.22/acre/year, accounting for 23.31 per cent of the total cost for the JICA farmers, whereas the non-JICA farmers incurred a higher expenditure of Rs. 14,878.13 for labour. All JICA farmers adopted shoot rearing method for silkworm rearing. In addition to reducing the chances of contamination, this method saves the labour use in silkworm rearing. On the other hand, many non-JICA farmers used the labour intensive tray rearing method for silkworm rearing due to non-availability of separate rearing house or insufficient space in their dwelling house to adopt shoot rearing method, which resulted in a higher cost on labour.

Table 4: Profitability in cocoon production between JICA and non-JICA farmers

(Rs./acre/year)

Sl. No.	Particulars	JICA farmers		Non-JICA farmers	
		Cost /Return	%	Cost /Return	%
A.	Variable costs				
1	Mulberry leaf	26341.53	43.95	18560.95	39.22
2	Dfls / chawki worms	4494.24	7.50	3058.15	6.46
3	Labour	13971.22	23.31	14878.13	31.44
4	Disinfectants and materials	6817.05	11.37	4432.36	9.37
5	Transportation and marketing	2395.12	4.00	1843.64	3.90
6	Interest on working capital	862.79	1.44	682.10	1.44
	Total variable costs	54881.95	91.56	43455.33	91.83
B.	Fixed costs				
	Depreciation on building and equipments	5057.70	8.44	3865.39	8.17
	Total cost	59939.65	100.00	47320.72	100.00
C	Revenue				
	Revenue from cocoon and by-products	97012.75		62978.51	
	Net return	37073.10		15657.79	
	B: C ratio	1.62		1.33	

The JICA farmers used more disinfectant chemicals and materials compared to non-JICA farmers for successful silkworm rearing. As a result, the JICA farmers incurred higher expenditure of Rs. 6,817.05/acre/year on disinfectants and materials, as against Rs. 4,432.36/acre/year spent by non-JICA farmers. The cost incurred on silkworm seed (dfls)/chawki worms was Rs. 4,494.24 and Rs. 3,058.15, respectively for JICA and non-JICA farmers.

The fixed costs, which include depreciation cost on rearing building and equipments and interest on fixed costs, was estimated to be Rs. 5,057.70/acre/year for the JICA farmers, which had a share of 8.44 per cent in the cocoon production cost. As the non-JICA farmers had limited facilities for silkworm rearing, their expenditure on rearing building and equipments worked out to Rs. 3865.39 accounting for 8.17 per cent of the total cocoon production cost. The total cost incurred on mulberry cocoon production worked out to Rs. 59,939.65 and Rs. 47,320.72, respectively for JICA and non-JICA farmers.

The gross revenue, which includes income from sale of cocoon and value of by-products generated, worked out to Rs. 97,012.75/acre/year for the JICA farmers and Rs. 62,978.51 for non-JICA farmers. The net revenue realized by the JICA farmers was higher (Rs. 37,073.10 acre/year) than that of the non-JICA farmers (Rs. 15657.79/acre/year), which implies that production of bivoltine cocoons by adopting improved silkworm rearing practices is more profitable than the crossbreed cocoons. The cost-benefit ratio worked out to 1:62 for the cocoon production for the JICA farmers, whereas the non-JICA farmers realized a lesser cost-benefit ratio of 1:1.33 for cocoon production.

It could be inferred from the above analysis that higher rate of adoption of technologies by the JICA farmers compared to the non-JICA farmers led to higher productivity and profitability. The success attained in the project could be mainly attributed to the entirely different approach adopted in the project, as bivoltine sericulture demands proper planning, systematic approach and organized extension. All the extension personnel in the JICA TSCs were trained on practical bivoltine sericulture technologies at Central Sericultural Research and Training Institute, Mysore to impart skills on bivoltine silkworm rearing and create a positive attitude towards bivoltine sericulture, as earlier attempts made in the country since 1972 for the introduction of bivoltine sericulture did not yield fruitful results.

Only the farmers who had basic facilities such as assured irrigation for mulberry garden, separate rearing house and shoot rearing system were adopted for bivoltine silkworm rearing under the project. The farmers who intended to rear bivoltine but did not possess separate rearing houses were provided financial assistance under Catalytic Development Programme (CDP) and bank loans for the construction of rearing houses.

Young age silkworm (chawki) rearing is the most crucial period of silkworm rearing that demands optimum temperature and humidity, hygienic conditions, quality tender mulberry leaf, good rearing facilities and above all technical skills. But most of the sericulturists are devoid of the above facilities and technical skills to rear chawki worms. If the chawki worms are not reared properly, the later stages will result in crop losses. Hence, the chawki worms were reared scientifically in privately maintained exclusive chawki rearing centers and only the young aged worms were distributed to JICA farmers.

The common practice of silkworm rearing in the villages in India is to have staggered brushings of layings, which leads to contamination of silkworm rearings from one farmer to another farmer. But under the JICA project, the rearing programme for each TSC were planned well in advance and the chawki worms were distributed to the adopted farmers in batches. The batch brushing was helpful not only for reducing contamination of rearings from one farmer to another but also for regular crop inspection and providing technical guidance for all the adopted farmers.

Above all, all the JICA farmers were made to adopt all the important technologies as a package for mulberry cultivation and silkworm rearing, and all the critical inputs required for silkworm rearing were made available to them in time. This helped in crop stability and yield and quality improvements with the farmers. In this way, appropriate technologies, crop planning, regular crop monitoring and review of the crop performance in the meetings helped the JICA farmers to adopt improved sericulture technologies to obtain higher yields.

Conclusion

The study clearly pointed out that the farmers who reared bivoltine silkworm under JICA assisted project obtained better yield and realized higher profit compared to the traditional crossbreed silkworm rearers. The study also showed that there is a significant gap in the adoption of improved practices between JICA and non-JICA farmers. V1 mulberry variety, wider spacing, separate rearing house, shoot rearing, purchase of young age worms from CRCs and use of disinfectants are the important technologies followed by the JICA farmers, in which the adoption rate was very less with the non-JICA farmers. However, it was observed that some inputs such as farmyard manure and chemical fertilizers were not applied by both the categories of farmers as per the recommended levels due to high cost. Hence, low cost bio-fertilizers and green manuring may be popularized with the farmers in order to reduce the application of chemical fertilizers and improve the soil fertility and condition. The adoption rate was not good with mounting techniques as well. Usage of proper mountages is necessary to produce good quality

cocoons with uniform size and shape. Educating the farmers about the new mountages and mounting techniques is necessary.

Bivoltine silkworm rearing requires improved facilities such as separate rearing house and shoot rearing system, which are to be strengthened with the traditional silkworm rearers through the Catalytic Development Programme (CDP) implemented by Central Silk Board with the support of State Governments. It could be realized from the results of the project that the bivoltine silk production could be increased in the country through planned and systematic extension approach. This calls for extending such bivoltine popularization programmes to other potential areas with a systematic extension approach to meet the country's increasing demand for quality silk.

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