Technological Impact on Productivity and Profitability in Mulberry Silk Cocoon Production

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Introduction

India is the largest consumer of natural silk in the world and the demand for silk is consistently increasing in the country. As a result, the demand-supply gap is widening in mulberry raw silk. Hence, there is an urgent need to improve the production, productivity and quality of Indian silk for meeting the import substitute for domestic market and compete in the international market especially in the changing scenario of global trade.

India has attained rapid strides in raw silk production and productivity in the last two decades owing to improved technologies evolved and popularized in sericulture. However, a wide gap still exists between the actual yield obtained in the farmers' fields and the production level actually possible with the existing new technology package. In Karnataka, the premier silk producing state in the country, the average productivity level of the cocoon was 664.92 kg/ha during 2007-08 (Department of Sericulture, Government of Karnataka) as against the potential yield of 1,500 kg/ha. This indicates that only about 44.33 per cent of the existing production potential of cocoon production is being realized in the state considering the potential yield level of ruling multivoltine and bivoltine hybrids. The gap between the potential and actual yield is due to not fully exploiting and managing the resources by the farmers to achieve high yield. Hence, there is a need to have new direction in planning transfer of technology by designing more effective linkages between scientists and farmers for technology information to mitigate the present problems in sericulture and meet the future challenges of the growing demand for silk, but with egalitarian consideration.

In order to bridge the yield gap existing with the farmers, CSRTI, Mysore have been implementing a demonstration programme since July 2003 to provide the technology packages as per the requirement of different agro-climatic and socio-economic

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conditions. The new technologies are demonstrated to the farmers as a package based on need assessment. In this context, a study has been taken up to analyze the impact of the programme on productivity, quality and profitability improvement in mulberry cocoon production.

Methodology in the Modified Extension Programme for Popularization of Sericulture

As silkworm is a domesticated insect which is highly susceptible to silkworm diseases and fluctuations in environmental conditions, careful adoption of improved technologies should be ensured for crop stability and for obtaining higher yields. However, owing to various technical and socio-economic reasons, the farmers are not able to adopt all the technologies in toto. As a result, less yield and frequent crop failure are common with farmers in sericulture.

In the conventional approach of conducting extension programmes, individual technologies are demonstrated to the farmers by the scientists and the extension workers, according to the situation and specific requirements of farmers. Nevertheless, the adoption of improved technologies as a package is essential to have successful crop harvests in sericulture. Taking this into consideration, a methodology has been formulated to identify the constraints faced by the farmers, develop a suitable package of technologies required for them and demonstrate the technologies continuously for a specific period of time for ensuring yield and quality improvement, crop stability and sustainability. The steps given below have been followed meticulously in planning, organization and implementation of the programme:

1. Four potential Technical Service Centres[1] (TSCs) were identified for implementation of the programme in consultation with the State Sericulture Department.
2. In each TSC, a cluster of 5 to 6 nearby villages were selected and in each cluster, 25-40 sericulturists were identified for the programme to start with.
3. A preliminary (reconnaissance) survey was conducted to understand the status and identify the problems of the sericulturists and constraints for lower yield. The information was collected to characterize the resources both biophysical and socio-economic, problems of existing production systems and their causes; and technological options and their appropriateness for the adopted families, in a participatory mode.
4. The data collected in the survey were compiled and analyzed. Based on the results, the problems of the farmers that are the bottlenecks in productivity and quality in each cluster were identified and prioritized in consultation with scientists, extension workers and farmers.

5. Technology modules comprising all important technologies required for mulberry leaf production and silkworm rearing were prepared in consultation with the scientists for major intervention with the farmers based on the requirements.
6. All the critical inputs were organized/arranged well in advance to make them available at the right time, right place and right cost.
7. All the selected farmers of each cluster were trained for getting thorough knowledge of the technical know-how and do-how.
8. The technology modules were implemented through proper scheduling and preparation of the crop calendar. The extension staff and the subject matter specialists regularly visited the farmers to provide technical guidance and crop supervision.
9. Silkworm rearing is conducted throughout the year. Normally, a farmer conducts rearing 5 to 10 times in a year After completion of each crop, the results of the crop were collected and analyzed. The technology adoption level was studied.
10. Mid term correction as per the feedback received from the farmers and extension workers was incorporated.
11. Regular extension programmes such as method demonstrations, group discussions, field days, study tours, experience sharing sessions etc. were also conducted based on the requirement.

Data Collection

The demonstration programme was implemented in Mysore and Mandya districts by the Central Sericultural Research and Training Institute, Mysore with 130 farmers. Thirty farmers who benefited from the project in TSC, Kodakola in Mysore district, 30 farmers in TSC, Srirangapatna and 25 farmers in TSC, Pandavapura in Mandya district were randomly selected and the required information was collected through interview using a pre-designed interview schedule.

Results and Discussion

A quantity of 8,26,450 dfls of bivoltine hybrids were chawki reared and distributed to 439 farmers spread over 25 villages under this programme, during 2003-04 to 2007-08 and an average yield of 66.05 Kg/100 dfls was obtained with an improvement in the yield level by 33.74 per cent. The quantum of cocoon produced under this programme during the period under the project was 5,45,878 Kg.

Improvement in Yield and Income Levels of Sample Farmers

The improvement in the yield and income levels of the adopted farmers under the project was analyzed and the results are presented in Table 1. The average mulberry holdings of the sample farmers increased from 0.65 acre to 1.15 acres, registering an increase of 78.35 per cent. Similarly, the number of dfls brushed per acre per year increased from 748 dfls to 1065 dfls indicating a significant improvement in mulberry leaf production due to the technologies advocated in the programme. Similarly, there was a 34.77 per cent jump in the cocoon yield. Significant improvement in mulberry leaf and cocoon yields resulted in a quantum leap in cocoon production from 364 Kg/acre/ year to 632 Kg. In percentage terms, the increase in cocoon production was a whopping 73.87 per cent. The cocoons produced under the extension programme fetched a higher price in the market due to improved quality. As a result, income was virtually doubled.

Table 1. Improvement in Yield and Income Levels of the Farmers

Sl No	Particulars	Before adoption	After adoption	% of improvement
1.	Average mulberry holding (Acre)	0.65	1.15	78.35
2	No. of dfls brushed/acre/year	748	1065	42.38
3	Yield/ 100 dfls (Kg)	48.60	65.49	34.77
4	Cocoon production/ acre/year (Kg.)	363.50	632.00	73.87
5	Price (Rs./Kg)	118.40	132.10	11.57

Input Use Pattern

Optimum use of recommended and quality inputs is essential for obtaining the desired yield in mulberry as well as cocoon production. Hence, the quantum of input use by the sericultural farmers before and after implementation of the programme was documented and the results are shown in Table 2. It can be inferred from the table that the usage of all the inputs except the rearing labour has increased significantly by the farmers after implementation of the programme. However, it can be noticed that the chemical fertilizers were not applied by the farmers as per recommendation. This is due to high cost and sometimes non-availability of the straight fertilizers recommended by the research institute.

As the farmers are not applying the right quantity of FYM and chemical fertilizers, now vermi-composting technology and green manuring are being popularized with the adopted farmers in order to recycle the sericulture wastes generated by the farmers to their garden and to improve the organic matter in the mulberry garden.

Table 2. Level of Input Use by the Adopted Farmers

Sl No	Input/output	Units	Before adoption	After adoption	% Improvement
1	FYM	Tonnes/acre	2	4	100.00
2	Fertilizer-N	Kg/acre	56	87	55.36
3	Fertilizer –P	Kg/acre	21	31	47.62
4	Fertilizer –K	Kg/acre	12	28.5	137.50
5	Mulberry labour	Man days/acre	65	85	30.77
6	No of dfls brushed	No/acre	748	1065	42.38
7	Bleaching powder	Kg/100 dfls	2	5	150.00
8	Chlorine di-oxide	l/100 dfls		2	
9	Vijetha	Kg/100 dfls	2	4	100.00
10	Rearing labour	Man days/100 dfls	29	24	-17.24

The cost incurred for the construction of vermi-composting shed for composting the sericultural wastes generated from one acre is estimated as Rs.14,000.00. CSRTI, Mysore and State Sericulture Departments are providing 50 per cent subsidy (Rs.7000.00) for the construction of vermi-composting sheds since 2005-06. The vermi-composting programme is getting a good response from the adopted farmers and 625 farmers have availed subsidy directly from CSRTI, Mysore for the construction of the vermi-composting sheds. A large number of farmers have also availed the facility from State Sericulture Departments.

The disinfectants were supplied free of cost to the farmers by the State Government as an incentive for promotion of bivoltine sericulture. Hence, the usage was almost as per recommendation. The decrease in labour use for silkworm rearing after implementation of adopted may be attributed to adoption of shoot rearing method of rearing, which requires less labour compared to the traditional method of tray rearing.

Adoption Pattern of Technologies

As proper adoption of sericultural technologies by farmers is vital for obtaining higher yield, the adoption pattern of the recommended sericultural practices by the adopted farmers was studied regularly to understand the impact of the programme. The results of adoption pattern of technologies are presented in Table 3. A high rate of adoption was noticed for most of the technologies such as V1 mulberry variety; training and pruning of mulberry plants; separate rearing house; CSR hybrid rearing; disinfection; maintenance of hygiene and bed spacing; use of bed disinfectants and shoot rearing.

Partial adoption was observed for FYM and fertilizer application, mounting of riped? worms and time of cocoon harvesting. The reason for partial adoption of fertilizer

application was high cost of chemical fertilizers and reduced availability of organic manure. As most of the farmers use hired mountages for mounting, they are not able to use correct type of mountages, maintain hygiene or harvest cocoons on the right day. The quality of cocoon is significantly affected by the mounting devices and the method of mounting followed by the farmers. Hence, in order to improve the quality of the cocoon produced under the programme, the new improved mountages such as Japanese type rotary mountages were supplied to the farmers at 50 per cent unit cost under the Catalytic Development Programme of the Central Silk Board.

Table 3. Adoption Pattern of Technologies by the Farmers

Sl No	Technology Components	Level of adoption (%)		
		Full	Partial	No
1	V1 variety	93.75	0.00	6.25
2	FYM/ Fertilizer application	40.63	59.38	0.00
3	Green manuring	31.25	0.00	68.75
4	Thinning and pruning	75.00	25.00	0.00
5	Mulberry pest control	0.00	31.25	68.75
6	Separate rearing houses	71.88	28.13	0.00
7	CSR hybrid rearing	100.00	0.00	0.00
8	Disinfection with bleaching powder and chlorine di-oxide	62.50	31.25	0.00
9	Shoot rearing	100.00	0.00	0.00
10	Feeding and rearing bed spacing	71.88	28.13	0.00
11	Use of bed disinfectants	100.00	0.00	0.00
12	Mounting methods & usage of mountages	31.25	68.75	0.00
13	Time of cocoon harvesting and deflossing	50.00	50.00	0.00

The adoption rate was less for paired row system of plantation, management of mulberry pests and green manuring. As only new gardens are planted with paired row system, the adoption rate is less with this practice. Most of the farmers are hesitant to use chemicals for the control of pests or diseases for the mulberry garden, as mulberry leaves are fed to silkworm. Sometimes, the control measures followed by the farmers for the mulberry pests are not effective, as integrated approaches are not followed by all the farmers in the surrounding area.

Brushing Quantity and Yield Pattern

The brushing and yield pattern of the adopted farmers was studied to understand impact of the programme on the brushing and yield improvement. The brushing pattern of the adopted farmers is presented in Table 4 and yield pattern in Table 5. It can be inferred from Table 4 that the number of farmers brushing less than 100 dfls has reduced after the implementation of the programme, whereas the number of farmers in the other categories has increased considerably. This was due to increase in mulberry acreage and leaf production with each the adopted farmers. The distribution of farmers was more (67.42%) in the category of 101-200 dfls.

Table 4. Brushing Pattern of the Adopted Farmers

Sl. No	Categories (No of Dfls brushed/batch)	Frequency (%)	
		Before adoption	After adoption
1	Less than100	27.27	8.33
2	101-200	56.82	67.42
3	201-300	14.39	15.15
4	More than 300	1.52	9.09
	Total	100.00	100.00

It is very interesting to note from Table 5 that 85.04 per cent of the farmers were obtaining an average yield of less than 50 Kg/100 dfls before the implementation of the programme. However, due to the programme, the yield level increased considerably and about 77 per cent of the farmers were able to obtain an average yield between 51 Kg and 70 Kg/100 dfls. About 18 per cent of the farmers were in the category of more than 70 Kg/100 dfls of cocoon yield.

Table 5. Yield Distribution Pattern of the Adopted Farmers

Sl. No	Yield (Kg/100 dfls) categories	Frequency (%)	
		Before adoption	After adoption
1	Less than 50 kg	85.04	3.94
2	51-60 kg	14.96	36.22
3	61- 70 kg	-	41.73
4	More than 70 kg	-	18.11
	Total	100.00	100.00

Profitability Improvement

The economics of cocoon production was worked out for cocoon production before and after implementation of the programme and the results are presented in Table 6. The cost of cocoon production increased to Rs.32777.73/acre/year from Rs.24997.64 after implementation of the programme.

Table 6. Cost and Return Structure in Cocoon Production before and after Implementation of the Extension Programme

Sl. No	Items	Costs/returns (Rs./acre/year)	
		Before adoption	After adoption
A.	**Variable costs**		
1	Bullock power	907.50	1118.50
2	Farmyard manure	1642.60	2456.88
3	Fertilizers	1350.60	2387.97
4	Irrigation	624.36	845.78
5	Dfls	1884.96	2451.10
6	Disinfectants	826.15	1938.20
7	Labour	11719.95	13451.22
8	Hiring charges of mountages	2244.00	2895.00
9	Transportation and marketing	1930.38	2334.87
10	Other costs	595.18	548.80
11	Interest on working capital	569.42	730.28
	Total variable costs	**19770.04**	**24349.47**
B.	**Fixed costs**		
1	Apportioned cost of establishment of mulberry garden	424.26	498.28
2	Depreciation on building and equipment	5227.60	8428.26
	Total fixed costs	**5651.86**	**8926.54**
	Total cost	**24997.64**	**32777.73**
C.	**Revenue**		
1	Total Income from cocoon	43038.40	83487.20
2	Income from by-products	611.15	1352.49
	Total revenue	**43649.55**	**84839.69**
	Net return	**18651.90**	**52061.96**
	B:C ratio	**1.75**	**2.59**

All the cost components increased in cocoon production due to usage of more inputs recommended under the programme. The gross revenue also increased significantly due to higher leaf yield, increase in laying consumption, more cocoon yield/100 dfls and higher price realization after implementation of the programme. Therefore, the gross revenue has increased from Rs.43649.55/acre/ year to Rs.84839.69. The net revenue, which is the difference between gross income and total cost worked out to Rs.18651.90 and Rs.52061.96, before and after implementation of the programme respectively. The cost-benefit ratio worked out to 1: 1.75 for cocoon production before implementation of the programme and 1: 2.59 after implementation. Thus, the analysis clearly indicates that the profitability from sericulture increased significantly for the farmers after implementation of the programme.

Summary and Conclusion

The results obtained in the study clearly indicate that the mulberry and cocoon yield levels improved significantly after implementation of the extension programme. There were more than two fold improvements in profitability due to the adoption of techniques recommended under the new extension programme. The technology demonstration as a package of all critical technologies and closer monitoring of crops are more effective for crop success in sericulture, rather than demonstrating individual technologies as per need, to the farmers. As it was demonstrated in the new extension programme, the farmers should be educated to adopt the improved technologies in toto as a package to obtain higher yields along with crop stability. Further, the demonstrations should be continued with the adopted farmers repeatedly over a period of time for sustenance of technology adoption. The lessons learnt from the programme are being extended to other areas by replicating in other extension programmes such as Cluster Promotion Programmes (CPP) of Central Silk Board for sericulture development.

Notes

Technical Service Centre (TSC) is the field extension unit of Department of Sericulture, Government of Karnataka.

Silkworm seed, which is free from diseases, is called Disease free layings (dfls). Each dfl has 400-500 eggs.

Bivoltine silkworm race has only two generations in a year under natural conditions. However, bivoltine can be reared 5-6 times in a year by manipulation. The bivoltine races are originally from the temperate zone. Better quality silk can be obtained from the cocoon produced by bivoltine silkworm compared to the popular multivoltine hybrids reared in India.

Chawki' means the first two instars of silkworm (out of 5 instars) in its larval stage. Chawki is the most crucial period of silkworm rearing that demands optimum temperature and humidity, hygienic conditions, good quality tender leaf, good rearing facilities and above all technical skills. As most of the silkworm rearers are devoid of the above facilities, the Chawki Rearing Centers (CRCs) have been established to ensure crop stability and high cocoon yield in the country.