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Research Note

Productivity and Profitability in Rainfed Sericulture – A Study in the District of Chamaraja Nagar in Karnataka

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Abstract

The resources-use pattern and profitability of dry land sericultural operations have been analyzed. The study has been conducted with the information collected by interview method from randomly selected 67 rainfed-sericulture farmers in the Chamaraja Nagar district of Karnataka. It has been revealed that the cash inputs such as chemical fertilizers and disinfectant chemicals are used less than the recommended quantities, whereas labour is used in excess. The production function analysis has indicated that bullock power, human labour, quantum of feed and disinfectants are the important inputs which significantly influence cocoon production. As regards the allocative efficiency of resource-use, bullock power is being used efficiently. Leaf, fertilizer and disinfectants are used at sub-optimal levels. The labour is being used in an uneconomical manner. It has been suggested that intensified extension efforts would bear fruitful results in popularizing the improved rainfed sericulture practices.

Introduction

Sericulture plays a vital role in rural development in Karnataka, as it integrates well with the farming systems and has the potential to generate attractive income throughout the year. Karnataka produced 8196 tonnes of raw silk during 2001-02, which accounted for about 51 per cent of the country's total silk production of 15,848 tonnes. As mulberry is highly versatile in nature, it is cultivated in a variety of soil types, a wide range of agro-climatic conditions and in both rainfed and irrigated areas. Out of 1,20,119 ha of mulberry area in Karnataka, rainfed mulberry occupies 24,985 ha, accounting for 20.80 per cent of the total mulberry area. The rainfed sericulture is distinct from the irrigated sericulture. As the rainfed farming

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is generally characterized by uncertainty and fluctuations in rainfall and other climatic conditions, there are wide spatio-temporal variations in the productivity levels in the rainfed sericulture. Quality mulberry leaf, separate rearing house with the required rearing appliances and proper rearing management, which are essential for the production of quality cocoons are lacking with the rainfed sericulturists. In this context, the study has been taken up to analyze the resource-use pattern and profitability of dry land sericultural operations with the following specific objectives: (i) To study the resource-use efficiency and productivity in sericulture farms; (ii) To assess the profitability of sericulture operations under rainfed conditions; (iii) To analyze the extent of adoption of recommended technologies by the farmers; and (iv) To identity the problems faced by the rainfed sericulturists.

Methodology

The following Cobb-Douglas type production model was chosen over the linear form based on the goodness of fit to study the input-output relationship and efficiency of each variable input in cocoon production under rainfed conditions:

$$Y = aX_1^{b1}\, X_2^{b2} \ldots\ldots X_6^{b6} \mu \qquad \ldots(1)$$

where,

Y = Production of cocoon (kg/acre/year)
X_1 = Bullock power (days/acre/year)
X_2 = Farm yard manure (tonnes/acre/year)
X_3 = Fertilizers (kg N, P and K /acre/year)
X_4 = Human labour (mandays/acre/year)
X_5 = Leaf used for production of one kg of cocoon (kg)
X_6 = Disinfectants (Rs/acre/year)

The resource-use efficiency could be judged based on the marginal value productivity (MVP), which indicates the increase in the gross return from the use of an additional unit of a given input, while keeping the level of other inputs constant. The MVP of the ith input factor was measured by using formula (2):

$$MVP = b_i \frac{\overline{Y}}{\overline{X}_i} P_y \qquad \ldots(2)$$

where,

$\overline{Y}$ = Average yield of cocoon per acre per year at the geometric mean level of all inputs,

$\bar{X}_i$ = Geometric mean level of ith resource, and

P_y = Price of one kg of cocoon.

Resource-use efficiency was studied by comparing the MVPs of each resource with corresponding factor costs at which each resource could be procured.

Data

The district of Chamaraja Nagar in Karnataka was purposively selected for the study, as it has the largest area under rainfed sericulture in Karnataka. Sixty-seven farmers, who were practising rainfed sericulture, were randomly selected from eight adjoining villages in the Chamaraja Nagar taluk and the required information was elucidated by using the pre-tested interview schedule. The data collected pertained to the year 2000-01.

Results and Discussion

Inputs-use Pattern

Optimum use of inputs is essential to obtain the potential yield of cocoons. However, as the farmers have limited resources, they make some adjustments in the allocation of their resources in order to operate the farm business at economic optimum level. Hence, the pattern of input-use for mulberry leaf production and silkworm rearing was studied and the results are presented in Table 1. The average use of farmyard manure was almost at its optimum level. Sericulture was the most feasible commercial activity in the study area. Further, mulberry is a perennial and nutrient-exhaustive crop. Hence, the farmers provided priority to the application of manures produced in their farm to mulberry fields to enrich the soil nutrients. As the family-labour availability was abundant and the scope of using the labour for other crops was limited due to seasonal nature of the agricultural crops, the availability of labour for sericultural activities was more. Hence, the use of labour was 40.43 per cent more than the requirement for silkworm rearing and 9.67 per cent excess for mulberry cultivation. A wide gap was observed in the use of fertilizers for mulberry garden and disinfectant chemicals in silkworm rearing. As most of the respondents reared silkworms in a portion of their dwelling houses, it was difficult to use strong chemicals for disinfection of the rearing place. The farmers, therefore, tended to avoid the use of chemicals in silkworm rearing. The studies conducted by Jayram *et al.* (1996), Datta *et al.* (1999) and Geetha *et al.* (2001) also revealed that the major inputs for practising sericulture namely, silkworm seed (dfls),

Table 1. Gaps in input-use by the sample farmers in the study area

Particulars	Unit	Recommended quantity	Actual use	Input gap (%)
Bullock power	Mandays/acre	4.00	14.17	-254.29
FYM	Mt/acre	4.00	5.77	-44.30
Nitrogen	kg/acre	40.00	16.46	58.84
Phosphorus	kg/acre	20.00	6.41	67.95
Potassium	kg/acre	20.00	7.44	62.80
Labour (mulberry)	Mandays/acre	27.00	29.39	-9.67
DFLs	Number/acre	600.00	427.82	28.70
Labour (rearing)	Mandays/100 dfls	28.00	39.32	-40.43
Bleaching powder	kg/100 dfls	5.00	5.30	89.35
Chlorine dioxide	litres/100 dfls	2.60	0.27	89.67
Formalin	litres/100 dfls	5.00	0.10	98.08
Lime powder	kg/100 dfls	8.00	2.41	69.84
Vijetha	kg/100 dfls	4.00	2.90	92.63

disinfectants, manures and fertilizers were in sub-optimal levels for mulberry cultivation and silkworm rearing by the farmers in different regions. Further, Jayram *et al.* (1996) pointed out that the major constraints in the usage of inputs in sericulture were due to lack of awareness about inputs, improper organization of channels of distribution and reluctance of farmers in accepting the improved practices generated by the research institutes.

Factors Influencing the Cocoon Production

A log-linear regression was fitted to study the factors influencing the cocoon production. Cocoon production was considered as a dependent variable and regressed with the factors of production such as bullock power, farm yard manure, fertilizers, human labour, quantum of leaf used for production of one kg of cocoon and cost of disinfectants. The estimated values of regression coefficients of all the inputs are presented in Table 2. The value of coefficient of multiple determination (R^2) was 0.75. The higher values of R^2 testified that the selected form of the production function was the best fit. The values of the regression coefficient were less than unity for all the inputs except in the case of farmyard manure and human labour. This shows that each of these inputs followed diminishing marginal productivity. The coefficients of bullock power, human labour, quantum of leaf used for production of one kg of cocoon, and disinfectants were positive and statistically significant. This implied that bullock power, human labour, quantum of feeding and disinfectants were the important inputs, which significantly influenced the cocoon production. Neelakantasastry (1982),

Table 2. Elasticity coefficients of factors of cocoon production

Factors of production	Coefficients	Standard error
Intercept	3.58	
Bullock power (days/acre/year)	0.08*	0.045
Farm yard manure (tonnes/acre/year)	-0.04*	0.021
Fertilizers (kg N, P and K /acre/year)	0.01	0.010
Human labour (mandays/acre/year)	1.088*	0.158
Disinfectants (Rs/acre/year)	0.05*	0.018
Leaf required for production of one kg of cocoon (kg)	0.38*	0.16
R^2	0.75	
No. of observations	67	

*Significant at 1 % level

Marihonnaiah (1986), Kulkarni (1992) and Sumanta Behera (2004) identified that dfls, human labour and disinfectants had positive and significant association with cocoon production. The elasticity of production was significant but negative for farmyard manure. This could be due to improper use of poor quality organic manures for the mulberry field. The regression coefficient of fertilizers was positive but statistically not significant. But Jayaram (1991) had reported significant and positive association of farmyard manure and fertilizer with the irrigated mulberry leaf yield.

Resource-use Efficiency

The resource-use efficiency was calculated for each input as the ratio of marginal value of product to their acquisition cost per unit and the results are presented in Table 3. The marginal value of product and the cost of input were almost equal for bullock power, which implied that the bullock power was used efficiently. The ratio between marginal value of product and the acquisition cost per unit was more than unity for leaf, fertilizer and disinfectants. This indicated that leaf, fertilizer and disinfectants were used at sub-optimal levels. Hence, there is a possibility of increasing the use of these inputs to the optimum level, where the efficiency of the input-use is maximum. The allocation efficiency was higher than unity for labour, which implied that the labour was used uneconomically. As family labour was available in abundance and the scope of using it for other crops is limited in the rainfed areas, it was used excessively and inefficiently. Similar observation was made by Singh and Vasishti (1994) with respect to small farmers in the Salem district of Tamil Nadu. Farmyard manure was found to be allocated uneconomically.

Table 3. Marginal value of product and input-use efficiency

Input	Marginal value of product (MVP)	MVP/cost of input
Leaf	0.03	1.38
Bullock power	21.52	0.90
Farm yard manure	-5.59	-0.21
Fertilizer	2.79	11.58
Labour	9.11	0.58
Disinfectant	2.35	7.10

Economics of Cocoon Production

Cocoon production involves two distinct activities — production of mulberry leaf, which is a field-related activity and the rearing of silkworm that is conducted in separate rearing houses or in a portion of the dwelling houses of farmers. Hence, the cost of production was worked out for the cultivation of mulberry and silkworm rearing separately and the results are presented in Table 4. The leaf production cost was worked out to be Rs 4254/acre/year. Bullock power, which is used for inter-cultivation by ploughing was the major component of the cost being Rs 1417, followed by labour (Rs 1083), farm yard manure (Rs 726) and fertilizers (Rs 383). As mulberry is a perennial crop, once it is planted, it will yield mulberry leaf from the sixth month to over fifteen years. Hence, the costs incurred during gestation period for the establishment of mulberry plantation was considered as fixed costs and apportioned for the entire life-period of the plantation by considering the economic life-period of mulberry as 15 years. The apportioned cost of mulberry was thus worked out to be Rs 86.69.

In silkworm rearing, labour cost was the major component, which worked out to be Rs 6136 (44.56 % of the total cost), followed by cost of leaf and depreciation of rearing-building and equipments, accounting for 30.90 per cent and 10.31 per cent of the total cost of production of cocoon, respectively. The cost of disinfectants was estimated at Rs 269. Most of the chemicals used for disinfection were supplied free of cost by either the State Sericulture Department or the private grainages from where the silkworm seeds were purchased. The total cost of cocoon production was worked out as Rs 13,770.

The farmers earned Rs 10534 by selling the cocoons and Rs 570 by selling the excess mulberry leaves produced in the garden to the needy farmers. The income obtained from by-products such as silkworm litter and leaf wastes, which can be used as organic manure after decomposing, worked out as Rs 462. The total revenue worked out to be Rs11,566/acre/year, which was less than the cost incurred for cocoon production. Hence,

Table 4. Costs and returns in silkworm-rearing in the study area

(Rs/acre/year)

Sl No.	Items production cost	Leaf costs/ returns	Rearing (%)	Expenditure
A.	**Costs**			
1	*Leaf cost*			
a	Bullock power	1417.16		
b	FYM	725.69		
c	Fertilizer	382.67		
d	Labour	1082.99		
e	Other costs	559.10		
f	Apportion cost of establishment of mulberry garden	86.69		
	Total leaf cost		4254.31	30.90
2	Dfls		708.76	5.15
3	Disinfectants		268.80	1.95
6	Labour		6135.67	44.56
7	Transportation & marketing		186.96	1.36
8	Others		494.58	3.59
9	Interest on working capital		301.23	2.19
10	Depreciation on building and equipments		1419.75	10.31
	Total cost		13770.05	100.00
B	**Revenue**			
	Total income from cocoon		10534.07	
	Income from by-products		461.77	
	Income from sale of leaves		570.23	
	Total revenue		11566.07	
	Net return		-2203.98	
	Total cost excluding imputed owned labour plus free disinfectants		8861.51	
	Net returns after adjustments		2704.56	
	B:C ratio		1.31	

the net revenue was negative with (-) Rs 2204/acre/year. However, if the imputed value of family labour utilized for silkworm rearing and free disinfectants supplied by the Department of Sericulture, Government of Karnataka, for the promotion of improved technologies were excluded from the total cost, the net revenue would be positive (Rs 2704 /acre/year) and the cost-benefit ratio would become 1: 1.31.

The surplus income generated in rainfed sericulture could be just enough to meet the wages of family labour. It is evident that with the inclusion of wages for family labour in the economics, the cocoon production activity was not profitable. The low profitability in rainfed sericulture could be attributed to less productivity and lower price fetched for the cocoons produced under the rainfed conditions. In contrast, the net returns generated in irrigated sericulture were very high, and were estimated as Rs 39,883/ acre/year by Dandin and Kumaresan (2003). The study conducted by Kumaresan and Vijaya Prakash (2001) also indicated that irrigated sericulture was more profitable than the agricultural crops like paddy, sugarcane, gingili and groundnut.

Adoption Level of Mulberry Cultivation and Silkworm Rearing Practices

As adoption of improved technologies is essential to realize the potential yield levels in the crop production, the adoption pattern of the improved practices by the farmers was studied and the results are shown in Table 5. Improved practices such as high-yielding mulberry varieties, application of manures and chemical fertilizers, harvesting of mulberry leaf, disinfection of rearing house, maintenance of hygienic practices, maintenance of bed spacing, bed cleaning, mounting, harvesting of cocoons and control of uzifly in silkworm-rearing were practised but not as per the recommendations by majority of the sample farmers, whereas separate rearing house, rearing of crossbreed silkworm, incubation, black boxing, shoot rearing, maintenance of temperature and humidity in silkworm-rearing, dusting of vijetha (the silkworm body and bed disinfectant, which protects silkworm larvae from diseases) and control of mulberry pests and diseases were not practised by most of the surveyed farmers. Poor economic condition did not permit the farmers to construct separate house for silkworm rearing. Lack of awareness and preference for the traditional practices were the reasons for not adopting proper incubation and black boxing techniques, which are important for uniform hatching of silkworm eggs. As most of the farmers were rearing silkworm in a portion of dwelling house itself, they were not able to disinfect the rearing space using chemicals or maintain the recommended temperature and humidity for silkworm-rearing properly.

Adoption coefficient was worked out to study the impact of socio-economic factors on adoption of different rainfed sericultural practices. For this purpose, full adoption was scored as 2, partial adoption as 1 and non-adoption as 0 for each technology and the total score (actual score) was worked out for each farmer based on the level of adoption of the technologies or practices recommended for rainfed sericulture. Then the adoption coefficient was computed for each farmer by using the formula (3):

Table 5. Adoption pattern of mulberry cultivation and silkworm-rearing practices by the sample farmers

Sl No.	Practice	Full adoption		Partial adoption		No adoption	
		No.	%	No.	%	No.	%
1	Improved mulberry variety	4	5.97	32	47.76	31	46.27
2	Spacing	67	100.00				
3	Manure	16	23.88	47	70.15	4	5.97
4	Chemical fertilizers			59	88.06	8	11.94
5	Weeding	67	100.00				
6	Harvesting	3	4.48	64	95.52		
7	Rearing house	8	11.94	4	5.97	55	82.09
8	Crossbreeds rearing	28	41.79			39	58.21
9	Disinfection			46	68.66	21	31.34
10	Hygiene practices			67	100.00		
11	Incubation	1	1.49	3	4.48	63	94.03
12	Black boxing	1	1.49	1	1.49	65	97.01
13	Shoot rearing	3	4.48			64	95.52
14	Bed spacing	1	1.49	66	98.51		
15	Bed cleaning			67	100.00		
16	Temperature & humidity maintenance			1	1.49	66	98.51
17	Vijetha			18	26.87	49	73.13
18	Mounting			67	100.00		
19	Harvesting	1	1.49	66	98.51		
20	Control of mulberry pests					67	100.00
21	Management of uzifly			48	71.64	4	5.97

$$\text{Adoption coefficient} = \frac{\text{Actual score obtained}}{\text{Total score obtainable}} \times 100 \qquad \ldots(3)$$

The adoption coefficient was considered as dependent variable and regressed with the socio-economic factors such as age, education level, extension participation, extension contact, mass media participation and area under mulberry to evaluate the factors influencing the adoption of improved sericultural practices. The estimated values of regression coefficients are presented in Table 6. The value of coefficient of multiple determination (R^2) was 0.33, which implied that the variables included in the regression model put together explained 33 per cent of the total variations. The coefficients of extension contact and mass media participation were positive and statistically significant. Singhvi *et al*. (1994) have also found that the rate of adoption was significantly associated with sericulturist's mass media participation, extension contact and

Table 6. Regression coefficients of factors influencing the adoption of improved sericultural practices

Parameters	Regression coefficients	Standard error	*t*-statistics
Constant	20.9375		
Extension participation	0.1582	0.1730	0.9146
Extension contact	0.3647	0.3173	1.1494
Mass media participation	1.0371	0.3448	3.0076
Age	-0.0026	0.0343	-0.0760
Education level	-0.3404	0.4688	-0.7261
Area under mulberry	0.3082	0.2076	1.4843
R^2		0.3267	
No. of observations		67	

cosmopoliteness. This implied that the contact with the extension workers and mass media played an important role in educating the farmers to adopt improved technologies. The regression analysis also revealed that the size of mulberry holdings had influence on the rate of technology adoption. The other socio-economic variables, namely age and education level did not have any significant association with the technology adoption.

Summary and Conclusions

The production function analysis has indicated that bullock power, human labour, quantum of feed and disinfectants are the important inputs which significantly influence the cocoon production. As regards the allocative efficiency of resource-use, bullock power is used efficiently. Leaf, fertilizer and disinfectants are used at sub-optimal levels. Hence, there is a scope of increasing the use of these inputs to the optimum level in order to achieve the efficient use. The allocation efficiency is higher than unity for labour, which implies that the labour is being used uneconomically. The surplus family labour could be utilized for off-farm activities for rational use of manpower.

The economic analysis has indicated that the surplus income generated in cocoon production activities under rainfed conditions could be just enough to meet the wages of family labour, as with the inclusion of wages for family labour in the cost, the cocoon production activity becomes non-profitable. The research conducted on rainfed sericulture is only limited compared to that on irrigated sericulture. Hence, cost-saving technologies with high-yielding mulberry varieties and silkworm hybrids suitable for rainfed conditions should be evolved and popularized in order to reduce the cost of production and improve the profitability in rainfed sericulture.

The adoption rates of improved sericultural practices have been lower with the rainfed farmers due to poor social and economic conditions. The regression analysis has shown that the extension contact and mass media play an important role in educating the farmers about adoption of improved technologies. This reveals that the intensified extension efforts would bear fruitful results in popularizing the improved rainfed sericultural practices.

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