Ind. Jn. of Agri. Econ.
Vol. 62, No. 4, Oct.-Dec. 2007

Yield Gaps in Mulberry Sericulture in Karnataka: An Econometric Analysis

S. Lakshmanan*

I

INTRODUCTION

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. It provides employment to approximately 58 lakh persons annually, most of them being marginal and small farmers. Micro level studies reveal (Lakshmanan *et al*., 1996, 1997ab, 1998ab, 1999) (Lakshmanan and Geeta 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.

In the global context, silk accounts for about 0.2 per cent of total textile fiber production (ITC, 2000). However, in value terms, silk stands for high value export-oriented items in the world trade. India poised to reach the position of second largest silk producer after the Republic of China in the world. The country produces all the four known commercial silk varieties, viz., mulberry, tasar, eri and muga. Of the total silk production, mulberry silk alone accounted for 89 per cent during 2004-05. In spite of the annual compound growth rate of 4.93 per cent of mulberry raw silk production during 1980-81 to 2004-05, the country has to import huge quantity of raw silk from the Republic of China and other countries every year to meet the growing domestic as well as export demand (Lakshmanan, 2006). This has led to import of silk to the tune of 7,948 tonnes during 2004-05. It shows that the industry needs to augment domestic silk production to bridge the gap between demand for and supply of quality silk production in the country.

II

MULBERRY SILK PRODUCTION IN INDIA

The performance of mulberry silk sector in major silk producing states during 1980-81 to 2004-05 is presented in Table 1. It is clear from the table that Karnataka has been the leading silk producer among the traditional states with -0.90, 4.29 and

*Scientist-C, Division of Sericulture Economics, Extension and Management, Central Sericultural Research and Training Institute, Sriramapura, Mysore-570 008.

TABLE 1. PERFORMANCE OF MULBERRY SILK PRODUCTION IN TRADITIONAL STATES OF INDIA DURING 1980-81 TO 2004-05

	Mulberry area (hectares)			Raw silk production (metric tonnes)			Silk productivity (kg/hectare)		
Name of States (1)	1980-81 (2)	2004-05 (3)	CGR (per cent) (4)	1980-81 (5)	2004-05 (6)	CGR (per cent) (7)	1980-81 (8)	2004-05 (9)	CGR (per cent) (10)
Karnataka	114800	77998	-0.90	2878	7302	4.29	25.069	93.617	5.18
Andhra Pradesh	18836	44885	1.99	797	5084	8.27	42.312	113.267	6.28
Tamil Nadu	16530	5073	-6.67	430	443	-0.98	26.013	87.325	5.69
West Bengal	10194	13424	1.83	355	1520	4.16	34.824	113.230	2.34
Jammu and Kashmir	501	6059	12.00	76	90	3.55	151.697	14.854	-8.46
All India	155161	171959	0.58	4193	14620	4.93	27.023	85.020	4.35

5.18 per cent annual compound growth rates in terms of area under mulberry cultivation, silk production and productivity during 1980-81 to 2004-05. Although the growth trends of mulberry acreage has been discouraging, the production and productivity of silk have shown a remarkable growth in Karnataka. It is partly due to large-scale adoption of new technologies by the farmers in the state. Since the sericulture activities in Andhra Pradesh were initiated in the later part of the 1980s, the growth momentum has surpassed other silk producing states in the country. It is estimated that the growth rates of mulberry acreage, raw silk production and productivity were 1.99, 8.27 and 6.28 per cent during 1980-81 to 2004-05, respectively. In the case of Tamil Nadu, the other traditional silk producing state in Southern parts of India, once considered to be a potential state for enlarging silk production, has failed to show better performance in recent years. The mulberry acreage has declined from 16,530 hectares in 1980-81 to mere 5,073 hectares in 2004-05 showing a negative growth rate of 6.67 per cent while the growth rates for production of silk and productivity were -0.98 and 5.69 per cent respectively for the same period. Though mulberry acreage and quantity of silk production declined, the silk productivity has shown a remarkable improvement from 26.013 kg/ha in 1980-81 to 87.325 kg/ha in 2004-05. This has become possible due to a large number of progressive farmers practicing sericulture in Tamil Nadu. In the case of West Bengal and Jammu and Kashmir, the growth rates of raw silk production were 4.16 and 3.55 per cent for the same period. As far as silk productivity is concerned, the growth rate for West Bengal was positive (2.34 per cent) while it was negative for Jammu and Kashmir (8.46 per cent). The negative growth rate in silk productivity in Jammu and Kashmir was mainly due to large number of marginal farmers undertaking cocoon production as their holding size and scale of rearing operation is uneconomical and adoption of new technologies in mulberry and silkworm rearing is too low. At all India level, mulberry acreage, silk production and productivity were reported to be 0.58, 4.93 and 4.35 per cent during 1980-81 to 2004-05. During the 1990s and later, the R&D units of Central Silk Board have evolved a number of new sericulture technologies to increase quality and productivity of silk and it has been popularised in the field. However, the newly evolved productivity-oriented technologies are not fully utilised by the farmers (Lakshmanan *et al*., 1998a,b and Lakshmanan, 2006). This partly explained the reasons for the existence of yield gaps at the farmer's field. It is reported that there is a wide yield gap that exist between the actual yield obtained by farmers and the potential yield, which could be possibly produced with the existing new technologies in the field (Lakshmanan, 1999).

Since Karnataka is being the pioneer state in mulberry silk production in the country, earned Rs. 746.09 crores by exporting silk products, accounted for 30.58 per cent of the total agricultural exports of Karnataka during 2002-03 (Deshpande and Prachitha, 2005), the silk potential has yet to be fully tapped as against the potential yield (Vijaya Prakash and Dandin, 2005a,b). Therefore, in order to find out the extent of yield gaps in the field, it is necessary to study the magnitude of the yield gaps in mulberry as well as cocoon production at different levels. Against this background, a study was conducted to analyse (i) the existence of yield gaps in mulberry and cocoon production at different levels; (ii) factors influencing to attain higher yield in both mulberry and cocoon production; (iii) the adoption level of newly introduced high-yielding mulberry and silkworm strains by the farmers; and (iv) how the resource use pattern contributed to the existence of yield gaps at the farmer's farms; and drawing suitable policy implications to develop sericulture in the study region.

III

DATABASE AND METHODOLOGY

A study was conducted to collect primary data from six villages of Malavali and Srirangapatna taluks of Mandya district in Karnataka during 2002-03. From each village, 20 farmers were randomly selected. Thus, the study constituted a total of 120 sample farmers. Of the 120 sample farmers, 60 farmers were bivoltine silk cocoon producers and another 60 were cross-bred rearing farmers. The potential yield for mulberry and cocoon were obtained from Central Sericultural Research and Training Institute (CSRTI), Mysore. The potential farm yield with respect to mulberry and cocoon were collected from the demonstrations conducted in the Mandya district under the project for Promotion of Popularising Practical Bivoltine Sericulture Technology (PPPBST) of Japanese International Co-operation Agency (JICA). For this study, two mulberry varieties, namely, K_2 and V_1 were considered, as these varieties were extensively cultivated in the study villages. Similarly, in silkworm rearing, cross-breed (PM X CSR_2) and bivoltine (CSR_2 X CSR_4) races were considered in the study.

IV

ANALYTICAL FRAMEWORK

(a) Yield Gap Analysis

Total Yield Gap (TYG)

It is the difference between the potential yield (Y_p) and the actual yield (Y_a). This total yield gap comprises yield gap-I and yield gap-II ….(1)

$$\text{Yield gap-I (per cent)} = \frac{(Y_p - Y_d)}{Y_p} x100$$

It is the difference between the potential yield (Y_p) and the potential farm yield (Y_d) ….(2)

$$\text{Yield gap-II (per cent)} = \frac{(Y_d - Y_a)}{Y_d} x100$$

It is the difference between the potential farm yield (Y_d) and actual yield (Y_a) ....(3)

Index of Yield Gap (IYG)

It is the ratio of the difference between the potential yield (Y_P) and the actual yield (Y_a) to the potential yield (Y_P), expressed in percentage terms.

$$IYG = [(Y_P - Y_a)/Y_P)]* 100 \quad ….(4)$$

Index of Realised Potential Yield (IRPY)

It is the ratio of the actual yield (Y_a) to the potential yield (Y_P) expressed in percentage terms.

$$IRPY = (Y_a/Y_P)*100 \quad ....(5)$$

Index of Realised Potential Farm Yield (IRPFY)

It is the ratio of the actual yield (Y_a) to the potential farm yield (Y_d) expressed in percentage terms.

$$IRPFY = (Y_a/Y_d) *100 \quad …. (6)$$

(b) *Functional Analysis*

The emphasis is made to popularise V_1 mulberry variety and rearing of bivoltine races in the field by the Department of Sericulture, Government of Karnataka, under assured irrigated condition in recent years. Hence, V_1 mulberry and bivoltine cocoon rearing were considered in the functional analysis. Regression analysis has been attempted to know the factors contributing for increasing production of V_1 mulberry leaf and bivoltine cocoon by the farmers. The Cobb-Douglas production function was used to find out the factors influencing on V_1 mulberry and bivoltine (CSR_2 X CSR_4) cocoon yield. For mulberry leaf production, the fitted model is as follows

$$Y_m = aX_1^{b1}X_2^{b2}\ldots X_8^{b8}\, e^u \qquad \ldots.(1)$$

Where,

Y_m = Quantity of V_1 mulberry leaf produced (kg/ha/year)
X_1 = Family labour (Man-days/ha/year)
X_2 = Animal power (Pair-days/ha/year)
X_3 = Irrigation (Number/ha/year)
X_4 = Farm yard manure (MT/ha/year)
X_5 = Chemical fertiliser (Kg/ha/year)
X_6 = Age (Years)
X_7 = Education (Schooling years)
X_8 = Experience (Years in sericulture)
a = Intercept
μ = Error term
$b_1 \ldots b_8$ = Regression coefficients

Similarly, for cocoon production, the model would be

Y_c = Quantity of bivoltine cocoon produced (kg/ha/year) …. (2)

Where

X_1 = Family labour (Man-days/ha/year)
X_2 = Dfls (Number/ha/year)
X_3 = Rearing house (dummy: 1 for separate rearing house; 0 for not)
X_4 = Disinfectants (Rs./ha/year)
X_5 = Mulberry leaf (Kg/ha/year)
X_6 = Age (Years)
X_7 = Education (Schooling years)
X_8 = Experience (Years in sericulture)
a = Intercept
u = Error term
$b_1 \ldots b_8$ = Regression coefficients

(c) *Adoption of Sericultural Technologies*

We consider, in this study, a multivariate technique for estimating the probability that an event occurs, the binary logistic regression model (Lakshmanan, 1999). Conceptually, the following is the adoption behavioral model used to examine the factors influencing adoption of sericultural practices.

$$Y_i = g\,(I_i) \qquad \text{....(1)}$$

$$I_i = b_0 + \sum b_j X_{ji} \qquad \text{....(2)}$$

Where Y_i is the observed response for i-th observation (i.e., binary variable, Y_i =1 for an adopter and Y_i= 0 for a non-adopter). The description of dependent and independent variables used in the model are given in Appendix.

It is an underlying and unobserved stimulus index for the i-th observation (conceptually there is a critical threshold (I^*_i) for each farmer; if $I_i < I_i^*$, the farmer is observed to be a non-adopter, if $I_i > I_i^*$, the farmer is observed to be an adopter). g is the functional relationship between the field observation (Y_i) and the stimulus index (I_i), which determines the probability of adoption of sericultural practices.

i = 1,2,…,k, are the observations on variables for adoption model, k being the sample size; j = 0,1,2,…,n is the total number of independent variables. X_{ji} is the j-th explanatory variable for the i-th observation; b_0 is the intercept and b_j are the coefficients of explanatory variables. The final form of the logit model used in this study for the adoption behaviour of the farmers is:

$$I_j \text{ (adoption of } V_1 \text{ mulberry)} = b_0 + b_1 \text{ farm size} + b_2 \text{ irrigation} + b_3 \text{ literacy} + b_4 \text{ credit} + b_5 \text{ Extension contact} + b_6 \text{ price of cocoon} \qquad \text{.... (3)}$$

$$I_j \text{ (adoption of CSR silkworm race)} = b_0 + b_1 \text{ farm size} + b_2 \text{ price} + b_3 \text{ extension support} + b_4 \text{ credit} + b_5 \text{ farm size} + b_6 \text{ cocoon price} + b_7 \text{ rearing house} \qquad \text{....(4)}$$

V

RESULTS AND DISCUSSION

Yield Gaps in Mulberry Leaf Production

Mulberry is a perennial crop and it is expected to yield an optimum level up to 15 years from the year of plantation. However, the yield variability is there for each variety as it depends upon its genetic characters and environment factors. K_2 is one such variety which is a traditional one and suited for local condition in Mandya district of Karnataka. The study reported that more than 80 per cent of the sample farmers planted K_2 variety under irrigated condition in the study villages. The potential yield for K_2 at research station is estimated to be 35 metric tonnes per hectare/year while at the demonstration site, the potential farm yield was reported to be 32.470 tonnes. It is estimated that there was an extent of 7.23 per cent of yield gap between potential and demonstration yield (Table 2). This gap is technically called as 'Yield gap I'. The 'Yield gap I' is calculated to understand to what extent the potential yield of research station is possibly achieved at the field demonstration. Similarly, the Yield gap II, between demonstration and actual yield realised by the farmers, helps to know to what extent the farmers by all categories, on an average, could have achieved by their field conditions, was observed to be 12.38 per cent. In quantity terms, the sample farmers produced on an average about 28.450 tonnes/ha/year as against 32.470 tonnes under demonstration plot yield. The total yield gap was estimated at 18.71 per cent.

TABLE 2. YIELD GAPS IN MULBERRY LEAF PRODUCTION UNDER IRRIGATED CONDITION

Sl.No (1)	Particulars (2)	K_2 variety (3)	V_1 variety (4)
1.	Potential yield (tonnes/ha/year)	35.0	65.0
2.	Potential farm yield (tonnes/ha/year)	32.470	49.450
3.	Average farm yield (tonnes/ha/year)	28.450	40.396
4.	Yield gap I (per cent)	7.23	23.92
5.	Yield gap II (per cent)	12.38	18.31
6.	Total yield gap (per cent)	18.71	37.85
7.	Index of potential yield realisation	92.77	76.08

Another popular mulberry variety, V_1 is of recent origin and is found to be a superior mulberry variety as compared to the other existing varieties with respect to quality and quantity characteristics under irrigated conditions. This suits for bivoltine cocoon production. The potential yield at research station is estimated to be 65 mt/ha/year under irrigated condition. The study revealed that the gap I for V_1 variety was to the extent of 23.92 per cent while at gap II level, it was 18.31 per cent. The total yield gap was observed to be around 37.85 per cent.

While comparing the magnitude of yield gaps at farmers' level, the yield gap with K_2 was narrow than that of V_1 variety, since K_2 variety was in existence since many decades in the study villages and it reached close to the potential farm yield, whereas, V_1 is of a new high-yielding variety and it is planted with limited scale which is expected to take some more years to reach the potential farm yield. The index of potential yield realisation was to the extent of 92.77 per cent for K_2 and 76.08 per cent for V_1 variety by sample farmers. The yield gap I exists as a result of differential environmental factors prevailing in the research station that could not be replicated at demonstration field under farmers' condition. However, the yield gap II could be narrowed down as the farmers move from traditional practices to adoption of new technologies (Vijaya Prakash and Dandin, 2005). The field findings amply show that efforts should be made to popularise V_1 variety in the field with more vigour as it suits to produce quality cocoon.

Yield Gaps in Cocoon Production

Mulberry leaf is the food for silkworms. The analysis of yield gaps at different levels in cocoon production reveals (see Table 3) that total yield gap for bivoltine and cross-bred races were estimated to be 23.18 and 19.52 per cent, respectively. The index of potential yield realisation was to the tune of 87.50 for bivoltine and 92.86 per cent for cross-bred cocoon production. The magnitude of yield gaps at different levels, yield gap I for bivoltine was estimated to be 12.50 per cent while it was 7.14 per cent for cross-bred races. With regard to yield gap II, it was 12.21 and 13.32 per cent for bivoltine and cross-bred races respectively. The study showed that the cross-bred rearers had almost achieved near to the potential yield as compared to bivoltine rearers, since bivoltine races are not always preferred by the farmers due to high investment and it needs to take more care during rearing than that of cross-bred races. Although in terms of yield differential, there is not much difference between bivoltine and cross-bred races, however, cocoon price makes all the difference to prefer bivoltine races by the farmers in the study region.

TABLE 3. YIELD GAPS IN COCOON PRODUCTION UNDER IRRIGATED CONDITION

Sl.No (1)	Particulars (2)	Bivoltine (CSR_2 x CSR_4) (3)	Cross-breed (PM x CSR_2) (4)
1.	Potential yield (100 dfls)	80.000	70.000
2.	Potential farm yield (100 dfls)	70.000	65.000
3.	Average farmers' yield (100 dfls)	61.452	56.336
4.	Yield gap I (per cent)	12.50	7.14
5.	Yield gap II (per cent)	12.21	13.32
6.	Total yield gap (per cent)	23.18	19.52
7.	Index of potential yield realisation	87.50	92.86

Factors Contributing to Production of V_1 Mulberry Leaf

Mulberry leaf production is carried out throughout the year. Therefore, for maintenance of mulberry plots, the recommended quantity of inputs are to be applied to obtain potential yield. Since V_1 variety is spreading fast in the field due to its features like high-yielding and superior quality and suitable for bivoltine rearing, it was considered in the study. There are nine independent variables (see Table 4), viz., family labour, animal power, irrigation, farm yard manure, and chemical fertiliser, age of the respondent, education level and experience of farmers which were expected to influence on the production potential of mulberry yield, are included in the model.

TABLE 4. FACTORS CONTRIBUTING TO MULBERRY LEAF PRODUCTION (V_1 VARIETY) UNDER IRRIGATED CONDITION

Sr.No (1)	Independent variables (2)	Unit (3)	Regression coefficients (4)	t-value (5)
1.	Intercept	-	0.674	-
2.	Family labour	Number	-0.342	-2.845*
3.	Animal power	Number	0.474	1.476
4.	Irrigation	Dummy	0.456	3.473**
5.	FYM	Tonnes	-0.257	-2.745*
6.	Chemical fertiliser	Kg	0.176	3.677**
7.	Age	Years	0.143	1.756
8.	Education	Years	0.894	0.976
9.	Experience	Years	0.467	2.756*
	R^2		0.73	

Note: ** and * indicate 1 and 5 per cent level of significance.

The mulberry production function model for V_1 variety revealed that irrigation, chemical fertiliser and experience of farmers in mulberry cultivation were positive and significant in increasing the production of V_1 mulberry yield. It is further observed that human labour and farmyard manure coefficients were negative but significant. It was reported during the field investigation that most of the sample farmers used excess of quantity of farmyard manure and engaged more family labour than the recommended level. The R^2 value indicates that 73 per cent of the variation was captured from the variables included in the model.

Factors Contributing to Production of Bivoltine Cocoon

Like mulberry leaf production, production of bivoltine cocoon requires some important resources like separate rearing house with required equipments, experience in bivoltine rearing, applying recommended quantity of disinfectants, etc., to produce quality and quantity of cocoon. In this study, nine variables (see Table 5) were included in the model to find out their influence on the production of bivoltine cocoon at the farmers' field. It is found that family labour, quantity of mulberry leaf fed, separate rearing house with required rearing equipments and number of dfls brushed were significant and positive which were considered to be the important factors in increasing bivoltine cocoon production. The other factors such as age, education and experience of farmers in rearing of bivoltine were positive but not significant. The only factor, namely disinfectants, was negatively associated with the production of bivoltine cocoon as most of the farmers did not know the proper use of disinfectants in rearing of silkworms.

TABLE 5. FACTORS CONTRIBUTING TO BIVOLTINE COCOON PRODUCTION UNDER IRRIGATED CONDITION

Sl.No (1)	Independent variables (2)	Unit (3)	Regression coefficients (4)	t-value (5)
1.	Intercept	-	1.767	-
2.	Family labour	Number	0.967	2.456*
3.	Seed (DFLs)	Number	0.176	3.654**
4.	Rearing house	Dummy	0.764	2.786*
5.	Disinfectants	Rupees	-0.164	-1.754
6.	Mulberry leaf	Kg	0.854	4.156**
7.	Age	Years	0.314	1.452
8.	Education	Years	0.610	1.012
9.	Experience	Years	0.145	1.113
	R^2		0.93	

Note: ** and * Significant at 1 and 5 per cent level.

Input Use Pattern in Sericulture

It is argued that either inadequate or excess use of resources in cocoon production would be expected to contribute for not attaining potential yield. In this contention, Table 6 highlights the inputs use pattern in sericulture. For bivoltine cocoon production, the study shows that barring FYM, the other important inputs such as NPK, Dfls, CLO_2 and Vijetha were applied at sub-optimal level as compared to the recommended quantity. Similarly, for cross-breed cocoon production, majority of the sample farmers applied excess quantity of FYM than the recommended levels. However, NPK, Dfls, CLO_2 and Vijetha were used in lesser quantity than the expected level.

TABLE 6. INPUT USE PATTERN WITH COCOON PRODUCTION

			Bivoltine Production			Cross-breed production		
Sr.No. (1)	Name of input (2)	Unit (3)	Recomm-ended level (4)	Actual use (5)	Per cent (6)	Recomm-ended level (7)	Actual use (8)	Per cent (9)
1.	Farm yard manure	Mt/ha/ Year	20	22.500	(+) 12.50	20	23.000	(+) 15.00
2.	Nitrogen (N)	Kg/ha/ Year	350	256.750	(-) 26.64	300	235.500	(-) 21.50
3.	Phosphate (P)	Kg/ha/ Year	140	98.450	(-) 29.68	120	72.450	(-) 39.63
4.	Potash (K)	Kg/ha/ Year	140	85.32	(-) 39.06	120	75.345	(-) 37.21
5.	Dfls brushed	No/ha/ year	4000	2800	(-) 30.00	2300	2050	(-) 10.87
6.	CLo_2	Lit/100 dfls	3.00	1.500	(-) 50.00	3.00	1.350	(-) 55.00
7.	Vijetha	Kg/100 dfls	5.00	3.000	(-) 40.00	4.00	2.450	(-) 38.75

Note: (+) sign indicates excess use and (-) sign shows under use of resources as against the recommended quantity.

Factors Influencing Adoption

It is understood that the presence of yield gaps are attributed to both input use pattern as well as adoption level by the farmers. In this context, the probability of adoption of two important technologies such as V_1 mulberry variety and rearing of CSR bivoltine races are studied through logit model. The influence of explanatory variables on the probability of adoption of high-yielding mulberry variety (V_1) and CSR silkworm race are given in Tables 7 and 8. Table 7 shows the results of logit model estimation for adoption of mulberry variety (V_1) influenced by factors which are considered for the study. The findings indicate that among the six variables studied, the probability of adoption by V_1 variety was significantly associated with cocoon price. The variables such as irrigation, and credit, extension contact and literacy were positive but non-significant. The only variable showed negative sign was farm size. The field experience shows that cocoon price directly influences the farmers to take up V_1 plantation in spite of it being capital intensive in nature as compared to other varieties. Also the study observed that the farm size did not influence the probability of adoption of V_1 variety and in turn it showed negative

TABLE 7: NON-LINEAR PARAMETER ESTIMATES OF LOGIT MODEL V_1 MULBERRY

Sr.No. (1)	Variable (2)	Sign (3)	Size (4)	Standard error (5)	Wald statistic (6)	Significance level (7)
1.	Constant	-	1.906	2.561	0.554	0.457
2.	Irrigation	+	0.937	1.483	0.399	0.527
3.	Farm size	-	0.366	0.384	0.906	0.341
4.	Credit	+	0.547	1.641	0.111	0.739
5.	Extension contact	+	0.302	1.960	0.024	0.878
6.	Cocoon price	+	4.322	2.411	3.213 *	0.051
7.	Literacy	+	1.532	2.232	0.471	0.493
	-2 log-likelihood				14.610	
	Cox and Snell R^2				0.40	
	Nagelkerke R^2				0.64	

* Significant at 5 per cent level.

TABLE 8. NON-LINEAR PARAMETER ESTIMATES OF LOGIT MODEL FOR BIVOLTINE RACES

Sr.No. (1)	Variable (2)	Sign (3)	Size (4)	Standard error (5)	Wald statistic (6)	Significance level (7)
1.	Constant	-	3.021	2.319	1.697	0.193
2.	Rearing house	+	2.121	1.374	2.384	0.123
3.	Farm size	-	0.402	0.298	1.817	0.178
4.	Credit	+	0.485	1.417	0.117	0.732
5.	Extension contact	+	1.973	1.205	2.678 *	0.102
6.	Cocoon price	+	3.331	1.472	5.120 **	0.014
7.	Family size	-	0.090	0.248	0.133	0.716
	-2 log-likelihood				19.572	
	Cox and Snell R^2				0.52	
	Nagelkerke R^2				0.69	

* and ** Significant at 10 and 1 per cent level, respectively.

sign. It implies that the higher farm holding size require higher capital and managerial input. Since most of the farmers in the study villages were marginal and small holders, increasing mulberry holding size would not be possible beyond 2 acres or so. However, two acres of mulberry garden with V_1 variety would be economical for rearing of around 250-300 dfls per crop throughout the year.

With regard to the probability of adoption of bivoltine (CSR silkworm races), factors like cocoon price and extension contacts influenced significantly and other variables such as credit and separate rearing house were positively associated. However, two variables viz., farm size and family sizes, which showed negative sign, were found to be disassociated with the adoption of CSR races in their rearing. The findings reflected the existence of field reality with respect to the adoption of mulberry V_1 variety and CSR silkworm races in the study villages. Farm size and family size were found to be less important factors affecting the adoption decision by the farmers. In both models, R^2 value revealed the goodness of fit of the model.

VI

POLICY IMPLICATIONS

The field study amply shows that the potential yield realisation was about 92.77 per cent in K_2 variety and 76.08 per cent in V_1 variety. The most important reasons for not attaining potential yield in V_1 variety was due to non-applcation of the recommended inputs, as it requires more inputs as compared to other varieties. The potential yield realisation of cross-breed cocoon (92.86 per cent) was higher than that of bivoltine cocoon (87.50 per cent), as the production of cross-breed cocoon is not much risky and requires lesser resources as compared to bivoltine cocoon production. However, the use of the family labour and FYM were observed to be in excess quantity in the production of mulberry leaf. This happens due to the availability of such inputs at the farmer's disposal.

The study suggests three measures to reduce yield gaps in the study regions. First, farmers should be educated regarding inputs usage, as excess use leads to increase in cost of production and sub-optimal use leads to low productivity. Therefore, to create awareness about input applications and adoption of new technologies, sericulture implementing agencies such as Department of Sericulture, NGOs and Self-Help Groups may implement suitable schemes to train the farmers to attain potential yield.

Secondly, the financial lending institutions should extend credit support to the needy farmers in time as that would help them to purchase crucial inputs to increase production. Thirdly, providing remunerative price for their produce and maintain cocoon price stability. Since cocoon price is directly related to adoption of the recommended technologies and utilisation of resources, the government should come up with price stability measures like Minimum Support Price (MSP) to protect farmers' interest to increase quality and quantity of cocoon production in the study regions. The measures suggested above if implemented properly, would ensure better quality and quantity of silk production in the long run in the study regions in particular and Karnataka in general.

Received December 2006. Revision accepted November 2007.

APPENDIX

DESCRIPTION OF EXPLANATORY AND CORRESPONDING BINARY VARIABLES USED BY LOGIT MODEL

Sr.No	Explanatory Variable (X_j)		Unit of variable	Description of Variable
(1)	(2)	(3)	(4)	(5)
1.	Irrigation	X_1	Binary	0 Inadequate irrigation 1 Adequate irrigation
2.	Farm size	X_2	Numerical	Acre
3.	Literacy	X_3	Binary	0 Illiterate farmer 1 Literate farmer
4.	Price	X_4	Binary	0 Unfavorable cocoon price 1 Favorable cocoon price
5.	Credit	X_5	Binary	0 Credit not availed 1 Credit availed
6.	Extension contact	X_6	Binary	0 No extension advice received 1 Extension advice received
7.	Rearing house	X_7	Binary	0 No separate rearing house 1 Separate rearing house
8.	Family size	X_8	Numerical	Number
9.	Adoption of V_1 mulberry	Y_i	Binary	0 Non adoption of HYV (V_1 Mulberry) 1 Adoption of HYV (V_1Mulberry)
10.	Adoption of bivoltine races	Y_j	Binary	0 Non adoption of CSR races 1 Adoption of CSR races

REFERENCES

Deshpande, R.S. and J. Prachitha (2005), *WTO and Agricultural Policy in Karnataka,* Research Report IX/ADRT/119, Agricultural Development and Rural Transformation Unit, Institute of Social and Economic Change, Bangalore.

ITC (2000), "Review of Silk", International Trade Centre, Geneva.

Lakshmanan, S. (1999) "Adoption of Sericultural Technologies and Productivity Behaviour of Sericulture in Tamil Nadu: An Econometric Analysis", Unpublished Ph.D Thesis, submitted to University of Mysore, Mysore.

Lakshmanan, S., B. Mallikarjuna, H. Hayaram, R. Ganapathy Rao, M.R. Subramaniam, R.G. Geetha Devi and R.K. Datta (1996), " Economic Issues of Production of Mulberry Cocoon Production in Tamil Nadu – A Micro Economic Study", *Indian Journal of Sericulture*, Vol.35, No. 2, pp.128-131.

Lakshmanan, S, B. Mallikarjuna, M.R. Subramaniam and R.G. Geetha Devi (1996), "Economics of Sericulture in Tamil Nadu ", *Indian Textile Journal*, April, pp.58-60.

Lakshmanan, S, B. Mallikarjuna and R.G. Geetha Devi (1997), "Economics of Scale in Mulberry Sericulture in Tamil Nadu", *Indian Journal of Sericulture,* Vol.36, No. 2, pp.133-137.

Lakshmanan, S., B. Mallikarjuna, H. Hayaram, R. Ganapathy Rao and R.G. Geetha Devi (1997b), "Economics of Sericulture –An Update", *Indian Silk*, May, pp.21-23.

Lakshmanan, S., B. Mallikarjuna, R. Ganapathy Rao, H. Jayaram and R.G. Geetha Devi (1998a), "Studies on Adoption of Sericultural Innovations at Farmer's Field in Tamil Nadu: An Empirical Analysis", *Indian Journal of Sericulture,* Vol.37, No.1, pp.52-56.

Lakshmanan, S., H. Jayaram, R. Ganapathy Rao, B. Mallikarjuna and R.G. Geetha Devi (1998b), "Manpower Utilisation in Mulberry Sericulture: An Empirical Analysis", *Manpower Journal,* Vol.33, No. 4, pp.49-63.

Lakshmanan, S., B. Mallikarjuna , H. Jayaram, R. Ganapathy Rao, and R.G. Geetha Devi (1999), "An Empirical Investigation on Labour Productivity in Mulberry Sericulture", *Indian Journal of Sericulture*, Vol.38, No.1, pp.48-52.

Lakshmanan, S. and R.G. Geetha Devi (2000), "Bivoltine Cocoon: Sericulture Investment and Return", *Indian Textile Journal*, April, pp.64-66.

Lakshmanan, S. and R.G. Geetha Devi (2005), "A Comparative Analysis of Economics of Bivoltine and Cross-breed Cocoon Production in Mandya District of Karnataka", *Indian Journal of Sericulture*, Vol.22, No.2, pp.179-182.

Lakshmanan, S. (2006), "Mulberry Sericulture in India: Needs Changes and Challenges", *Agriculture Today*, Vol.9, No.9, pp.12-15.

Vijaya Prakash, N.B. and S.B. Dandin (2005a), "Yield Gaps and Constraints in Bivoltine Cocoon Production in Mandya District of Karnataka- An Economic Analysis", *Indian Journal of Sericulture*, Vol.44, No.1, pp. 50-54.

Vijaya Prakash, N.B. and S.B. Dandin (2005b), "Factors Influencing the Adoption of Bivoltine Sericultural Practices in Mandya District of Karnataka – An Economic Analysis", *Indian Journal Sericulture*, Vol.44, No.1, pp.55-58.