



## Employment potential of mulberry sericulture: A case study of Karnataka

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### ABSTRACT

Karnataka is the leading state in mulberry sericulture. The activities involved in cocoon production for mulberry cultivation and silkworm rearing are avenues of high employment generation and hence focussed in the present study. Chitradurga, Kolar and Koppal districts from different geographical regions were selected. The employment generation in sericulture was collected through personal interview method during 2018-19, from 60 respondents. Tabular analysis, functional analysis, frequency, percentage method and trend analysis were used. General Linear Model (GLM) was constructed to identify the factors influencing employment and labour productivity was estimated. The average employment generated in the state per acre per annum was 584 man days. Around 48 per cent farmers have generated employment of about 500 to 600 days. The labour-output ratio proved the significant contribution of labour for profitable sericulture. The variability in employment is explained significantly by man days, area, experience and disease free layings (df/s) reared. The findings suggest that encouraging farmers to take up mulberry in a sustainable manner by diversifying the cropping systems will significantly improve the standard of living.

**Keywords:** Sericulture, employment, mulberry, cocoon

India has a rich and complex history in silk production and its silk trade which dates back to 15<sup>th</sup> century. Silk has been intermingled with the life and culture of the Indians and also stands for livelihood opportunity for millions, owing to its high employment potential, low capital requirement and remunerative nature of its production. The sericulture industry is based on rural on-farm and off-farm activities with enormous employment generation potential as one of the most appropriate avenues for socio-economic development. Sericulture industry provides employment to approximately 9.18 million persons in rural and semi-urban areas in India. Of these, a sizeable number of workers belong to the economically weaker sections of the society, including women (CSB 2019). The above paragraph is taken as a review from CSB, 2019.

India has the unique distinction of being the only country producing all the four known commercial silks, namely, *Mulberry*, *Tasar (Tropical, Oak)*, *Eri* and *Muga*, of which *Muga* which is produced only in India with its golden yellow glitter is a prerogative of India. The Brahmaputra valley of Assam is only place in the world where muga rearers have been rearing muga silkworm traditionally since time in memorial (Bonia, 2020). India is the second largest producer of silk in the world. Among the four varieties of silk produced in 2018-19, Mulberry accounted for 71.45 per cent (25,345 MT), *Tasar* 8.4 per cent (2,981 MT), *Eri* 19.48 per cent (6,910 MT) and *Muga* 0.66 per cent (233 MT) of the total raw

silk production of 35,468 MT. (CSB, 2019). Types of silk produced are classified as four including both Oak and Tropical as *Tasar* silk. The details provided are pertaining to India.

Mulberry sericulture is predominant in southern states of the country viz. Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra, Telangana, Madhya Pradesh and Kerala which together contribute to around 86 per cent of the total mulberry silk produced. It is the only cash crop that provides attractive incomes to the farming community especially small and marginal farmers (Jagannath, 1995). Sericulture is one of the prominent enterprises, which provided full time employment to the entire family. One hectare of mulberry creates employment of 13-16 persons per year and their location specific analysis indicates that for a production of one kilogram of raw silk, 11 mandays are required which can, in turn, employ 30 mandays for production of silk fabric (Vijaykumar *et al.*, 2007). It improves the standard of living and life style of the people in rural area by providing sufficient employment and income opportunities and hence it is also called as the '*Kalpavriksha*' or the '*Kamadhenu*' of the poor. It is one of the instrument for controlling the migration of people from rural areas to urban areas for employment (Marella, 2013).

Mulberry sericulture is an art of silk production which includes major activities like mulberry cultivation, silkworm rearing under pre-cocoon sector and post

cocoon production. The employment generation pattern of the sericulture industry is classified into two major types as direct employment through mulberry cultivation; leaf/shoot harvesting; silkworm rearing; cocoon harvesting, transportation and marketing; indirect employment for reeling; twisting; weaving; printing and dyeing; finishing; silk waste processing (Gangopadhyay, 2008). Additional employment was generated through other activities involved for the construction of silkworm rearing house, installation of drip irrigation, operation of equipments, digging of borewell, etc. A model depicting the opportunities for employment generation in pre-cocoon sector of sericulture is given in Fig. 1. As cocoon production is labour oriented and involved lot of drudgery, the employment potential of pre-cocoon sector of sericulture is highlighted in the present study.

Karnataka is the leading silk producing state which contributes around 50 per cent of the total silk production in India (Annual Report, Central Silk Board (CSB, 2019). Almost 88 per cent of Karnataka sericulture is spread in southern part of Karnataka, which is fast modernizing by factors like urbanization, industrialization, accessibility of markets and sericulture Technical Service Centres (TSC).

In view of the importance of sericulture enterprise, an attempt has been made to enlighten the significance of pre-cocoon sector of sericulture for employment generation in Karnataka. The activities involved in cocoon production for mulberry cultivation and silkworm rearing are avenues of high employment generation and hence focussed in the study.

## MATERIALS AND METHODS

The study was conducted in the Chitradurga, Kolar and Koppal districts of Karnataka. This area was selected because of the significant contribution concerning to the area and production of mulberry cocoons in the state representing different geographical regions, thereby providing a medium of significant income and employment generation. A Multistage random sampling technique was used to select the farmers from different climatic regions. At the first stage, 3 districts namely, Chitradurga, Kolar and Koppal were selected based on area under mulberry cultivation located in different climatic regions. In the second stage, two talukas under each district were selected and two villages from each taluk were selected randomly. The list of respondents was developed based on the area under mulberry cultivation and five growers from each village were selected randomly, thus forming a sample of 60 farmers.

The study was based on both secondary and primary data. The secondary data were collected concerning to the area under mulberry cultivation and cocoon production from the Sericulture Department and Technical Service Centres (TSCs). The primary data was collected based on pre-testing schedule by adopting a personal interview method from the selected households in the study area for finding out the total employment generated, income obtained, labour efficiency, and factors influencing the employment.

## Descriptive tools

The employment generation in mulberry cultivation, cocoon production, status of sericulture were calculated by conventional analysis using averages and percentages.

## Analytical tools

### Regression analysis

Regression analysis is widely used statistical model in various research fields to know the effect of one or more explanatory variables on the response variable. Ordinary Least Squares (OLS) methodology is generally used to estimate the parameters in the model. In the study, six explanatory variables have been used to know their effect on employment generation. Mathematically, the model can be written as:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

Where,  $Y$  = Employment generation per acre per annum (MD)

$X_1$  = Total no. of work-days (No. of working days created for a particular work)

$X_2$  = Education (years)

$X_3$  = Family members (number)

$X_4$  = Area (acres)

$X_5$  = Experience in sericulture (years)

$X_6$  = Dfls reared per annum (number)

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$  are the parameters to be estimated using OLS method. The error terms are independent and identically distributed normally distributed with mean 0 and constant variance.

## Labour productivity

Employment in sericulture depends upon productivity of land as well as labour, other than climatic factors. Labour productivity in sericulture measures the number of units of output (cocoon) produced per unit of labour used in the process of production. It is a partial productivity indicator also called as Labour - Output ratio and it is calculated by dividing the quantity of output by the total units of labour used (Roy *et al.*, 2012). The formula is given below:

$$\text{Labour productivity in sericulture} = \frac{\text{Quantity of cocoons produced (kg)}}{\text{Total labour engaged (No.)}}$$

## RESULTS AND DISCUSSION

### Establishment of the mulberry garden

Mulberry is a perennial crop and it starts providing potential leaf yield from the second year onwards and lasts for 15 to 20 years without a significant reduction in the yield. All the farmers in the study area had planted V1 variety under paired row system [(5 + 3) x 2] and 3 x 3m spacing, which is a ruling variety in South India. With good irrigation facilities and nutrient management, the optimal potential yield obtained was 55 - 60 MT/ha/ year.

The establishment of garden includes the activities of land preparation to pruning after six months. A total of 111 MD were employed on an average for establishment of one acre mulberry garden in the study area (Table 1). Among the total labour engaged, 70 per cent was utilised for weeding and irrigation/maintenance of drip irrigation system. All the sample farmers have installed drip irrigation system in the garden which helped to save the manpower requirement drastically compared to furrow irrigation system adopted earlier. Making ridges and furrows in alternate crops (1<sup>st</sup> and 3<sup>rd</sup> crops), 2 ½ times during a year requires 75 MD (Prasad *et al.*, 2012). The V1 mulberry saplings were purchased from the nurseries. It had reduced the time (3 months) and additional requirement of man days for raising nursery. The men labour accounted to 65 per cent of the total labour requirement for establishment of the garden.

The inter-cultural operations were taken up using power tiller and accounted to 16 machine hours. FYM of 10 MT/acre was applied in two splits; once during the onset of monsoon and second after six months by engaging 27 MD. A total of 9 MD were employed for application of fertilisers annually. In Chitradurga district, *Poshan* which is a multi-nutrient formulation for healthy growth of mulberry was sprayed once in alternate crops. Pruning and cleaning was taken up using power cutter and with a less manpower requirement of 42 MD only. The plant protection measures were taken up depending on the incidence of pests and 6 men labour were engaged annually. Overall, a total of 100 men and 70 women labour were engaged for annual maintenance of mulberry garden with women involvement up to 41 percent.

In Chitradurga district, 25 men labour were employed per annum to carry out disinfection and washing of equipments and it was 22 MD, 21 MD in Kolar and Koppal districts respectively. During the third, fourth and first two days of fifth stage of silkworms, labour of 2 MD were utilised per day and later 5 MD per day were engaged. A total of 270 MD were generated for silkworm rearing and shoot harvest from one acre of mulberry garden.

Picking of matured worms for spinning the cocoons (mounting) and cocoon harvest are the core areas along with silkworm rearing to provide employment at large scale. Bamboo chandrike are the traditional and most commonly used appliances in Karnataka. Adoption of plastic mountages (*Netrika*) is increasing now-a-days and had reduced the manpower requirement for mounting to 40 labours per annum. Harvesting of cocoons is another women friendly activity and generated employment to 69 women per annum from one acre of mulberry garden. All the farmers in the study area had marketed the cocoons at Government cocoon market, Ramanagar and for farmers from Koppal district, it took 2 days to travel to Ramanagara market to sell the cocoons every time.

Overall, 54 per cent of the labour force engaged in silkworm rearing was women. Sericulture is an occupation by and for women because women form more than 60 per cent of the workforce and 80 per cent of silk consumption. Rubia *et al.* (2019) worked out that, about 2,575 women work days comprising about 60 per cent were generated per annum out of a total 4,225 work days in all the activities in sericulture per hectare in case of irrigated mulberry production.

### Factors influencing the employment pattern

The employment generation in sericulture is influenced by many factors. Family labour which contributes to 60 per cent of the total work force is considered as one of the determining variable. Education is one of the important determinants in order to enhance the production. The level of employability rises with the increase in level of education. Work-days considered refer to the number of working-days created by a particular work. Higher man-days offered by a job also make it more stable, assuring an average income throughout the year. It is hypothesized that greater level of employment is associated with higher man days created by the activity. The total employment generated also depends on the average land holding, the total number of dfls reared per annum and the experience of the farmer silkworm rearing.

Summary statistics of one dependent variable and six explanatory variables was provided in Table 2 which includes mean, standard deviation, coefficient of variation (CV), minimum and maximum.

Stepwise section method was employed to select the appropriate explanatory variables. Table 3 shows the significant variables which are total man-days, area, experience and dfls reared. Table 4 shows the significance of the model at 1 per cent level of significance as the p-value is <0.0001 which rejects the null hypothesis of model insignificance.

**Table 1: Manpower engaged in establishment and maintenance of mulberry garden (MD/acre)**

S. No.Particulars	Chitradurga			Kolar			Koppal			Overall			
	M	F	Tot	M	F	Tot	M	F	Tot	M	F	Tot	
<b>I Establishment of mulberry garden</b>													
i	Planting	2	8	10	2	9	11	1	7	8	2	8	9
ii.	Manuring	12	2	14	14	0	14	11	5	16	13	2	15
iii.	Fertiliser application	4	0	4	6	0	6	2	4	6	4	1	5
iv.	Hoeing/weeding	10	24	34	12	28	40	14	27	41	12	26	38
v.	Irrigation/ maintenance of drip irrigation system	37	0	37	36	0	36	43	0	43	39	0	39
vi.	Miscellaneous	3	0	3	2	3	5	4	3	7	3	2	5
<b>Sub-total</b>		<b>68</b>	<b>34</b>	<b>102</b>	<b>72</b>	<b>40</b>	<b>112</b>	<b>75</b>	<b>46</b>	<b>121</b>	<b>73</b>	<b>39</b>	<b>111</b>
<b>II. Annual maintenance of mulberry garden</b>													
i.	Inter cultivation												
a	Bullock pairs	0	0	8	8								
b	Machine hours	13	14	17	16								
ii.	Manuring	19	4	23	25	0	25	25	8	33	23	4	27
iii.	Fertiliser application	3	6	9	8	0	8	4	5	9	5	4	9
iv.	Hoeing/weeding	8	43	51	4	45	49	0	59	59	4	49	53
v.	Irrigation/maintenance of drip irrigation system	29	0	29	31	0	31	26	0	26	29	0	29
vi.	Pruning and cleaning	39	10	49	28	15	43	22	11	33	30	12	42
vii	Plant protection measures	6	0	6	8	0	8	5	0	5	6	0	6
viii.	Miscellaneous	4	0	4	3	2	5	3	3	6	3	2	5
<b>Sub-total</b>		<b>108</b>	<b>63</b>	<b>171</b>	<b>107</b>	<b>62</b>	<b>169</b>	<b>85</b>	<b>86</b>	<b>171</b>	<b>100</b>	<b>70</b>	<b>170</b>
<b>III. Silkworm rearing per annum</b>													
1	Disinfection	15	10	25	13	9	22	13	8	21	13	9	22
2	Silkworm rearing, shoot harvest	160	136	296	130	124	253	112	148	259	146	128	274
3	Mounting - (plastic/ rotary/ bamboo)	9	28	37	11	28	39	11	32	43	11	29	40
4	Harvesting and bed cleaning	16	83	100	22	68	90	16	54	70	18	69	87
5	Marketing & transportation of cocoons	16	0	16	10	0	10	10	0	10	12	0	12
6	Miscellaneous	0	0	0	5	10	15	6	5	11	4	5	9
<b>Sub-total</b>		<b>217</b>	<b>258</b>	<b>475</b>	<b>191</b>	<b>238</b>	<b>428</b>	<b>167</b>	<b>247</b>	<b>414</b>	<b>203</b>	<b>240</b>	<b>443</b>

(M- Male, F - Female, Tot - Total)

**Table 2: Summary statistics of dependent and explanatory variables**

Variable	Mean	Std Dev	CV	Minimum	Maximum
Employment Generation	584.48	58.54	10.02	454.00	709.00
Total man days	160.19	19.54	12.20	124.00	192.50
Education	7.38	3.99	54.11	0	15.00
Family members	4.64	1.56	33.60	2.00	9.00
Area	1.88	0.96	50.93	0.30	5.0
Experience	8.64	5.86	67.88	2.00	28.00
Dfls reared	1162.00	263.66	22.69	600.0	1500.00

**Table 3: Summary of stepwise selection**

Step	Variable entered	PartialR-square	ModelR-square	F value	Pr > F
1	Total man days	0.9900	0.9900	2963.91	<.0001
2	Area	0.0024	0.9924	9.21	0.0050
3	Dfls reared	0.0011	0.9935	4.61	0.0407
4	Experience	0.0007	0.9942	3.15	0.0872

**Table 4: Analysis of variance**

Source	DF	Sum of squares	Mean square	F-value	Pr > F
Model	4	10630551	2657638	1147.43	<.0001
Error	27	62536	2316.16		
Uncorrected Total	31	10693087			

**Table 5: Parameter estimates for the selected variables**

Variable	DF	Parameter estimate	Standard error	t-Value	Pr >  t
Total man days	1	3.98705	0.28225	14.13	<.0001
Area	1	38.69396	9.79371	3.95	0.0005
Experience	1	-2.90062	1.63426	-1.77	0.0872
Dfls reared per annum	1	-0.08962	0.04192	-2.14	0.0417

**Table 6: Status of sericulture in Karnataka**

S.No.	Particulars	Chitradurga	Kolar	Koppal	Overall
1	Batches reared per annum (No.)	5	5	4	5
2	Dfls reared per batch	217	209	230	218
3	Dfls reared per acre per annum (No.)	1197	1268	1010	1162
4	Cocoons produced (kg)	894	831	764	830
5	Average market rate obtained (Rs./kg. of cocoons)	407.24	394.75	250.76	352.33
6	Average yield(kg. per 100 Dfls)	79.28	77.20	66.05	74.73
7	Labour involved				
i.	Mulberry cultivation (MD)	166	167	165	151
ii.	Silkworm rearing (MD)	475	428	414	433
	<b>Total</b>	<b>641</b>	<b>596</b>	<b>579</b>	<b>584</b>
8	Labour consumption per 100 Dfls	42	41	42	41
9	Value of output (Rs.)	364072	360654	299488	341059
10	Imputed value of labour (Rs.)	193668	179344	175470	183944
11	Labour-Output ratio	0.53	0.50	0.59	0.54

**Table 7: Productivity of raw silk in Karnataka**

Particulars	Chitradurga	Kolar	Koppal	State Overall
Area under mulberry (acres)	4568	49980	1020	261444
Villages involved in sericulture (No.)	272	1477	156	11211
Families engaged in sericulture (No.)	2222	19167	524	137890
Average land holding (acres)	2.06	2.61	1.95	1.90
Estimated raw silk production (MT)	582	5897	111	11592
Productivity of raw silk per family (kg.)	262	308	211	84
Raw silk productivity per unit area (kg./acre)	127	118	108	44



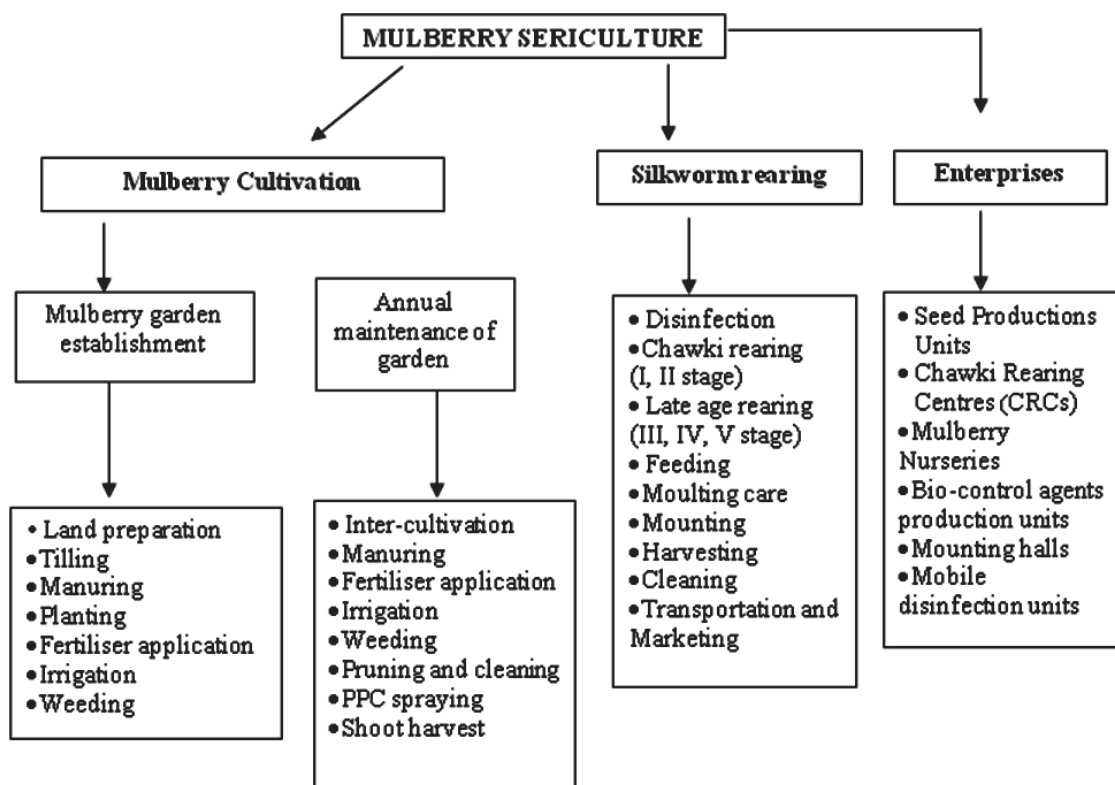


Fig. 1: Schematic representation for employment generation in pre-cocoon sector of sericulture

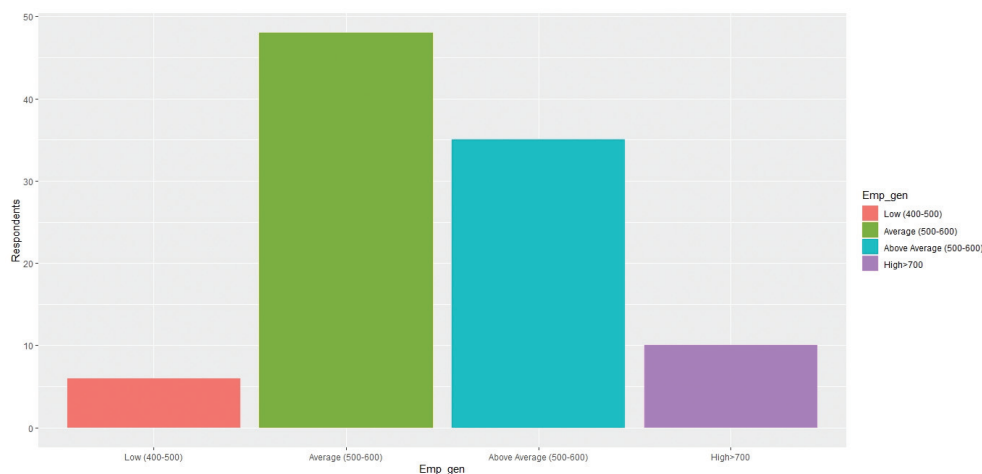


Fig. 2: Employment generation in mulberry sericulture (per acre per annum)

Adjusted  $R^2$  for the above estimated model was 99.33 which indicate that about 99.33 per cent variability in the employment generation was explained by total no. of man-days, area, experience and dfls reared per annum. All the variables were found significant at 5 per cent level of significance except experience which was found significant at 10 per cent level of significance (Table 5). It was observed from the table that

employment generation was increased 3.98 units per unit increment in total no. of man-days and one unit increment of area lead to 38.69 unit increment of employment generation. However, it was seen that employment generation was decreased 2.90 units and 0.08 units per unit increment of experience and dfls reared per annum respectively.

### Sericulture status in Karnataka

With the interventions of the present technologies, the high yielding mulberry variety V1 and bivoltine hybrids are enabled to take up silkworm rearing throughout the year.

The average number of crops taken per year was 5 in the Chitradurga and Kolar districts; it was only 4 in Koppal district (Table 6) due to the adverse climatic conditions. Around 209 to 230 Dfls were brushed per batch per acre across the state. The average annual income estimated from sericulture per annum was Rs. 3.41 lakh; in Chitradurga it was Rs. 3.64 lakh whereas in Koppal it was Rs. 2.99 lakh only. The variation in income attributes to the less number of crops taken during the year with the existing hot and dry conditions in Koppal district, it also affected the quality of cocoons obtained thereby attained the less market price. The highest labour-output ratio in the state was 0.50 for Kolar district.

The average market rate obtained per kg of cocoons was Rs. 407 and Rs.394 for the Chitradurga and Kolar farmers respectively. The total employment generated per acre of mulberry garden per annum was 641, 596, 579 MD in Chitradurga, Kolar and Koppal respectively. The raw silk productivity in the state was estimated to be 107 kg per acre and it was highest in Chitradurga district with 127 kg (Table 7). Around 48 per cent of the farmers have generated employment to 500 to 600 days per annum and 35 per cent farmers generated 600 to 700 days of employment (Fig. 2). Among the total labour employed, 60 per cent was the family labour and hence the profit realised was more in sericulture. Imputed value of labour was estimated at average wage rate of Rs. 300 per day and it accounted to Rs. 1.83 lakhs. The labour-output ratio ranged from 0.50 (Kolar) to 0.59 (Koppal) and implies that the contribution of labour was significant for practising sericulture profitably.

Sericulture was proven to provide year round employment to large sector of rural folk in the state. Regression analysis revealed that sericulture is contributing in generating enormous employment opportunities to rural folk. Among the respondents, 48 per cent had generated employment of 500 to 600 days per annum and 35 per cent had generated 600 to 700 days of employment. The average annual income estimated from sericulture per annum was Rs. 3.41 lakh; in Chitradurga it was Rs. 3.64 lakh. The highest labour-output ratio in the state was 0.50 for Kolar district. The raw silk productivity in the state was estimated to be 107 kg per acre and it was highest in Chitradurga district

with 127 kg. Employment generation was increased 3.98 units per unit increment in total no. of man-days and one unit increment of area lead to 38.69 unit increment of employment generation. However, it was seen that employment generation was decreased 2.90 units and 0.08 units per unit increment of experience and dfls reared per annum respectively. Further extension of technical and financial support to various activities in sericulture will enable to develop potential entrepreneurship. Encouraging farmers to take up mulberry in a sustainable manner by diversifying the cropping systems and adopting Integrating Farming System (IFS) will significantly contribute in improving the standard of living.

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