Chapter 6
SUMMARY, CONCLUSION AND
POLICY IMPLICATIONS
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6.1 INTRODUCTION

India is the second largest producer of silk (16,525 MT, 2006-07) in the world next only to China (93,100 MT, 2005). Karnataka is the leading sericulture state which contributes around 50 per cent of the total silk production. Sericulture involves cultivation of mulberry and rearing of silkworm. The silkworm crop requires about one month time from preparation (cleaning of rearing house), brushing of silkworm eggs and till harvesting of the cocoons. The climatic conditions of Karnataka favour sericulture throughout the year. Hence, there will be regular crops throughout the year. Farmers take 10-12 crops in a year. Sericulture is labour intensive and requires constant attention and monitoring of crops throughout the year. Silkworm is sensitive to climatic changes and suffers from different diseases.

In Karnataka state, earlier sericulture was considered as a subsistence crop practiced cultivated on marginal dry lands with lesser water resources. Over the years, with technological advancement, sericulture is shifted to more fertile and irrigated lands giving commercial status to sericulture. With introduction of new varieties of mulberry and silkworm races, the area under mulberry has increased from 86,800 ha during 1970-71 to 1,67,778 ha during 1994-95. The quality and quantity of production also increased steadily over the years. The area under irrigation has increased from 20 per cent during 1970-71 to almost 90 per cent during 2007-08. Since 1995-96, despite the improvement in the technology and productivity, the area under mulberry and the cocoon production has been on decline. Further, a wide gap prevails in the yield levels of the farmers to that of potential yield levels. Sericulture being sensitive to climatic factors suffers from uncertainties. With globalisation, the policies have changed, throwing the industry to compete in the global markets.
Taking all these parameters into consideration a need was felt to analyse the yield gap and uncertainty in sericulture in Karnataka State with the following specific objectives.

6.1.1 SPECIFIC OBJECTIVES OF THE STUDY

1. To assess the yield gap in mulberry cultivation and silkworm rearing with the given technology of the sample farmers in the study area.

2. To assess the uncertainty involved in mulberry cultivation, silkworm rearing and marketing of cocoons in the study area.

3. To study the knowledge and adoption of sericulture practices by the sample farmers in the study area.

4. To suggest appropriate policy measures to minimize the yield gap and uncertainty in mulberry sericulture in the study area.

6.2 METHODOLOGY

6.2.1 SAMPLING DESIGN

The study was conducted by collecting primary data from 120 sample farmers in Karnataka State. Stratified random sampling was adopted for sampling. Two districts in traditional belt and two districts in non-traditional belt of Karnataka State having higher area under mulberry were selected. Thus, 4 districts viz., Kolar, Mandya, Chitradurga and Belgaum were selected. Two taluks from each of the district having higher area under mulberry were selected. A total of eight taluks were selected. From each of these selected taluks, 15 farmers were selected at random. A minimum of 3 villages per taluk were covered depending on the density of the farmers in the taluk.
6.2.2 SOURCES AND METHOD OF DATA COLLECTION

Both primary as well as secondary data were collected for the study. Primary data were collected from the 120 sample farmers using the pretested questionnaire prepared for the study. Necessary secondary data on sericulture in Karnataka in general and selected districts in particular were collected from the Department of Sericulture, Govt. of Karnataka, Bangalore and the Zilla Panchayat Offices of the Department of Sericulture in respective districts.

6.2.3 IDENTIFICATION OF VARIABLES AND METHOD OF ANALYSIS

Simple analytical tools like averages and percentages have been widely employed. Coefficient of variance (CV %) has been used to analyse and compare the variations in different parameters. For analyzing the time series data, average annual compound growth rates (CGR) were worked. Apart from this the following statistical tools and econometric models have been employed.

6.2.3.1 Yield gap analysis

Yield gap I: It is the gap between the research yield and the attainable yield. Yield gap I is also expressed as percentage to the research yield.

Yield gap II: It is the gap between the attainable yield and the anticipated yield. Yield gap II is also expressed as percentage of the attainable yield.

Yield uncertainty: It is the gap between the anticipated yield and the actual yield. Yield uncertainty is also expressed as percentage of the anticipated yield.

Total yield gap: It is the gap between research yield and the actual yield. Total yield gap is also expressed as percentage of research yield.
**Crop uncertainty**: It is the uncertainty arising out of full or partial silkworm crop failures. It is worked out as follows.

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\text{Crop Uncertainty} = \frac{\text{Crop failures (DFLs)} + (\text{Partial failures (DFLs)/2})}{\text{Total DFLs}} \times 100
\]

**Price uncertainty**: It is the gap between the anticipated price and the actual price. Price uncertainty is also expressed as percentage of the anticipated price.

**Total uncertainty (gross returns)**: It is the gap between the anticipated gross returns (estimated with anticipated yield and anticipated price) and the actual gross returns per ha of mulberry. Total uncertainty is expressed as percentage of the anticipated gross returns.

### 6.2.3.2 Analysis of variance (ANOVA)

Two-way analysis of variance (ANOVA) was adopted to test the yield differences of Factor A: yield levels (attainable yield, anticipated yield and actual yield) and Factor B: regions/districts (Kolar, Mandya, Chitradurga and Belgaum). The number of observations is 30.

### 6.2.3.3 Production Function Analysis

Cob-Douglas production function analysis was employed as an analytical tool for assessing the relationship between:

(i) Mulberry yield per ha per year \( (Y) \) and three independent variables \( (X_i's) \).

(ii) Cocoon yield per 100 DFLs \( (Y) \) and five independent variables \( (X_i's) \).

Separate production functions were fitted for anticipated yield and actual yield for mulberry and cocoon production. In order to study the technological gaps between anticipated yield and actual yield, the model following Bisalaiah
(1975) was employed. Chow’s-F test was employed to test the difference between two production functions.

6.2.3.4 Path Coefficient Analysis

Path Coefficient Analysis was used as an analytical tool for delineating the direct and indirect relationship between:

(i) Mulberry leaf yield per ha per year (Y) and five independent variables.
(ii) Cocoon yield per 100 DFLs (Y) and five independent variables.

6.3 RESULTS AND DISCUSSION

The data collected from different sources were analysed employing appropriate statistical tools. The results of the analysis have been summerised and presented here.

6.3.1 CROPPING PATTERN FOLLOWED BY THE SAMPLE FARMERS

The average agriculture land holding of the sample farmers of Karnataka was 3.72 hectares with 60 per cent irrigation (2.21 ha). Sericulture was mainly grown under irrigation occupying around 40 per cent of the irrigated land and/or 23.57 per cent of the total agriculture land. Under irrigated conditions sericulture was the major crop of the sample sericulturists (39.70 per cent) followed by plantation crops (31.64 per cent) and cereal crops (16.69 per cent). The major plantation crop under irrigation was sugarcane followed by coconut and banana. Maize and Paddy were the major cereal crops followed by ragi grown in kharif under irrigation.

Under rainfed condition, field crops were grown only during kharif season. Majority of which include oilseeds and pulses (35.09 per cent) and
cereal crops (32.11 per cent). Plantation crops mainly mango and nilgiri (eucalyptus) accounted for 17.14 per cent of the rainfed lands.

During rabi season field crops were grown under irrigated conditions. Cereals occupied 77.70 per cent of the total crops grown under rabi season. Paddy and wheat were the major cereal crops followed by ragi and jowar.

**Kolar District:** The average agriculture land holding of sericulturist was 3.43 ha with 41.17 per cent irrigation. Sericulture was the major crop accounting for 81.37 per cent of irrigated lands. Other crops grown under irrigation were ragi, paddy, banana and vegetables. Plantation crops mainly mango and nilgiri (Eucalyptus) occupied 51.46 per cent of the rainfed land. Ragi was the only cereal crop grown in rainfed lands during kharif season. Around 25 per cent of the rainfed land left fallow.

**Mandya District:** Average land holding of the sample sericulturist was only 2.11 ha with almost cent per cent irrigation. Mulberry occupied 27.12 per cent of the area of the sericulturist. Sugarcane and paddy were the major crops.

**Chitradurga District:** The average size of the farm of a sericulturist was 5.18 hectare with 54.14 per cent irrigation. Sericulture (40.81 per cent) and plantation crops (30 per cent), mainly coconut followed by banana were the major crops under irrigated lands. During kharif season vegetables, ragi and paddy under irrigation and groundnut and jowar under rainfed condition were cultivated. Ragi was major crop of rabi season under irrigation followed by paddy, wheat, maize and to some extent jowar.

**Belgaum District:** The average land holding of sericulturists was 4.18 ha with 60 per cent irrigation. Sericulture occupied 25.68 per cent of the irrigated land. Plantation crops (38.39 per cent) and cereal crops (26.78 per cent) occupied the
major portion of the irrigated land. Sugarcane was the main plantation crop and maize was the major cereal crop under irrigation. Beetlevine, banana and grapes were grown to some extent. Oilseeds (mainly groundnut) and pulses were also grown under irrigated conditions in kharif. During rabi season sunflower, bengal gram and groundnut were grown in some portion of the irrigated lands. Under rainfed condition and during kharif season, cereal crops (bajra, maize and jowar) and oilseeds and pulses mainly horse gram followed by ground nut and soybean were cultivated. During rabi season under irrigation cereals like wheat and barley; oilseeds and pulses like sunflower, bengal gram and groundnut were cultivated. Around 15 per cent of the rainfed land was left fallow.

6.3.1.1 Sericulture

In sericulture, most of the farmers have taken up new and the latest mulberry variety and silkworm hybrids in the study area. About 87 per cent of the mulberry area is under V1 variety with remaining 13 per cent was covered by mainly K2 and to some extent S36 variety. Out of the four sample districts, Kolar district had replaced almost all the area under mulberry by V1 variety (98.95 per cent) followed by Belgaum district (93.62 per cent). Mandya and Chitradurga districts were having 85.42 per cent and 72.51 per cent of mulberry area under V1 variety.

In the sample of 120 farmers, 38 farmers reared both BV and MV hybrids, 79 farmers reared only MV hybrid and only 3 farmers that too in Belgaum district reared only BV hybrid. Of the total DFLs reared by sample farmers in Karnataka, only 18.57 per cent accounted for BV hybrid DFLs. Belgaum farmers reared more of BV hybrids (37.86 per cent) followed by Chitradurga (21.47 per cent). Traditional districts reared comparatively lesser percentage of BV hybrids.
6.3.2 SPATIAL, SEASONAL AND TEMPORAL VARIATIONS IN SERICULTURE IN KARNATAKA

Spatial, seasonal and temporal variations in different parameters of sericulture in Karnataka were analysed using secondary data collected from the Department of Sericulture, Govt. of Karnataka. Sericulture being sensitive to climatic factors there is seasonal and spatial variation in productivity and crop uncertainty. Traditional districts of sericulture show better rearing performance but uprooting is more as these districts are near to big cities where real estate prices are escalating and facing labour problem. The seasonal variation in mulberry performance indicated that uprooting is taking place during the month of March, April and December. The favourable season for new plantation is from July to October. Crop uncertainty was high in the case of bivoltine cross (BV) compared to multivoltine cross (MV). Uncertainty also varied over different seasons and races. The productivity also varied with the seasons and races.

The temporal performance was studied from 1970-71 to 2007-08. The data indicated that there was rapid growth in sericulture with certain fluctuations till 1994-95. Thereafter, the mulberry area and cocoon production declined. The productivity of cocoons increased significantly over the period. Because of technological improvements and introduction of new bivoltine silkworm (CSR) hybrids the renditta decreased tremendously. Hence, the declining trend did not affect silk production much. The silk production varied marginally from 1994-95 onwards with insignificantly negative growth rate.

6.3.3 YIELD VARIATIONS OF THE SAMPLE FARMERS IN SERICULTURE

A maximum number of farmers (39.17 per cent) were obtaining mulberry yield range of 25-35 MT per ha per year and 15.83 per cent of the farmers
obtained the yield in the lowest range of 15-25 MT per ha per year. Majority (about 70 per cent) of the farmers were obtained below average yields. The coefficient of variation of mulberry yield of the farmers of Karnataka was higher (36.17 per cent) indicating higher mulberry yield variations. This leaves lot of potential for exploitation of mulberry yield which ultimately decides the cocoon production and productivity through proper extension and support system.

In the case of silkworm rearing the frequency of the farmers obtaining the below average yields were higher in both BV and MV cocoon production. About 25 per cent of BV farmers and 30 per cent of MV farmers obtained the average yields. Few traditional farmers excelled with potential yield of BV hybrid. Few Belgaum and Kolar farmers excelled in MV rearing.

6.3.4 YIELD GAP AND YIELD UNCERTAINTY IN SERICULTURE

Despite the development of high yielding mulberry varieties and silkworm races, the farmers are unable to attain the potential research yield. The present study analyses the total yield gap into three different gaps (yield gap-I, yield gap-II and yield uncertainty).

A wider total yield gap was observed in mulberry leaf production (47.46 per cent) compared to silkworm rearing and cocoon production (mainly MV) which was only 14.46 per cent. A high yield gap-I (33.40 per cent) was observed in mulberry with yield uncertainty of 12.42 per cent. Mandya district showed highest yield gap-I (45.38 per cent per crop and 38.93 per cent per year) and Belgaum district showed the least yield gap-I (10.94 per cent per crop and 28.75 per cent per year) followed by lesser yield gap of 29.41 per cent per crop and 28.19 per cent per year in Kolar district. This indicates the efficiency of Belgaum farmers in mulberry cultivation. The variation in the natural resources like soil, water and climatic changes are mainly responsible for higher yield gap-I.
in mulberry. Yield gap-II in mulberry was only 9.92 per cent. Yield gap-II and uncertainty were higher in the case of Belgaum and Mandya districts as these two district suffer mainly from variation in water supply i.e. water shortage in Belgaum district especially during summer season and water logging in Mandya district during rainy season.

In the case of silkworm rearing and cocoon production, the yield gap was higher in BV compared to MV cocoon production. Multivoltine hybrids form the major portion of the total cocoon production, the total yield gap in MV hybrid was 14.46 per cent which was mainly due to uncertain factors to the extent of 9.24 per cent. Yield uncertainty (MV) was higher in Belgaum and Mandya district (10.47 and 10.37 per cent respectively) which may be due to climatic variations. Yield uncertainty was higher in BV hybrid than in MV hybrid cocoon production.

6.3.5 UNCERTAINTY IN SERICULTURE

Sericulture suffers from different uncertainties from mulberry leaf production till the cocoons are marketed. Total uncertainty in sericulture is worked out to be 35.12 per cent. Mulberry showed highest yield uncertainty (12.42 per cent) followed by cocoon yield uncertainty (9.71 per cent) and price uncertainty (9 per cent). The uncertainty due to crop failures was around 4 per cent (crop uncertainty). Total uncertainty was highest in the case of Mandya district (46.12 per cent) which is mainly attributed to soil and water logging problems apart from negligence of the farmers from mulberry cultivation till marketing of cocoons as they have better alternate crops like paddy and sugarcane. Farmers of Chitradurga suffered least uncertainties (29.88 per cent) as they had advantages of sparsely distribution of sericulture crops which avoid spread of diseases and advantage of marketing with equal proximity to the
major markets which reduced the price uncertainty. Higher uncertainties were observed in bivoltine compared to multivoltine sericulture.

Analysis of the factors that influence uncertainty indicates that labour is the major problem in sericulture. Timely supply of labour with better skills would improve the crop and reduce uncertainty. Assured and dedicated labour especially involvement of much family labour with continuous supervision would reduce uncertainty in sericulture. Importance need to be given for cultivation of mulberry especially in avoiding mulberry pests like bihar hairy caterpillar, army worms which need to be identified in the initial stage (especially eggs) and physically destroy them. Apart from this water conservation measures especially in Belgaum district and providing better drainage especially in Mandya district would reduce uncertainty in mulberry and increase yield levels. In the case of cocoon production, the selection or supply of quality of the eggs is very important which would reduce both crop and cocoon yield uncertainties. The diseases and pests (uzi fly) in silkworm rearing have to be controlled with proper preventive measures like timely disinfection and bed disinfection. The price uncertainty can be overcome by keeping an eye on market information and selection of proper market which would significantly contribute to increase the profitability in sericulture.

6.3.6 INPUT-OUTPUT GAP IN SERICULTURE

6.3.6.1 Input-Output gap in mulberry

It was observed that the average application of chemical fertilizers N, P and K in the farmers fields were comparatively lesser than the research recommendations. Further, the proportion of N, P and K applied were not on par with the proportion recommended as indicated by the disproportionate percentage gap (54.6, 37.06 and 22.75 per cent respectively). Use of nitrogen
was very less compared to the recommendations (45.40 per cent). Application of FYM was around 7 per cent more than the recommended. Labour was being used 30 per cent less than the recommended. It has been observed that farmers avoid lot of cultural practices (cleaning, pruning of side shoots, plucking of unhealthy leaves etc.) which demand more labour. Further, timely supply of labour is a major problem for the villagers and labour for mulberry competes with the labour for other agricultural crops. Sub-optimal use of inputs and labour in mulberry has resulted in mulberry leaf yield which is almost 50 per cent of the potential yield of 70 MT per hectare per year.

Comparing the sample districts under study, Mandya farmers applied less quantity of NPK followed by Belgaum farmers. Kolar farmers applied higher doses of NPK and higher quantity of FYM compared with other districts. The analysis of input use per crop indicated that the Belgaum farmers employed relatively more labour than other districts. Labour employed for mulberry was least in the case of Mandya district. High leaf yield per ha per crop of 9 MT per ha per crop was observed in the case of Belgaum farmers which is mainly due to the higher labour employed in monitoring their garden. Higher mulberry leaf yield per ha per year and per crop in the case of Kolar farmers was mainly due to higher doses of inputs (i.e. both chemical fertilizers and FYM). The yield level was low for Mandya district which was mainly due to application of lower doses of fertilizers and use of less labour. Kolar and Belgaum farmers are blessed with fertile soils which are very much suitable for mulberry cultivation. Chitradurga farmers do not possess much fertile soils apart from that they have scarcity of water which may be the reason for lower yields.

6.3.6.2 Input-output gap in cocoon production

In the case of cocoon production, the disinfection chemicals (Chlorine-dioxide, Bleaching Powder, Lime powder) being used by the farmers were not as
per the recommendations. Chlorine-di-oxide was being used less than the recommended dose but was being compensated by the use of Bleaching powder which may be because of the cost of the inputs. Bleaching powder is cheaper, but the effectiveness of Chlorine-di-oxide is relatively better and has less corrosive effect. Use of lime powder was on par with recommendations. Bed disinfection chemicals are being used almost 50 per cent less than the recommended. Rearing space provided was more than recommended and labour was also being used around 40 per cent more than research estimations. Higher use of labour than recommended may be because of the fact that most of the silkworm crops are taken up in and around the dwelling houses. The family women labour is involved in rearing who take care of rearing along with other activities.

The results were similar in all the four districts except some variations as discussed below. The Belgaum farmers used less of disinfection chemicals i.e. Chlorine-di-oxide but the use of bleaching powder was as per the recommendations. Employment of labour per 100 DFLs was very high in the case of Mandya farmers followed Belgaum farmers. The efficiency of labour use was observed in the case of Chitradurga farmers who employed relatively lower mandays but higher than research estimations. Further, Chitradurga farmers provide wider space which was around 60 per cent higher than the recommended. While, Kolar farmers provided less space than recommended.

6.3.7 RESOURCE USE EFFICIENCY AND TECHNOLOGICAL GAP IN ANTICIPATED AND ACTUAL YIELDS IN SERICULTURE:

In the case of mulberry, the models explained 66 per cent and 60 per cent of the variation in the anticipated and actual yields respectively. Further, the MPPs and MVPs were worked out for different inputs. The MVP indicated that mulberry yield responds economically well to chemical fertilizers and FYM.
with values more than Rs. 1 per rupee of investment in these inputs. The MVP of labour was economically lower (0.54) indicating the inefficiency; but the importance of labour in mulberry cultivation cannot be ignored. The inefficiency of labour may be due to higher cost, lower efficiency and untimely supply of labour. The neutral technological gap was 19.28 per cent which was more than the total gap in the yield (15.11 per cent) and the $R^2$ value was higher for anticipated yield as against the actual yield function. This indicates that there were more of yield uncertainties than anticipated in mulberry leaf production.

In the case of silkworm rearing and cocoon production, the MVP for labour was very much less and was only Rs 0.18 per rupee invested indicating the inefficiency in the use of labour input. A high MVP of Rs. 9.56 per rupee invested in bed disinfectant followed by an MVP of Rs. 1.21 (more than 1) in the case of general disinfectants indicates the importance of these inputs in silkworm rearing. The MVP at factor inputs for leaf and rearing space were positive indicating the significant contribution of these inputs in the cocoon productivity. Use of recommended quantity of bed disinfection chemicals and general disinfectants in relation to the higher rearing space provided by the farmers would improve the cocoon productivity. The quality of mulberry leaf is having positive MPP and MVP (at factor input) indicates that mulberry productivity and quality leaf would improve cocoon productivity both per 100 DFLs and per ha.

Technological decomposition analysis indicate that the anticipated cocoon productivity due to leaf did not materialize in the actual yield levels as indicated by the high positive non-neutral technological difference (31.44 per cent). This may be mainly due to the uncertain factors that operate in the mulberry leaf production. The technological inefficiency in leaf is compensated by the more efficiency than anticipated in other inputs resulting in the technological efficiency of actual yield over anticipated. Bed disinfection
chemicals, rearing space and labour expressed relatively higher efficiency than anticipated. The production function of actual yield was having significantly higher returns to scale and higher R² value indicate that apart from uncertainty in cocoon production, the higher level of anticipation (anticipational error) has influenced the gap which is being reflected in the neutral technological gap.

6.3.8 DIRECT AND INDIRECT EFFECTS OF DIFFERENT INPUTS IN SERICULTURE

Path coefficient analysis was employed to delineate the direct and indirect effects of different inputs in mulberry as well as silkworm rearing. In mulberry cultivation, the total effect of FYM is highest as indicated by the highest correlation coefficient with yield (0.726) compared to other inputs followed by labour (0.599). Further, FYM (78.08 per cent) has the highest direct effect followed by labour (69.08 per cent). The indirect effects are more among N, P and K themselves, indicating that these inputs perform better in proper combination. FYM being a wholesome input works more independently and effectively as it is having most of the nutrients required for the plant growth in proper proportions. Mulberry cultivation responds more directly to the human labour (69.08 per cent). The indirect effect is mainly thro' the application of FYM. Increased application of FYM invites more labour for its application and the problems of weed that arise out of application of FYM.

In the case of silkworm rearing, the bed disinfection chemicals was having higher total effect followed by rearing space and labour as indicated by the correlation coefficients (total effect). Apart from this they have higher direct effect. Increase in rearing space reduces the effect of disinfection chemicals to a greater extent and bed disinfection chemicals to some extent as indicated by the negative indirect effects. The direct effect of leaf is very less (11.58 per cent). Better quality of leaf would be the prime factor which improves the
immunity of silkworm towards diseases and increases the response to disinfection chemicals and other inputs as indicated by higher indirect effects (88.42 per cent).

6.3.9 KNOWLEDGE AND ADOPTION OF SERICULTURE PRACTICES OF THE SAMPLE FARMERS

Sericulture farmers of Karnataka state have better knowledge and adoption of silkworm rearing practices compared to mulberry cultivation practices. In the case of mulberry cultivation, the farmers lack knowledge and adoption of proper dose of chemical fertilizers, mulberry training practices and use of proper micronutrients for production of quality leaf. Farmers of Belgaum district had comparatively better knowledge and adoption level of mulberry cultivation practices.

In the case of silkworm rearing farmers have lesser knowledge and adoption of chawki rearing practices and use of rotary mountages. District-wise analysis indicate that Kolar and Belgaum farmers had better knowledge and adoption of silkworm rearing technology followed by Chitradurga farmers.

6.4 CONCLUSIONS

Sericulture is the major crop of sample sericulturists in the study area. Plantation crops mainly sugarcane and coconut and cereal crops mainly paddy and maize form the alternate crops to sericulture. For Kolar sericulturists, sericulture was the major crop (81.37 per cent). For Mandya sericulture farmers, sugarcane and paddy were the alternate crops next to sericulture. Coconut is the major crop next to sericulture for Chitradurga farmers. In the case of Belgaum sericulture farmers, sugarcane and maize formed the major alternate crops. Sericulture farmers in the study area cultivate mainly V1 variety
of mulberry. They rear both bivoltine and multivoltine hybrids. Around 80 per cent of the silkworms reared were multivoltine hybrids.

Karnataka is the leading sericulture state in the country, with 94 per cent of the cocoon production is from the southern traditional sericulture districts. Sericulture was practiced on marginal rainfed lands at subsistence level during 1970s. Over the years with the support of R&D, the potential high yielding mulberry varieties and silkworm races were developed. Eventually, sericulture was shifted to more productive and irrigated lands giving commercial status. There was rapid growth in sericulture upto 1994-95. Later, sericulture showed declining trend. Uprooting of mulberry especially in the traditional districts of the state due to urbanization is the major concern of sericulture development in the state. Non-traditional districts provided a ray of hope by taking up sericulture to some extent with low productivity level.

The study revealed that the productivity and quality of mulberry leaf is the most important factor in deciding cocoon production and productivity. Unfortunately, it was observed in the study area that the yield gap in mulberry is higher with higher yield gap-I and yield uncertainty. The main reason for the yield gap I is variation in the soil and climatic conditions over different regions. Yield uncertainty is mainly due to labour problem followed by water scarcity and water logging problems due to variations in the rainfall pattern and sudden outbreak of diseases and pests. Sub-optimal and disproportionate use of inputs along with labour problem contribute to yield gap II to a greater extent and yield gap I and yield uncertainty to some extent. Quality mulberry leaf can be obtained by applying more of organic manures like FYM, vermicompost, etc. to supply required micro and macro nutrients in proper proportions and to maintain soil health in the long run. Use of chemical fertilizers should be restricted to supplement the shortage after application of organic manures.
The macronutrients NPK need to be used in proper proportions as per the recommendations along with necessary micronutrients.

The yield uncertainty played a major role in the total yield gap in silkworm rearing and cocoon production. Except mulberry leaf, all other inputs in silkworm rearing do not have direct relation with the productivity of cocoons and form supplementary inputs. Assuming that quantity of mulberry supplied to silkworm being maximum and constant as silkworm feeds continuously and voraciously during the rearing period, supplementary inputs like disinfection and bed disinfection chemicals help to prevent and control of diseases in silkworm. Effectiveness of these inputs depends on variation in the disease incidence and resistance power of the silkworm. Variation in disease incidence further depends on the variation in climatic and environmental conditions that support pathogens. Hence, yield uncertainty plays major role. Use of quality mulberry leaf brings up the robust silkworm with disease resistance. Use of recommended disease control measures especially bed disinfectants which is being used almost 50 per cent of the recommendations would help to combat cocoon yield gap in general and yield uncertainty in particular.

Apart from yield uncertainty both in mulberry and silkworm rearing, silkworm crop uncertainty and price uncertainty affect the profitability in sericulture. Total uncertainty in sericulture is worked out to be 35.12 per cent. The empirical analysis, the opinion analysis and the informal discussions reveal that labour problem which is the major cause for yield gap, uncertainty and the declining trend in sericulture in the State. The supply of poor quality silkworm seed (eggs) forms the next major reason for yield uncertainty and crop uncertainty. The quality egg followed by efficient chawki rearing (producing healthy chawki worms) would be the prime factor next to quality leaf for overcoming yield gap and yield uncertainty in cocoon production. The responsibility of the farmers does not end with the mulberry cultivation,
silkworm rearing and production of cocoons. Efforts to have market information and selection of proper markets would help to combat price uncertainty to some extent. Further, it can be concluded that uncertainties in general cannot be controlled but can be understood and managed to bring down their influence in the production and profitability.

The resource use efficiency analysis revealed that labour productivity in sericulture is economically low and inefficient. Labour productivity (MVP) in silkworm rearing is comparatively lower (Rs. 0.18 per rupee invested) than in the case of mulberry cultivation (Rs. 0.54 per rupee invested). Lower productivity of labour in silkworm is due to comparatively higher use of labour than estimated supporting the theory of law of diminishing marginal productivity. Lower use of labour in mulberry is mainly due to lower productivity. Rearing of silkworm being sensitive activity, most of the operations are inevitable with the higher labour use with lower productivity. Farmers avoid certain operations in mulberry cultivation with lesser use of labour than estimated due to lower productivity of labour. Hence, availability of productive labour is the prime factor that decides the adoption of different technologies to attain the potential yield in sericulture.

6.5 POLICY IMPLICATIONS

1. Karnataka is showing a declining trend with uprooting of mulberry. Presently, non-traditional areas of Karnataka are the ray of hope. Hence, sericulture needs to be extended to non-traditional areas bit away from the influence of urbanization for sustenance. In this regard, a region specific perspective plan for development of sericulture in the state especially for non-traditional areas needs to be developed considering the technology, cropping pattern and socio-economic characteristics of
the farmer. The plan has to strive for the sustainable development of sericulture in the state.

2. The domestic demand for silk in India is almost 26,000 MT per year; whereas, the current production is around 16,000 MT. The potential demand supported by modern technology and infrastructure, especially in Karnataka call for better expansion and growth in the industry.

3. Sericulture fits to wide range of socio-economic conditions of the farmers and entrepreneurs with much economic advantages. The extension planning should focus on covering different socio-economic categories i.e. from subsistence farming to corporate sericulture; from poor soils and barren lands (tree cultivation) to fertile and irrigated lands. Technology package for such differentiated requirements need to be developed. This would help in increasing the total production through horizontal expansion.

4. High amount of untapped potentiality exists in sericulture especially in mulberry leaf production. Vertical expansion in sericulture can be attained by exploiting the potentiality. Mulberry needs to be given utmost priority as the yield gap is very high. The quality and quantity (productivity) of mulberry has direct bearing on the cocoon productivity and overcoming uncertainty in cocoon production. Importance need to be given more for transfer of technology to boost vertical expansion in sericulture.

5. The organic manures need to be extensively used to meet the nutritional demand of mulberry garden for quality leaf. The fertilizers N, P and K need to be used in proper proportion to the recommendation for obtaining higher productivity and quality in mulberry. Further, for proper
recommendations, soil testing needs to be done regularly at least once in two years.

6. Training of mulberry by removing side branches and keeping the garden clean demands higher labour which needs to be undertaken for improving quality and productivity of mulberry leaf.

7. Labour is the important input in agriculture in general and sericulture in particular which influences all other operations and input use. Ensuring dedicated and productive labour especially family and permanent labour would help to exploit the potentiality in sericulture.

8. R&D in agriculture and rural labour management needs to be given importance and the same should become one of the management input to be transferred to the farmers. The government and/or the policy makers have to come forward and plan programmes to sustain labour productivity. Skill development programmes in agriculture / sericulture have to be included in the development plans.

9. Pests like bihar hairy caterpillar and army worms lay eggs in masses in the garden especially beneath the leaf and attack in swarms in an uncontrolled manner. Constant observation of the garden for the same may help to collect such egg masses and destroy them. This would certainly reduce uncertainty in mulberry due to these pests.

10. Water conservation measures in water scarcity areas as in Belgaum district and providing better drainage system in water logging areas like in Mandya district would reduce uncertainty in mulberry and increase yield levels.
11. The silkworm rearing is mainly influenced by yield uncertainty. In order to overcome uncertainty in silkworm rearing, timely and efficient application of disinfection and bed disinfection chemicals is very important along with optimum use of these chemicals. Further, these chemicals need to be applied in proportion to the rearing space provided.

12. In the case of cocoon production, the production and supply of quality of the eggs is important to reduce both crop and cocoon yield uncertainties. The seed legislation should ensure the production and distribution of quality layings to the farmers.

13. Informal observation in the field revealed that rotary mountages have significant role in production of quality cocoons with significant improvement in the productivity. Farmers get 5-6 per cent higher productivity with 5-10 per cent higher price for their produce. The rotary mountages are short in supply. The government needs to arrange for availability of the same along with extension support.

14. Further, it was observed informally in the field that farmers who are practicing organic farming with zero chemicals were able to attain higher quality and productivity with least uncertainties. Hence, organic farming technology may be popularized directly or after fine tuning it.

15. The price uncertainty can be overcome by keeping an eye on market information and selection of proper market which would significantly contribute to increase the profitability in sericulture.