AN ECONOMIC ANALYSIS OF MULBERRY CULTIVATION, PRODUCTION AND MARKETING OF SILK COCOONS IN NORTHERN KARNATAKA

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1. INTRODUCTION

India is mainly an agriculture based country with 65 per cent of its population dependent on agriculture for their livelihood. Further, about 70 per cent of the people live in rural areas and more than 40 per cent of the rural population still lives below the poverty line. In developing countries like India, the small sized holdings owned by a large proportion of farmer's in the absence of alternative sources of income and employment. It is considered as one of the main factors causing rural poverty and hindering agricultural growth. Small holders are able to realize only a part of the production potential due to physical, technological and institutional constraints. Government of India is committed to provide employment guarantee to one person from each family of below poverty line in the rural areas. Further, in order to control migration of rural poor to urban places, Government of India has been encouraging regular income and employment oriented farming approaches, one such potential farming enterprise is sericulture.

Sericulture is one of the important sectors of economy in India and plays an important role in poverty alleviation. Compared to agricultural crops, sericulture provides more employment round the year and fetches higher income to the rural farm families. Sericulture has been an important income generating cottage based industry in the country. This industry has been providing sustainable income for different strata of people in the rural society including the landless.

Sericulture is an important agro-based rural industry that helps rural economy and generates higher income and employment. It is practiced in a wide range of agro-climatic regions like forests, hilly areas and plains. In fact, the recent technological advancements have made it possible to practice it on an intensive scale, mainly due to increased profits obtained from it as compared to most of the crops and enterprises.

China, the leading producer of silk in the world produced silk to the tune of 1,04,000 metric tonnes during the year 2009-10 accounting for 81.89 per cent of the world's silk out put. India is the second largest producer of raw silk with an area of 1,83,773 lakh hectares under mulberry cultivation and production of 19,690 metric tones thereby accounting 15.5 per cent of the total global raw silk production during the year 2009-10. India has unique distinction of being the only country in the world which produces all the known commercial varieties of silk – mulberry, tropical tasar, temperate tasar, eri and muga.

Sericulture is a cottage industry and one of the most labour intensive sectors in Indian economy combining both agriculture and industry. Sericulture is practiced in over 60,000 villages in India. In Karnataka, it is practiced in 19,868 villages and sericulture industry provides direct employment and livelihood to more than 11 lakh persons engaged in different sericultural activities like mulberry cultivation, silkworm rearing, silk reeling, twisting, dyeing and weaving.

Sericulture industry supported by way of providing employment to six million rural people in our country. The majority of them belong to the economically backward sections of the society, as well as to the scheduled castes, schedule tribes and adivasis. From the cultivation of mulberry on one acre of land to the final silk weaving stage creates 1,000 man days of employment. Sericulture in India has turned out to be a highly remunerative enterprise with minimum capital base and yielding reasonably good returns vis-à-vis other enterprise. It is one of the most stable enterprises which provides regular flow of returns in the tropical states of the country throughout the year.

Mulberry silk is produced from silkworm (*Bombyx mori* L.) which feeds on mulberry leaves. Silkworm rearing is location specific, requires temperature ranging from 70^0 F to 85^0 F, humidity in the range of 60 to 80 per cent and the annual rainfall of about 600 mm found suitable for cultivation. Silkworms produce the cocoon in about 25-30 days, after which worms spin cocoons. These cocoons are sold to the reelers at the regulated cocoon markets. The reelers convert them into silk yarn. In the major silk producing states, there are well established cocoon markets for the sale of cocoons. The reeled silk is bought by weavers and this transaction takes place through the silk exchanges.

Sericulture industry concerned with the production of silk is divided into seven phases, *viz*., cultivation of mulberry, silkworm seed production, rearing of silkworm, reeling of raw silk twisting, dyeing and weaving of silk. Cultivation of mulberry and rearing of silkworms are the farm based activities managed by the silk cocoon producers. It is possible to harvest four to seven crops per year in the tropical areas. Although, sericulture has been practiced on small or medium sized holdings in our country, the remunerative return from sericulture has enabled a few large-scale ventures also.

Mulberry leaves form the major share of the cost of cocoon production. Production of the silk depends upon the quality and quantity of the silk cocoon produced and which in turn depends on mulberry leaves produced.

Sericulture in Karnataka has 200 years history. It was introduced by King Tippu Sultan who needed high value, low volume commodities to trade with Europe in exchange for arms and ammunitions. Sericulture took its roots in Karnataka due to the meticulous care taken in its propagation by him. The rulers succeeding him in Mysore also continued the royal patronage to this activity. Subsequently, the British encouraged the production of mulberry silk in Mysore and Kollegal areas which were then in the Madras province. Though Kashmir and West Bengal were the leading sericultural states in India in the past, later Karnataka became the leading producer of silk and currently accounting for 44.09 per cent of the mulberry silk production in the country. This was possible because of a conducive climate, institutional support and planning and the traditional skills of the farmers.

Since sericulture is a state subject, Government of Karnataka launched intensive programmes like, Karnataka Sericulture Project with the assistance from the World Bank to develop sericulture industry in the state. The idea was to expand the production base and to provide a sound infrastructure to the industry.

A large chunk of labour is employed in all the sericulture based activities and the industry is a boon to the labour-surplus countries like India. Sericulture also employs a sizeable share of women labour. The women participation in sericulture ranges between 55 and 60 per cent. Due to the significance in the economy, the year 1994 was observed as “The Year of Women in Sericulture”.

Out of the total silk production in the country, about 45 per cent is accounted by Karnataka, it was followed by Andhra Pradesh, West Bengal and Tamil Nadu. The five traditional states where sericulture is practiced are Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu and Kashmir. These states together accounts for most of the mulberry silk production in the country.

The area under mulberry in Karnataka during 2010-11 accounted for 62,697 hectares and with 52,708 tonnes of silk cocoons. In Karnataka, more than 1.26 lakh families are depending on sericulture and more than 7430 reeling families converts the cocoons to 7338 MT of silk yarn. Remunerative prices for silk cocoons gave an impetus and farmers who had uprooted mulberry also returned to replant mulberry many times.

The budget for 2011-12 is considered as agriculture budget and several beneficiary oriented schemes for farmers were announced. However, sericulture sector is denied of the benefit by announcement of reduction in customs duty in the union budget. Once the prices of cocoons and raw silk reduced, there was a large-scale uprooting of mulberry in the sericulture belts of Karnataka which resulted in drastic decline in raw silk production in turn increased the gap of demand and supply of silk.

Therefore keeping this in view and the importance of the sericulture industry, its contribution to the farm economy, the present study was undertaken to analyse the various aspects of production of mulberry cocoon and cocoons marketing by farmers. Hence, the present study was conducted with the following specific objectives.

1. To analyze trends in mulberry area and cocoon production in Karnataka.
2. To workout costs and returns in mulberry cultivation and cocoon production.
3. To study the costs incurred by farmers in marketing of cocoons.
4. To document constraints in the cultivation of mulberry production and marketing of cocoons.

Hypotheses

1. Area under mulberry and silk cocoon production has been increasing over the years.
2. Production of mulberry and silk cocoon is profitable to the farmers.
3. Cost of marketing of cocoons varies across the districts.
4. Farmers have constraints in the production of mulberry, cocoons and in cocoon marketing.

Importance of the present study

Karnataka accounts for 56.85 per cent of the country's cocoon production and in the vertex of the silk map. In the state, about three lakh families are engaged in mulberry cultivation and 22 lakh people in the silk yarn reeling industry. The Karnataka Silk Marketing Board has been designated as the intervening agency to purchase raw silk from the open market. In Karnataka, sericulture is highly concentrated in the southern districts of Kolar, Bangalore, Chikkaballapur, Ramanagar, Mandya, Mysore and Chamarajanagar which are regarded as traditional sericultural districts. Of late it has been practiced extensively in the non-traditional areas of Northern Karnataka as well. There is an ample scope for the further development of sericulture in the northern districts of the state due to favourable natural endowments. Sericulture is rapidly progressing in Belgaum and Bagalkot districts with a mulberry area of 443 and 370 hectares and a cocoon production of 256 tonnes and 124 tonnes, respectively during 2011-12. From the point of view of farmers, there is a need to find ways of obtaining higher net returns from the sericulture enterprise. In this direction, the study on economic aspects of mulberry cultivation and silk cocoon production assumes utmost importance. There are no studies conducted, as yet in Belgaum and Bagalkot districts on the economics of sericulture. Such studies, besides being useful to the existing silk cocoon producers, are also useful to prospective farmers who intend to venture in its production and also for commercial banks and other financial institutions in estimating the credit requirements for mulberry cultivation and silk cocoon production. The results of the study would also be helpful in formulating strategies for employment opportunities.

Limitations of the study

Mulberry leaf production in this study is essentially the yield as measured through it's harvest and utilization in cocoon production. Unlike other crops, ready mulberry plots are not cleanly and completely harvested; some leaf remains behind in the plot either due to the under-sizing of the quantity of layings reared or earlier completion of rearing or rapid disperse of pests and diseases to silkworms *etc.* such surplus leaf if not used for another rearing is usually fed to cattle and this utilization is covered under 'leaf-fodder' in the study.

The leaf produced by the farmers is mainly used in his own cocoon production and very small proportion of it is sometimes lent freely to other farmers in the periods of shortages. Hence, the price of the leaf in the study is assumed one, arrived at in consensus with the farmers. Returns from mulberry cultivation are thus purely hypothetical. The actual profitability may be different if actual sale and purchase of leaf were to occur in production area.

The year to year wide variation in yield is a common phenomenon observed in mulberry crops and silk cocoon production. The major factors influencing this phenomenon include, climatic variations, occurrence of pest and diseases, variations in inputs used and the quality of mulberry leaf grown and fed to the silkworms.

The average yield of only one year was considered in the study and the study has not taken into account the extent of variations caused by these factors on the productivity levels.

The average prices realised by sericulturists during the study year was calculated and used in converting production figures from quantities to value term, although the prices realised would be different from crop to crop and farmer to farmer every year.

The production life of mulberry garden was taken to be 15 years even though the garden life could be extended beyond through better management.

Presentation of the study

The study has been presented in six chapters. Chapter-1 outlines the special features of sericulture enterprise, brief history, nature and importance of the study, specific objectives and limitations of the study.

Chapter-2 briefly looks at the relevant studies conducted in the past on trends, costs and returns, and constraints in sericulture.

Chapter-3 comprises the methodology followed in the study area beginning with the description of study area, the sampling design, the concepts used and the method of evaluation of inputs. The characteristics of the functional forms used in the analysis have also been explained.

Chapter-4 presents the results obtained from the study in tabular forms, accompanied by explanatory notes.

Chapter-5 discusses the results of the study and an attempt to discern the cause-effect relations possibly exists therein. The results are also discussed in comparison with other relevant studies wherever possible.

Chapter-6 presents the summary of the results of the study and explains how far the objectives of the study have been fulfilled and hypotheses justified. It also puts forward the relevant policy implications.

Plate 1 : View of mulberry garden

Plate2 : View of rearing house with shelves

Plate 3: View of feeding method to silkworms

Plate4: Chawki rearing tray

Plate 5: Plastic collapsible mountages

2. REVIEW OF LITERATURE

Review of literature gives the guidelines from the past researchers and provides a foundation to the theoretical framework for the present investigation. The review of the past literature makes the investigator to get an insight into the methods and procedures to be followed. The available literatures relevant to the objective of the present study were reviewed. The literature directly related to the current research is rather limited. So, the studies related to the other crops or technologies were reviewed and highlighted under the following headings.

2.1 Trends in mulberry area, production and productivity of silk cocoons.

2.2 Costs and returns of mulberry cultivation and cocoon production.

2.3 Allocative and use efficiency of resources in sericulture.

2.4 Marketing of cocoons and other related crops

2.5 Constraints involved in sericulture.

2.1 Trends in mulberry area and production of silk cocoons

Parathasarathy (1984) measured the growth rates and instability in agricultural production for different districts of Andhra Pradesh. He used Schultz's (1953) year-to- year variation as one of the approaches to measure instability. The study concluded that the degree of instability in agricultural production was high in all districts. It was higher for food grains than for 'all groups'. The districts of north coastal Andhra combine high instability with low growth. Nalgonda district in Telungana was rather unique in having experienced high growth rates of production with low instability. The post green revolution period showed a higher degree of instability. The districts which achieved higher growth rates were also subject to greater instability.

Lakshmanan and Thiagarajan (1989) indicated that 90 per cent of the silk was grown in south India and mainly in Karnataka. The compound growth rate for mulberry silk production, acreage and yield in India for the period 1971-72 to 1985-86 were estimated at 4.0, 2.6 and 1.6 per cent, respectively. The area under mulberry increased from 1.05 lakh acres in 1971-72 to 2.18 lakh acres in 1985-86 while, the raw silk production increased from 2046 tonnes to 7029 tonnes over the period. Karnataka was found to account for 61.2 per cent of total raw silk production in the country.

Thangamuthu and Venkataravi (1989) made an analysis of trends in mulberry cultivation, cocoon production and the reeling of raw silk for the period of 1979-80 to 1986-87 in their study on assessment of the potentialities in sericulture in Tamil Nadu; found that there was a substantial increase in the area under mulberry cultivation resulting in an increase of about 40 per cent per annum in cocoon production. They stated that the state's weaving sector had not developed in line with raw silk production, resulting in almost half the silk being exported to neighbouring Karnataka. They also estimated that the development of the weaving sector could result in the generation of direct employment for more than 8000 persons.

Lakshmanan and Thiagarajan (1991) reported that Karnataka accounted for 58 per cent of total production of mulberry silk in India. A steady increase in growth rate over the years except during the second plan period was observed. Component analysis was used to conclude that area effect played a major role in the growth of silk when compared to yield effect.

Raveendaran *et al.* (1993) reported that silk production in India registered a 6.6 per cent compound growth rate in recent years and the growth rate has been over 10 per cent. They concluded that silk worm rearing is one of the most profitable enterprises even for small farmers and therefore, efforts should be made by the Department of Sericulture to increase the area under mulberry where irrigation is available. Increased production of mulberry cocoons would lead the way to an increase in foreign earnings potential.

Raveendra *et al.* (1997) conducted a study on seasonal, spatial and temporal performance of sericulture in Hassan district of Karnataka. They reported that the average annual compound growth rate of productivity for bivoltine cocoons was 5.3 per cent.

Cocoon productivity for cross breed showed an insignificant growth rate. The total cocoon production trend registered an annual compound growth rate of 36.98 per cent.

Kuruvila (2001) studied the export performance of pepper during global scenario. The growth rate on pepper production and export were 0.66 per cent and 4.26 per cent, respectively. These growth rates were far below to Vietnam's growth rates of 13.40 per cent and 7.84 per cent in production and export during 1990-2000. However, Brazil, Indonesia and Malaysia had negative growth rates during the same period in respect of production and export.

Namasivayam and Richard Paul (2004) estimated trend in area, production and productivity of coconut in India for the period (1977-78 to 2001-02),the entire analysis was done in three phases for the overall period under study with 1977-78 to 1986-87 as Phase - 1,1987-88 to 1996-97 as Phase-2 and 1997-98 to 2001-02 as Phase-3. The trend in growth rate analysis revealed a positive growth in area, production and productivity over the years in first two phases, while, in the third phase, productivity was negative.

Sharma Amod and Kalita (2008) conducted a study on trends in area, production and productivity of major fruit crops in Jammu and Kashmir. Data pertaining to area, production and productivity of major fruit crops were collected from Horticulture Department of Jammu and Kashmir state for the period of 25 years from 1974-75 to 1999-2000. Linear, Quadratic and Exponential function were used for analysis of data. The results revealed a positive and significant growth rates in area, production and productivity for all the major fruit crops in the state.

Anil Kumar Yadav (2008) worked out compound growth rates for area under mulberry, production and productivity of silk cocoons in Kolar and Chikkaballapur districts of Karnataka during 1996-97 to 2006-07. The results revealed that area of mulberry and production and productivity of silk cocoons declined at the compound growth rate of 5.74, 4.26 and 3.96 per cent per annum, respectively.

Jose and Jayashekar (2009) in his study on growth trends in area, production and productivity of arecanut in India used time series data on area, production and productivity of arecanut for a period of 30 years, employed compound growth rate and linear regression to analyse the data. The findings revealed that during last 15 years due to favourable price, area has increased by more than two times and production by three times.

Sharad and Shekhar (2008) studied the status of silk production in India during the period 1980-81 to 2004-05. It revealed that the pattern of growth in area under mulberry cultivation has increased with significant rate of 0.25 per cent. The production and productivity of raw silk showed high significant growth of 5.06 per cent and 4.80 per cent, respectively. The production of raw silk has increased mainly due to high yielding mulberry varieties and silk worm breed.

Veeranagouda *et al.* (2011) studied the growth rate scenario of chilli in northern Karnataka. The study revealed that northern Karnataka as a whole registered positive compound growth rate for area (13.76 per cent), production (13.88) and productivity (12.20). These registered values were non-significant at both ten and five per cent level of significance.

2.2 Costs and returns of mulberry cultivation and cocoon production

Nanjareddy *et al.* (1971) reported that the total cost of silkworm rearing was Rs. 9,205.75 per hectare. The gross and net returns per hectare were Rs. 16,878.80 and Rs. 7,673.10, respectively.

Kasiviswanathan and Krishnaswamy (1972) compared the cost of silk cocoon production under farmer’s practices and under recommended package of practices. By adopting recommended package of practice, the cost of cocoon production was reduced from Rs. 7.46/Kg to Rs. 4.90/Kg.

Venkataram (1974) reported that the net income from one hectare of sericulture in irrigated land was about Rs. 12,500 or about four times the income possible from one hectare of the same under rainfed conditions.

Improved practices were found to reduce the cost of production of mulberry leaves from Rs. 0.25 to Rs. 0.16 per kg. Rearing bivoltine according to recommendations increased the annual income from Rs. 6,000 to Rs. 27,500 per hectare.

Nataraja and Thomas (1976) based on their survey in 15 villages of Karnataka reported that the yield of bivoltine breeds, multivoltine hybrids and traditional hybrids were 31 kg, 27 kg and 21.5 kg per 100 dfls, respectively and gross income obtained from these races were Rs. 900, Rs. 780 and Rs. 450 per 100 dfls in that order.

Murthy (1977) conducted a study in Devanahalli taluk of Bangalore district, which revealed that the cost of cocoon production per annum was Rs. 14,082 with 93 per cent of it being operational costs. An average of 4,749 layings was reared per hectare per annum, obtaining 1128 kg of cocoons. The net returns per hectare were Rs. 8,203. Mulberry cultivation and cocoon production employed 375 and 642 man days, respectively and 53 bullock pair days. The proportion of family labour was 64 per cent. Rearing of five cocoons per annum proved more advantageous.

Sahabhalmik and Mukhopadhyay (1977) reported cocoon yield of 1,440 per hectare per annum in West Bengal. A total cost of Rs. 18,067.50 per ha was required for their production. The net profit was Rs. 4,292.50.

Ullal and Narasimhanna (1978) estimated the total cost of mulberry and cocoon production at Rs. 10,500 and Rs. 30,000.

Aiyaswamy (1980) in Coimbatore district observed the labour requirement at 607 man days and 827 woman days per hectare for the maintenance of garden and rearing of worms to produce 957 kg of cocoon. The cost of production of one kg of cocoon was Rs. 17.67, of which variable cost alone was Rs. 13.82. The net return from one hectare of cocoon production was Rs. 7,018.70.

Nanaiah (1981) reported that sericulture was a highly profitable enterprise in Karnataka and provided the returns throughout the year, earning a gross income of Rs. 15,450 per acre by rearing 1,313 dfls.

Jolly (1982) in a study conducted in Karnataka estimated the per hectare total cost, gross and net returns at Rs. 28,725, Rs. 55,200 and Rs. 26,275, respectively for cocoon production under irrigated conditions. Under rainfed conditions the per hectare cocoon production cost was Rs. 12,110 and the net profit was Rs. 5,390.

Neelakanta Sastry (1982) conducted a study in Chittoor district of Andhra Pradesh and reported that 2,968 dfls were reared per hectare utilizing 1,037.17 man days and 15.51 pair days of bullock labour. The total cost of cocoon production was Rs. 18,322 yielding 1.116.38 kg of cocoon and the production cost per kg was Rs. 16.41. The net income was Rs. 17, 843.22 per hectare.

Chandrashekhara Reddy (1985) conducted a study on economics of sericulture in Dharmapuri district of Tamil Nadu and reported that the cost of silk cocoon production per hectare was Rs. 29,930.65 in which the operational cost was Rs. 28,015.97 (93.60 per cent) and the fixed cost was Rs. 1,914.07 (6.40 per cent). The returns from silk cocoon (1,225 kg) and by-products like manure, gantu (wood) and stem was Rs. 49,992.90. The net return was estimated at Rs. 20,062.25 per hectare per annum.

Murthuza Khan (1985) in his study under irrigated sericulture in Bangalore district found that 780 bivoltine layings were reared per acre per annum using 11,472 kgs of leaf and there by obtaining 279 kgs of cocoons. Alternatively, 1,231 multivoltine layings were reared in an acre using 10,800 kgs of leaf and obtaining 429 kgs of cocoons on the process. Bivoltines consumed 1,470 kgs of leaf and yielded 30 kgs of cocoons per 100 layings, while, multivoltines consumed 877 kgs of leaf and yielded 35 kgs of cocoons per 100 layings. The net returns for bivoltines and multivoltines were Rs. 4,743 and Rs. 3,068 per acre. The labour utilized by either race was 578 man days per acre and the family labour proportion was 91 per cent and 99 per cent for bivoltines and multivoltines, respectively.

Hanumappa (1986) considering the period from 1979-80 to 1983-84 found that, in the inner non-traditional sericulture region containing Dharwad district, the leaf yield was 16,286 kgs per hectare in 1983-84.

One hectare of mulberry required Rs. 5,226 as operational cost and reared 2,166 crossbreed layings per annum. The cocoon yield was 453 kgs per hectare. The yield per 100 layings was 20.92 kgs for improved and 10 kgs for bivoltine races. The leaves consumed for 100 layings worked out 752 kgs. The gross cost, gross returns and net returns of silkworm rearing per hectare were Rs. 11,258, Rs. 11,950 and Rs. 692, respectively. Mulberry cultivation required 371 man days and silkworm rearing required 823 man days of labour, the proportion of family labour and hired labour in them being 41 per cent and 39 per cent, respectively.

Datta and Ravikumar (1988) worked out the rearing potential per acre using 200 layings, 800 layings and 1,000 layings for the first, second and from third year onwards after the establishment of mulberry garden. The operational cost for rearing 200 layings was worked out at Rs. 985 and 45 man days of labour were utilised for the rearing. The yield of cocoon at the rate of 35 kgs per 100 layings, combined with returns from by-products, namely mulberry twigs, bed refuse and worm litter produced gross receipts of Rs. 2,610, Rs. 14,440 and Rs. 18,115 in the first, second and from third year onwards of cultivation in that order. Returns over operational costs per acre were Rs. 3,608 for the second year and Rs. 5,848 from third year onwards while, the first year suffered a loss of Rs. 544.

Kerutagi (1991) estimated that the average yield of cocoons obtained from a hectare of mulberry crop in Bijapur district was 1,001.40 kg. The gross returns from silk cocoon enterprise was Rs. 88,961.96 per hectare and this included the value of cocoons (Rs. 84, 718.44), 20 cart loads of litter (Rs. 1,160), 67.64 cart loads of stalks (Rs. 1,054.32). The net returns from cocoon production amounted to Rs. 52,680.16 per hectare.

Lohar (1993) studied the cost and returns of silkworm cocoons and their marketing in Gadhinglaj and Wai Tahsils in Kolhapur region of Maharastra. The study revealed that the major items of rearing cost were the cost of mulberry leaves (Rs. 417.24) and labour (Rs. 387.75). The per crop average production of cocoons was 32.58 kg in Gadhinglaj and 32.42 kg in Wai Tahsils and Rs. 3,566.20, respectively. The total income at the overall level worked out to Rs. 2,451.64.

Yadaiah and Sarangapani (1994) studied the costs and employment generation in sericulture enterprise in Warangal district of Andhra Pradesh. The total employment generated was about 923.31 man days and the total cost was Rs. 13,902.57 per hectare. Sericulture was found to be the most beneficial enterprise in those drought prone areas.

Jagannathan (1995) studied the cost and returns structure and employment generation in sericulture enterprise in Coimbatore district of Tamil Nadu. The study revealed that the cost declined with the increase in size of the farms (marginal, small, medium and big). The cost incurred ranged from Rs. 12,000.37 per hectare in case of marginal farms to Rs. 10,763.62 per hectare in case of big farmers. Farmers of all categories realised more than 97 per cent of their income only from the sale of cocoons. Income from sale of leaves and cuttings were nil for small farmers and it increased along with the farm size. The total labour employment generated ranged from 1,392.5 man days in the case of marginal farmers to 1,423.63 man days in case of big farmers. The net income between marginal farmers and big farmers ranged between Rs. 13,779.63 and Rs. 29,073.43.

Lakshmanan *et al.* (1997) traced out the cost and returns profile per hectare of mulberry in Salem and Dharmapuri districts of Tamil Nadu. In their study on economies of scale in mulberry sericulture they estimated that an average of Rs. 1.52, 1.28, 1.16 and 1.09 were incurred in producing one kg of mulberry leaf while, in the case of cocoon it worked out to be Rs. 79.46, 64.24, 63.73 and 54.31 for holding size Group- I (0.01-0.50 ha), II (0.51-1.00 ha), III (1.01-1.50 ha) and IV (>1.50 ha), respectively. The investment over per rupee indicated that farmers with the largest holdings (size IV) had the highest returns. They also suggested that specific development schemes like implementation of minimum support price for cocoon, coverage of crop insurance for silkworm rearing and diffusion of cost effective and eco-friendly new technologies at faster rate would help in enhancing production of quality cocoon in these regions.

Lakshmanan *et al.* (2000) compared economic benefit over investment in rearing bivoltine and crossbred cocoons in their study on economics of bivoltine versus cross breed cocoon production in K. R. Nagar taluk of Mysore district.

The study revealed that bivoltine rearing earns higher net returns than crossbred production owing to climatic suitability, skilled manpower and technical guidance received from developmental agencies.

Chandrappa *et al.* (2001) conducted a cost-returns analysis for shoot feeding and shelf rearing methods of mulberry cocoon production in Shidlaghatta and Chintamani taluks of Kolar district, Karnataka. The total initial investment on building and equipment was Rs. 4,06,720 for shoot feeding and Rs. 2,57,600 for shelf rearing (capacity of 500 Dfls). The corresponding values were Rs. 23,189.97 and Rs. 27,490.77 per year and Rs. 2108.19 and Rs. 2499.15 per crop for shoot and shelf rearing methods, respectively. The recurring expenditure per crop was Rs. 15,977.42 for shoot feeding and Rs. 17,509.96 for shelf rearing, of which the expenditure on leaf, labour and layings were maximum in both cases. For shoot feeding and shelf rearing methods, the average cocoon yields were 52.10 and 51.50 kg for 100 Dfls and the net returns were Rs. 13,824.39 and Rs. 11,540.89, respectively. The average cost incurred for producing a kilogram of cocoon was higher with shelf rearing (Rs. 77.71) than shoot feeding (Rs. 69.43). The returns per rupee invested was higher with shoot feeding (Rs. 1.76) than shelf rearing (Rs. 1.58).

Rao *et al.* (2001) in their study on comparative economics of cocoon production in coastal area and traditional areas of Andhra Pradesh showed that the cost and returns structure of cocoon production varied widely between the two areas. The cost of cocoon production was evaluated to be Rs. 24106.31 and Rs. 26810.03 in Chittoor (traditional area) and Eluru (coastal area) areas, respectively. The average yield obtained by the Chittoor farmers was higher (42.99 kg/100 dfls) than that of Eluru farmers (38.50 kg/100 dfls). The Eluru farmers realized a lower average price for cocoon (Rs. 98.75/kg) compared to Chittoor farmers (Rs. 106.50/kg) due to the non-availability of marketing facilities in that area which in turn caused deterioration of cocoon quality due to long distance transportation for marketing. The net revenue earned by Chittoor farmers was higher (Rs. 16966.51) than that of Eluru farmers (Rs. 5863.55). The cost benefit ratio was estimated at Rs. 1:1.70 and 1:1.22, respectively for Chittoor and Eluru areas. They also recommended that the extension agency should intensify its efforts and strengthen the marketing system in new areas to make the enterprise more viable.

Srinivasa *et al.* (2001) reported that the total cost of production of cocoons was Rs. 32786.75, Rs. 37427.46 and Rs. 34638.31 for bivoltine, multivoltine rearers and the overall category, respectively, in their study on cropping patterns and income levels of sericulturists in Mandya district, Karnataka. The net returns for the three categories were found to be Rs. 15756.86, Rs. 20051.16 and Rs. 18235.24, respectively. They also stated that the net returns were low in the case of bivoltine rearers compared to the multivoltine rearers as the bivoltine race (CSR) was reared only from September-February in which only 3 crops could be harvested as compared to 5 crops of multivoltine.

Umesh *et al.* (2001) observed that under shoot feeding, the total cost of cocoon production per crop of 500 dfl's was Rs. 17794.77, of which the expenditure on silkworm rearing alone was Rs. 15865.08, whereas under shelf rearing, the total cost of cocoon production and silkworm rearing was Rs. 19687.14 and Rs. 17396.24, respectively, as indicated from their study on economic performance of mulberry cocoon production under different methods using chawki worms in Chintamani taluk of Kolar district. The costs of mulberry leaves accounted for the highest costs in both rearing methods, followed by labour and chawki worm costs. However, the cost incurred for labour in shelf rearing method was marginally higher (23.10%) over shoot feeding (19.38%). On an average, rearers have realized a net returns of Rs. 14655.23 under shoot feeding and Rs. 12342.86 under shelf rearing for every crop of 500 dfl's. To produce 1 kilogram of cocoon under shoot feeding and shelf rearing, rearers have to spend Rs. 67.15 and Rs. 75.29, to gain a net returns of Rs. 55.30 and Rs. 47.20, respectively. For every rupee invested in cocoon production, returns of Rs. 1.82 in shoot feeding and Rs. 1.63 in shelf rearing is expected.

Hiriyanna *et al.* (2002) evaluated the economics of CSR hybrids 'vis-à-vis' the popular multi x bi hybrid (PM x NB4D2) in their study on comparative economics of bivoltine hybrids with multi x bi hybrid cocoon production. The expenditure incurred for rearing CSR hybrids was higher than that of multi x bi hybrid rearing due to usage of more inputs but benefit cost ratio-wise, CSR hybrids were rated better than multi × bi hybrids.

Reddy *et al.* (2002) reported in their study on comparative economic analysis of bivoltine and multi-bivoltine silkworm rearing in Karnataka, that the total annual operational costs incurred by small, medium and large farmers for multi bivoltine cocoon rearing was Rs. 12 864, Rs. 18 339 and Rs. 22 463. The number of disease free layings and number of hired labour used annually by small, medium and large farmers for rearing multi-bivoltine cocoon ranged from 1099 to 1249 and 58 to 273 mandays, respectively.

Rane and Bagade (2006) worked out cost and returns involved in cultivation of banana in Sindhurg district of Maharashtra. The primary data were collected through pre-tested schedule. Simple averages and tabular presentation were used for analysis. The per hectare cost of cultivation in Dodamarg tahsil and Sawantwadi tahsil were found to be Rs. 1.28 and Rs. 1.15 lakh, respectively with a net returns of Rs. 1.52 and Rs. 1.53 lakh, respectively.

Gururaj *et al.* (2007) reported in their study on sericulture at Kodagapura: a case study that the sericulturists who switched over to PM x CSR2 (as it was better yielder hence, more remunerative) in Kodagapura village recorded a cocoon yield of 52.22 kg/100dfls and showed an improvement of 10kg (26.3 per cent) over the bench mark cocoon yield of 41.32 kg/100dfls and earned better returns of Rs. 1800-2500/ 100 dfls after launch of Institute Village Linked Programme in 2004-05.

Lakshmanan and Geetha (2007) demonstrated in their study on employment opportunities in sericulture in Tamil Nadu that female labour participation is higher in particular and employment opportunities are even wider in sericulture in general as compared to other crops. They showed that mulberry sericulture generated 532 man days (of this, 319.20 man days utilised were from own family source and 212.80 man days hired) from one year period, in its activities such as garden establishment, leaf production, silkworm rearing and marketing while it was 296.15 man days for sugarcane and 133.50 man days for turmeric. They also observed that the sex ratio in labour participation was the highest in sericulture *i.e.* 1:1.86 while it was 1:0.93 for sugarcane and 1:1.49 for turmeric.

Sale *et al.* (2007) studied the Economics of Production and marketing of Jaggery in Kolhapur district. Random sampling was done for the selection of jiggery producers and the data obtained were analysed by simple tabular method. The conclusions of the study were per ton cost of cultivation of sugarcane was estimated to Rs. 648.24, the per quintal cost of production of jiggery including marketing charges worked out to Rs. 982.16 and the net profit per quintal and per hectare from jaggery production was worked out to the tune of Rs. 117.84 and Rs. 11219, respectively.

Anil Kumar Yadav (2008) in their study on yield gaps and constraints in cocoon production in Karnataka revealed that in Kolar district, from 100 dfl, farmers produced 65.23 Kg of cocoons and 8.40 quintals of litter, the total cost was Rs. 7160.97 in which operation cost was Rs. 6710.64 and total fixed cost was Rs. 450.33. The major costs were mulberry leaf (Rs. 3616.24) and labour cost (Rs. 1636.63). While in Chikkaballapur district, using 100 dfl, farmers produced 66.04 Kg of cocoons and 7.50 quintals of litter, the total cost incurred in rearing 100 dfl was Rs. 7399.49. The total operational cost was Rs. 6959.06 in which mulberry cost (Rs. 3724.83) and labour charges (Rs. 1740.69) were the major costs. The gross returns obtained per 100 dfl in Kolar district was Rs. 9386.24. Net returns were Rs. 2225.27 and the B:C ratio was 1.31. Whereas in Chikkaballapur district, the gross returns obtained was Rs. 9395.15 per 100 dfl. The net returns were Rs. 1995.18 and the B: C ratio was 1.27.

Hajare *et al.* (2008) observed that the contribution from sericulture enterprise was found to be highest at 52 per cent (Rs. 82315/ha/yr) followed by paddy-sunflower (20 per cent), soybean-wheat (15 per cent) and soybean-gram (12 per cent) in paddy area, whereas it was as high as 54 per cent followed by cotton-pigeon pea (17 per cent), soybean-wheat (16 per cent) and soybean-gram (13 per cent) in cotton area and sustained income continued up to 15-20 years.

Mahalakshmi (2009) conducted a study on Cost and Return in Vanilla cultivation with special reference to Coimbatore district by collecting information on costs, returns and investment in vanilla cultivation from 59 vanilla growers. The study revealed that BC ratio of processed vanilla was 19.89 as against 17.49 for green vanilla beans. NPV for the processed vanilla beans was 4034906.34 as against 2916173.92 for green vanilla beans.

Green beans and processed beans have the payback period of three years but green beans deliver greater profit than processed beans in subsequent years. This study pointed the potential of vanilla crop in yielding better returns for the investment made.

Purushothaum and Rao (2009) conducted a study on Economics of sericulture in Ananthapur district of Andhra Pradesh. Cost and returns from cross breed (Pure Mysore × CSR2) silkworm rearing was estimated. The study has shown that net returns from one acre of mulberry worked out to Rs. 52,206 per year. The cost-benefit ratio of sericulture was worked out to be significantly higher (1:1.94). Detailed study of the economics revealed that the major economic factor contributing for the total cost in sericulture was labour which was 32.54 per cent for silkworm rearing and 13.95 per cent for mulberry production. Another important item was cost of equipment for silkworm rearing which is about 11.27 per cent.

Balasarswathi *et al.* (2010) revealed the costs incurred towards establishment of mulberry garden in Theni district of Tamil Nadu. It worked out to an average of Rs. 8069.50 for establishment of one acre of mulberry garden. The different costs associated with garden establishment indicated that the highest share (28.20%) was incurred for FYM followed by Rs. 4020.00 for human labour which accounts to 22.20 per cent of the total cost of establishment. Out of the total establishment cost, human, animal labour and tractor power formed the major share (28.60%). Among the inputs, FYM and chemical fertilizers formed the major share (30.40%).

The different costs associated with the mulberry garden maintenance indicated that the highest share was incurred for human labour (42.0%) due to scarcity of man power in Theni district of Tamil Nadu. The cost of labour, FYM and fertilizer, all put together accounted for 72.90 per cent of the total production cost in the study area. The unit cost of leaf production (per kg) was estimated to Rs. 1.39.

They also reported that the cost of mulberry leaf (Rs. 2023.00) was major cost component followed by labour (Rs. 8600.00). Depreciation cost on rearing house and rearing appliances which were accounted as fixed cost in silkworm rearing was Rs. 6110.00 and its share to the total cost of cocoon production was 12.20 per cent. It was estimated that an average of Rs. 43413.28 was incurred the cocoons, an average of Rs. 4126.00 was spent.

2.3 Allocative and use efficiency of resources in sericulture

The use of production function analysis to assess the productivity of resources in sericulture and other similar crop is discussed below.

Murthy (1977) used a Cobb-Douglas type of production function for mulberry leaf production in Bangalore district, Karnataka. The six independent variables namely land, manure, fertilizers, number of irrigations, human labour and other variable costs explained 95 per cent of variation in the leaf yield. The coefficients of land, fertilizers and irrigation were significant. The ratio of marginal value product to factor cost indicated an economic utilization of land, fertilizer and irrigation, while manure, human labour and other variable costs were used in excess of optimum.

Neelakantasastry (1982) fitted a Cobb-Douglas type of production function for cocoon production with the explanatory variables of cost of leaf, human labour, cost of eggs, rent on mountages, marketing charges and cost of disinfectants. The variables of cost of eggs, human labour, marketing charges and cost of disinfectants had positive and significant regression coefficients. About 93 per cent of the variations in the cocoon yield was explained by the selected variables.

Chandrashekhar Reddy (1985) in his study on sericulture in Dharmapuri district of Tamil Nadu fitted a modified Cobb-Douglas function mulberry cultivation selecting labour (mandays), manure (in Rs.), fertilizers (in Rs.), number of irrigations, fixed investment on the farm (in Rs.) and acerage under mulberry as the independent variables and was able to explain 60 per cent of the variation in the leaf yield. The coefficients fertilizer, fixed investment and irrigation were significant and positive. Fertilizers and irrigation showed scope for further utilization while the use of other resources was either less profitable or resulted in losses. In a similar function for cocoon for cocoon production he selected leaf (kg), layings (Nos), labour (mandays), disinfectants (in Rs.), percentage of successful crops and other variable costs as independent variables and accounted for 94 per cent of the variation in the cocoon yield.

Layings and percentage of successful crops had significant and positive coefficients. Layings and cost of disinfectants showed scope for further investment while the remaining inputs were used in excess of optimum.

Murtuza Khan (1985) employed a separate modified Cobb-Douglass function each, to study bivoltine and multivoltine cocoon production in Bangalore district, Karnataka. The independent variables selected were identical for both the cocoon variety function and they were layings (nos), leaf (kgs), human labour (mandays) and mountages used (Nos). These variables explained 87 per cent and 61 per cent of the variation in yields of bivlotine and multivoltine cocoon yields, respectively. Mulberry leaf and quantity of layings had positive and significant coefficients, while labour had a negative coefficients in both functions. Further expenditure on leaf only, would prove profitable while expenditure on labour would reduce the returns in both cases.

Rehber and Aksoy (1985) fitted a Cobb-Douglass type of function to study cocoon production in Bursa province of Turkey, with three explanatory variables, namely, variable costs in Turkish liras, labour (mandays) and space of rearing rooms (in sq. mtrs). All this inputs had positive and significant regression coefficients and explained 90 per cent variation in cocoon yield. The marginal value product to factor cost ratio revealed that labour was used efficiently while other two inputs were underutilized. Two dummy variables, one of the geographic location of rearing and another for the effect of cooperative hatching were introduced stepwise in the above regression. It was found that rearing in mountains had a significant and negative effect on cocoon yield as opposed to rearing in the plains and cooperative hatching had a positive effect on cocoon yield as opposed to hatching in houses.

Chandra Reddy (1987) employed a modified Cobb-Douglass function for the study of sericulture in Chittoor district, Andhra Pradesh. The production function for mulberry leaf projected mulberry area (ha.), human labour (mandays), manuares and fertilizers (in Rs.), irrigation charges and share of establishment charges as the independent variables and they explained 94 per cent of the variation in the independent variable of leaf yield. All regression co-efficient were positive and all but that of irrigation were significant. However, increases only in land and labour resources were profitable. The cocoon production function defined leaf (kgs), layings (nos), human labour (mandays), mountages (nos), disinfectant costs and electricity charges as the explanatory variables and found that except leaf and lighting, all other variables had a positive effect on cocoon yield and except human labour all variables were significant.

Marihonnaiah (1987) using a modified Cobb-Douglass production function regressed the variables of mulberry acreage, labour (mandays), fertilizers (Rs.) and manure (cart loads) on mulberry leaf yield in his sericultural study in Tumkur district, Karnataka. Mulberry acreage had significant and positive coefficients in all farmer size groups. Labour had a positive, significant and manure had a negative, non-significant coefficient in all but the large farmer groups. Further increases in fertilizer and mulberry acreage would prove profitable to all groups. The five variables regressing on cocoon yield were layings (nos), percentage of successful crops, labour (mandays), fixed costs and leaf (kgs). Leaf and had positive and significant coefficients in marginal and large farmers groups. Further investment in all inputs except fixed cost would prove profitable. The coefficient of multiple determinate (R^2) ranged from 62 to 95 per cent in the mulberry leaf production and from 85 to 95 per cent in the cocoon production function.

Chandra Reddy *et al.* (1990) discovered that the log linear type of production function gave the best fit when studying the year wise resource productivity in betel-vine cultivation, upto third year after planting. The R^2 for all three years was 80 per cent. Among the four independent variables manure and fertilizers had positive and significant coefficients; miscellaneous costs had a negative non-significant coefficient. The dependent variable was gross income. All variables were expressed in terms of rupees per hectare.

Regression, apart from resource productivity, has also been used for other aspects. Kumaresan *et al.* (1994) used regression as one of the methods to estimate the replacement age of a mulberry garden. The independent variable cocoon yield in kgs was regressed by the age the mulberry garden, the data for which was obtained from a random, farmers sample in Kollegal taluk, Mysore district.

The regression function which had a quadratic form, put forward eighteen years as the age at which the plantations were to be replaced. The fit of the function was 0.946 and significant at 1 per cent.

Jagannathan (1995) found that the major source of farm energy was bullock power. The average use of bullock labour declined with increased farm size. It was noticed that, the small farmers used the bullock labour intensively on their farms as compared to that of medium and large farmers. Comparing the operation-wise employment of owned and hired human labour, it was inferred that the employment of human labour declined with the increase in the farm size, which implied that small farms were more labour intensive than medium and large farms. Among the operations, more than 50 per cent of owned labourers were employed in harvesting for all farms whereas more than 50 per cent of hired labour, were employed in different cultivation operations. It was found that the percentage of owned labour in the average employed labour force declined and the percentage of hired labour increased with the increased farm size. It revealed that small farmers used more of owned labourers while medium and large farmer used more of hired labourers.

Verma (2002) employed Cobb-Douglas production function for evaluating resource use efficiency in onion. The marginal value product of seed, manures and fertilizers, human labour and machine power were (Rs. 0.15, Rs. 1.51, Rs. 0.69 and Rs. 0.28) found to be positive on small farms while it had negative value on bullock labour, plant protection and irrigation (Rs. –0.13, Rs. –0.49 and Rs. –0.47), respectively. This implies that in case of the small farms seed, manures and fertilizers, human labour and machine power were underutilized and bullock labour, plant protection and irrigation were used excessively on the farms. In case of large farms, marginal value product of seed, manures and fertilizers, human labour, bullock labour and plant protection were (Rs. 0.80, Rs. 0.34, Rs. 0.18, Rs. 0.01 and Rs. 0.15) positive, while it was negative for machine power and irrigation, respectively (Rs. –0.16 and Rs-0.01) implying that on the large farms seed, manures and fertilizers, human labour, bullock labour and plant protection chemicals were underutilized, while machine power and irrigation were excessively used, indicating scope for increased use up to the optimum level where the efficiency of the machine power and irrigation use was maximum.

Suresh and Keshava Reddy (2006) studied resource-use efficiency of paddy cultivation in Peechi Command Area of Thrissur district of Kerala and examine the resource productivity and allocative and technical efficiency of paddy production. The cost of cultivation of paddy in the command area has been found as Rs 21603/ha, resulting in a BC ratio of 1.34. The elasticity coefficients for chemical fertilizers, FYM and human labour have been observed significant and positive. The allocative efficiency could reveal that marginal return per one rupee increase under these heads would be Rs 2.83, Rs 1.57 and Rs 1.17, respectively. The average technical efficiency of the paddy farmers in the command area was found as 66.8 per cent. Education of the farmer and supplementary irrigations provided during the water-stress days could enhance the technical efficiency.

Srinivasa *et al.* (2008) reported that the quantum of resources used was less with the farmers of Chamarajnagar district compared to that of Kolar district. The fertilizers were used less than the recommended quantity in both the areas. The allocative efficiency analysis showed that labour was over used in the study areas and fertilizers and disinfectants were used in sub-optimal levels. In Kolar district, the variables such as FYM, fertilizers, disinfectant and leaf quantity depicted a positive and significant relationship with the output indicating the correct levels of usage of the inputs. The marginal value and input use efficiency indicated that the resources such as bullock power (21.52) in Chamarajnagar and fertilizer (7.76) in Kolar district were utilized the most efficiently. The study coincluded that the most of the quantum of resources used in sericulture should be increased in the study area, especially the fertilizers in mulberry garden and disinfectants in silkworm rearing for more efficient use of resources and for earning better income.

Tarunvir Singh and Jyoti Kachroo (2009) studied the resource use efficiency of dry land maize in Jammu District of J & K State. The study could examine using Cobb-Douglas production function and the values of regression coefficient of maize for area farmyard manure + fertilizer were 0.971, 0.211 and -0.386, respectively. The value of area and farmyard manure + fertilizer with positive sign indicated that one per cent increase in the use of these inputs could increase the returns by 0.971 per cent and 0.211 per cent, respectively.

The negative sign of the regression coefficient of human labour showed that one per cent additional expenditure on the use of human labour would reduce the return from maize crop by 0.386 per cent. The benefit-cost ratio worked to be 2.17, 2.31, 2.11, 1.49, 0.87 and 0.66 for A_1, A_2, B_1, B_2, C_1 and C_2 costs, respectively. The coefficient of variation cropped area, yield and net returns were 57.34 per cent, 60.20 per cent and 64.82 per cent, respectively.

Nethrayini (2010) in her study on an economic analysis of contract farming of Gherkin under Agri-Export zone in Karnataka examined that the Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratio was greater than unity for human labour (1.79), plant protection chemicals (3.18) and staking materials (2.66) indicating the greater scope for using additional units of these resources to increase gross income from gherkin cultivation. The MVP to MFC ratio was positive but less than unity for bullock and tractor labour and was negative for seeds and FYM and fertilizers indicating that these inputs were overused.

2.4 Marketing of cocoons and other related crops

Pujari (1998) studied the marketing of Pomegranate and Ber. He found that marketing cost of Pomegranate and Ber were Rs. 3.32 and 2.49 per kg, respectively in Sholapur district. The price spread between minimum and maximum prices were Rs. 6.50 and Rs. 2.78 in the case of Pomegranate and Ber, respectively.

Dhage and Rahane (2003) estimated the per quintal cost of marketing of grapes in Nashik district; The study revealed that at the overall level the average per quintal cost of marketing worked out to Rs. 557.10 and the major items of cost of marketing were packing (35.32%) followed by transport (32.23%) and commission (19.39%). Per quintal cost of marketing observed to increase with an increase in size group of holding.

Ladaniya and Wanjari (2003) conducted a study on marketing pattern of 'Mosambi' sweet orange in selected district of Maharashtra. In the study, it was noticed that, farmers with small mosambi plantations were more inclined to sell produce to pre-harvest contractors. This type of decision making by the producers it was attributed to lack of will to take risks associated with marketing and lack of financial assistance required during mosambi production process, while growers with large plantations farmers sold mosambi fruits themselves in distance market. Market efficiency was higher when farmers themselves marketed fruit in distance market. It was also opined that, as the market distance and number of intermediaries increased in marketing cost and margins of cost marketing also increased. Further it was noticed that the market efficiency and share of farmers in consumer's price was decreased.

Mali *et al.* (2003) studied marketing of banana in Jalgoan district of Maharashtra. To market banana in Delhi market they had identified three marketing channels *viz*., farmers direct sale through co-operatives marketing societies, private traders sale through co-operative fruit sale societies and sale through Local merchants/group sale agencies. Further, the grade wise quantities of banana were sold by banana growers to various marketing agencies. For this purpose, the entire produce of banana was graded into 5 grades, according to weight of the bunches as 'Super' grade (above 16 kg.), 'A' grade (14 to 16 kg.), 'B' grade (12 to 14 kg.), 'C' grade (10 to 12 kg.) and 'D' grade (below 10 kg.) by all sample growers among the five grades, the highest quantity of the produce was of 'A' grade (27.30%) and the lowest (8.06%) of the 'D' grade produce was realized by the sample farmers. Among the three marketing agencies, 57 per cent of total quantity was marketed through local traders (group sale agencies) and it was followed by the private traders through co-operative fruit sale societies (26%). Only 17 per cent of the total produce was marketed directly in Delhi market through co-operative fruit marketing societies. The grade wise per quintal marketing cost and net price realized from banana for on farm sale through different marketing agencies were studied and it was noticed that, at overall level the average per quintal gross price realized by the farmers was Rs. 369.44 for all grade together. The per quintal marketing cost was Rs. 27.55 and the net price realized at the overall level was Rs. 341.89. Whereas the per quintal cost of marketing was the highest (Rs. 29.47) in case of local traders, followed by co-operative fruit sale societies selling the produce to the private traders (Rs. 27.32). Per quintal cost of marketing was the lowest (Rs. 16.50) in case of co-operative fruit marketing societies selling the produce in Delhi market.

Khunt *et al.* (2003) conducted study on utilization and disposal pattern of pomegranate in the Bhavnagar district of Saurashtra region, Gujarat. It was evident from the study that marketable surplus was 98.38 per cent. The share of home consumption, relatives and religious purposes were negligible and loss due to damage was only 0.83 per cent. The disposal pattern of pomegranate marketable samples in different market stated that majority of the farmer (33) had disposed off 59.01 per cent of their pomegranate production in the local market *i.e.* Bhavnagar city. A few of the pomegranate grower (5) sold their fruits in Rajkot city (12.31%) very little portion of their pomegranate production was sold in other distance places. The marketing cost of pomegranate showed that, transport cost *i.e.* Rs. 29.52 per quintal (50.46%) formed that total market cost and other important items of marketing cost were packing charges (18.08%), grading cost (16.26%) and loading-unloading charges (11.47%). All items put together the total marketing cost per quintal amounted to Rs. 58.50 and the net price received by the growers was Rs. 859.66 per quintal.

Joy (2004) studied the marketing of coffee in Wayanad district of Kerala and found that withdrawal of Coffee Board has led to the emergence of intermediaries in trade. Middlemen sell the coffee directly from farmers to wholesalers who in turn export it. The expenses on transportation, storing and marketing which constituted only 26 per cent of the total cost in 1980 increased to 67 per cent in 1990. All the burden of the increase in marketing costs fell upon the farmers and reduced their profits.

Navadkar *et al.* (2005) conducted study on marketing of vegetables grown around Pune city and revealed that, per quintal cost of marketing of selected vegetables was more in terminal market (Rs. 112.67 per quintal) than in primary market (Rs. 57.84 per quintal). The proportionate share of transportation and commission charges to total marketing cost were significantly more in terminal marker. The producers' share in consumes' rupee was observed to be the least in terminal market for vegetable like cabbage and the highest in bhendi in the same market.

Wayan (2005) studied marketing of coffee in North Sumatra and found that market performance is relatively efficient as indicated by the relatively fair profit margin gained by collectors, traders and exporters and high farm gate price. The profit margins range from 2.8 – 3.8 per cent of FOB price while farm gate price is around 86.4 per cent.

Lakshmanan *et al.* (2008) conducted a study on economic appraisal of silk cocoon production in Southern India. The study was conducted mainly in Karnataka, Tamil Nadu and Andhra Pradesh. The marketing cost incurred in these states was found to be Rs 2166.65, Rs. 1855.75 and Rs. 1799.98 per acre per annum, respectively.

Mallikarjuna *et al.* (2008) conducted a study on economic analysis of sericulture vis-a-vis other selected agricultural crops under rainfed condition in Chamrajnagar district of Karnataka. The study on marketing cost revealed that farmer has incurred cost of Rs. 700.00 per acre per year. The contribution of marketing cost towards total cost was found to be 3.19 per cent.

Anil Kumar Yadav (2008) conducted study on Yield gaps and constraints in cocoon production in Karnataka. The study on marketing of cocoons in Kolar and Chikkaballapur district revealed that the farmer has incurred marketing cost of Rs. 125.12 and Rs. 159.27 per 100 Kg of cocoons, respectively.

Purushothaum and Rao (2009) conducted a study on Economics of sericulture in Ananthapur district of Andhra Pradesh. The study on marketing of cocoons in study area revealed that the farmer incurred marketing cost of Rs. 291 per acre per annum. The marketing cost contributed nearly 0.53 per cent to the total cost of cocoon production.

Munikrishnappa *et al.* (2009) studied the economics of sericulture in drought prone region of Andhra Pradesh. The farmer incurred marketing cost of Rs. 1799.98 per acre per year. It has contributed nearly 3.67 per cent towards total cost of cocoon production.

2.5 Constraints involved in sericulture and other related crops

Murtuza Khan (1985) in a study on economic analysis of seed cocoon production in Anekal taluk of Bangalore district reported that all the respondents of multivoltine cocoon production expressed the incidence of uzifly as the major problem.

Infections from muscardine and flacherie diseases were reported by 64 per cent and 46 per cent farmers, respectively. On the other hand, 22 per cent and 26 per cent of the farmers expressed the problem of shortage of irrigation water, non availability of disease free layings and human labour. About 68 per cent of the respondents had no separate rearing house. In the case of marketing, 50 per cent of the respondents expressed the lack of transportation facilities. Under-weighment and poor prices of cocoons were the other major problems as opined by 34 per cent and 6 per cent of the sericulturists, respectively.

Ramakrishna (1987) in his study on silk cocoon production in Karnataka, indicated that uzifly incidence was the major problem in cocoon production, which was reported by all the respondents, while 97 per cent of the respondents expressed their inability to have separate rearing house. Incidence of muscardine and grasserie were reported by 85 per cent and 81 per cent of the farmers. With regard to marketing, 93 per cent of the farmers were unhappy with weighment of cocoons and 87 per cent of the respondents suspected the existence of an illegal collusion between buyers and bidding agents.

Reddy (1990) conducted a study on the characteristics and performance of farm entrepreneurs involved in sericulture in Chittoor district of Andhra Pradesh. The problems expressed by sericulturists were lack of improved mulberry variety (33 per cent), inadequate irrigation facility (60 per cent), non availability of disease free layings in time (25 per cent), lack of separate rearing houses (75 per cent), lack of timely credit (80 per cent), fluctuation in prices of cocoon (34 per cent) and inadequate transfer of technology.

Kerutagi *et al.* (1994) identified the constraints in silk cocoon production in their study on problems of sericulture enterprises in Bijapur district, Karnataka. The constraints identified include the incidence of pests (uzi fly) and diseases, water scarcity in the summer months, excess heat in summer. They also suggested some measures to overcome these constraints like uzi fly can be prevented using individual tray covers of nylon mesh, proper disinfection of all the materials used in the silk cocoon production and rearing of silk worm in huts and mud houses to control excess heat during summer.

Jagannathan (1995) identified the constraints encountered by sericulture farmers in Coimbatore district of Tamil Nadu. The study revealed that inadequate market facilities (80 per cent), lack of control measures for silkworm diseases (74 per cent), non-availability of labour for picking of leaves (70 per cent), high wage rates of labour (64 per cent), non-availability of disease free layings (52 per cent), disinfection chemicals in time (48 per cent) and lack of skilled labourers for rearing silkworms (60 per cent) were the major problems.

Das *et al.* (1997) identified thirteen problems in the development of sericulture *viz.*, non-availability of leaf; non-availability of disease-free layings (dfls); lack of suitable silkworm races; unfavourable climate; high incidence of disease and pest; low cocoon production; poor quality cocoons; non-availability of markets; lack of technical knowledge; existence of alternative crops; lack of government assistance; lack of skilled labour; and lack of finance. They also mentioned the fourteen measures suggested by the farmers in improving the sericulture industry *viz.*, arrangement for subsidy; availability of irrigation water; supply of rearing appliances; establishment of regulated market; supply of dfls in time; arrangement for post-cocoon services; imparting training; financial assistance; supply of various input materials; supply of quality dfls; supply of HYV mulberry plants; controlling and monitoring input prices; regular vigilance by the office staff (both central and state); and strict maintenance of a crop schedule.

Dodamani *et al.* (1996) identified the constraints in mulberry cultivation and silk cocoon production in their study on problems of sericulture enterprises in Gulbarga district, Karnataka. They indicated that the incidence of pest and disease as well as shortage of irrigation water were the major problems in mulberry cultivation. Non availability of separate rearing rooms, shortage of rearing equipment, mortality of layings and lack of availability of disease-free layings were the other problems faced by farmers in silk cocoon production.

Lin-YiFu (1998) found that the highest experimental yield is about 16 t/ha, which is about three times the average farm yield in his study on rice production constraints in China. More than 70 per cent of the gap between the highest experimental yield and the average farm yield belonged to yield gap I. Both yield gaps I and II were attributed to a small number of factors.

For yield gap I, important variety-related factors were canopy architecture, photosynthetic rate and growth duration and important environment-related factors are duration of sunshine, accumulated heat units and soil condition. For yield gap II, the main constraints arise from low soil fertility; cold, waterlogged and acid soil; drought, submergence, heat and cold at the seedling, vegetative and anthesis periods; lodging; weeds; sheath blight; and stem borer.

Jha and Viswanathan (1999) revealed that although food grain production increased at 2.73 per cent per annum, low yield and declining area contributed to the low level of agricultural output in their study on problems and prospects of agricultural development in Bihar in which analysis is conducted on the trend and pattern of growth in area, production and yield of food grains across different agro-climatic zones/districts. The South West and North West plains (among the zones) Purnea, Rohtas and Bhojpur (among the districts) accounted for a high share of food grain production. Among the food grain crops wheat, maize and paddy witnessed higher growth rates. Yield gap between potential and actual yield was 50%-70 per cent. Low use of modern inputs resulted in low yield. The high incidence of concealed tenancy (60%) dominated by absentee landlords and high land fragmentation restricted farm investment and diffusion of modern technology to a large extent.

Chaudhary (2000) discussed the constraints faced and approaches to bridge the gap in his study on strategies for bridging the yield gap in rice: a regional perspective for Asia. He also reported that exploitable yield gaps of rice were caused by various factors, including physical, biological, socioeconomic and institutional constraints and an integrated programme approach is required to bridge the gap.

Siddhartha *et al.* (2000) in a study on constraints in crop production in irrigated farms in Birbhum district of West Bengal observed that constraints like drainage problem, poor water management in *kharif* season, poor yield, high cost of cultivation under low land, non availability of assured irrigation, wastage of water through overflowing under medium land and scarcity of water, erosion of soil and nutrients, high fertilizer consumption and high water requirement in *rabi* and pre-*kharif* season under high land situation are responsible for yield gap in the field level.

Anonymous (2001) reported in the study food independence in the Republic of Belarus: problems and prospects that the factors inhibiting the ability of Belarus to increase food output and exports were: an inefficient agricultural production system based on kolkhozy and sovkhozy; a lack of incentives for efficient production; an aging technology and equipment base and inability to replace it; difficulties facing scientific research work in this field; relative unattractiveness of Belarussian foods compared with foreign equivalents (e.g. in packaging and range of products available); trade barriers imposed by foreign countries; and the lack of a stable domestic market for foods.

Jansirani *et al.* (2001) reported that the major constraints faced by the betel vine growers were Varietal susceptibility to pest and diseases (84%) and soil and water problems (76%). More than half of the growers have expressed high cost of fertilizers (56 per cent) followed by high cost of pesticides (54%) and lack of technical guidance (53%). The major constraint such as non-availability of inputs in time was expressed by less than 50 per cent of the respondents.

Babanna (2002) Observed that non-availability of labour at right time (75%), identification of pests and diseases (73%), controlling the pests and diseases (67%), non-availability of technical knowledge (58%), not getting proper remunerative price (43%), non-availability of processing units (41%), non-availability of continuous power supply (38%), lack of knowledge on processing procedure (37%), non-availability of finance (26%), non-availability of marketing facilities (25%), credibility of knowledge (16%), non-availability of inputs at right time (12%) and lack of transport facility (8%) were the major constraints faced by the arecanut growers in Shimoga district.

Gaddi *et al.* (2002a) revealed in their study on yield gaps and constraints in the production of *rabi* sorghum in Bijapur and Gulbarga districts of Karnataka that the suboptimal use of plant nutrients, human labour and bullock labour on farmers' field vis-à-vis demonstration plots were the major factors conditioning yield gap.

Substandard and costly chemical fertilizer and plant nutrients, labour shortage, non-availability of desired variety seed, unfavourable climatic conditions and incidence of pest and diseases limited sorghum productivity on farmers' fields.

Gaddi *et al.* (2002b) reported in their study on yield gaps, constraints and potential in cotton production in North Karnataka that non-availability of labour and incidence of pest and diseases, non-application of chemical fertilizers at the recommended level and non-availability of recommended variety and genuine seeds among the large farmers were the major constraints faced by the farmers of Dharwad and Bellary districts in cotton production.

Latha (2003) found that the major constraints faced by coconut growers in central dry zone of Karnataka were erratic supply of electricity, high cost of inputs, lack of knowledge regarding pest and diseases, lack of technical guidance and lack of water for irrigation. Regarding marketing of coconut major problems faced were high transportation charges, lack of storage facilities, lack of cooperation, high commission charges and distant location of market.

Mwanga and Cloete (2003) observed in their study on the role of horticulture: issues, opportunities and constraints in Africa, that the major constraints to produce horticultural crops or processed products that meet the export market standards were poor communication system, lack of market infrastructure, agro-processing plants, marketing credit, proper market organization, proper pricing, uniform grading and standardization of weights and measures, inadequate and poor dissemination of market information, poor post-harvest handling and low productivity.

Naeem *et al.* (2004) identified the major problems faced by the farmers of Bannu district, Pakistan in their study on major *rabi* (wheat and gram) and *kharif* (sorghum and maize) weeds of agronomic crops lack of information regarding chemical weed control, increase of weed density per unit area due to use of modern agricultural production practices, irrigation water deficit, high electricity charges of tube wells and high charges of agricultural machinery were listed as the problems faced by the farmers. The farmers used a number of weeds as a fodder and green vegetables.

Ahuja *et al.* (2005) conducted study on yield gaps and constraints in the production of mung and moth bean in arid Rajasthan. They revealed that the production losses (70 per cent for mung bean and 55 per cent for moth bean) were maximum due to insects/pests attack in both the crops. High cost and non-availability of high-yielding-variety seeds were the major socioeconomic constraints in arid region.

Prakash and Dandin (2005) in their study on yield gaps and constraints in bivoltine cocoon production in Mandya District of Karnataka revealed that the major constraints for bringing down economically recoverable gaps were crucial inputs such as mulberry leaf, disinfectants, human labour and mountages.

Athar and Bokhari (2006) identified, in their study on ethnobotany and production constraints of traditional and commonly used vegetables of Pakistan, that the most important constraints in summer and winter vegetables as lack of physical and social infrastructures, absence of market knowledge, use of improper seeds, high infestations of pests and diseases, post-harvest deterioration and lack of effective extension work.

Alimi *et al.* (2007) found in their study on economic rationale of commercial organic fertilizer technology in vegetable production in Osun State of Nigeria that major constraints to the use of commercial organic fertilizer are doubtful efficacy, offensive odour, heavy weed infestation, bulkiness and lack of funds in descending order of importance which if eliminated will boost demand for commercial organic fertilizer and improve production of vegetable for consumption.

Anil Kumar Yadav (2008) in their study on yield gaps and constraints in cocoon production in Karnataka revealed that the major constraints in cocoon production were attack of pests and diseases, high wage rates of labour, inadequate technical guidance from extension personnel, improper disinfection of rearing house and rearing equipments.

Santhosh (2008) analyzed production and processing of Red gram in Gulbarga district of Karnataka. He documented that major problems faced by the processors were poor supply of power scarcity of labour as well as non availability of credit formed another problem.

Dar *et al.* (2009) conducted a study on constraints of silkworm rearers in Kashmir valley for adoption of rearing technologies. The study revealed that maximum rearers i.e., 83.30 per cent reported that mulberry cultivation has been traditionally public sector activity and hesitate to spare their small holdings for mulberry plantation only. So, the severe shortage of mulberry leaves was perceived as one of the major problems during the peak periods. Most of the rearers i.e., 8.00 per cent reported heavy loss due to lack of post-harvest technologies and proper marketing infrastructure in the valley conditions. About 64.44 per cent of selected farmers perceived that they harvest low yield due to lack of technical information and timely supply of inputs.

Ruchira Shukla (2011) was conducted a survey to know the constraints in adoption of recommended technologies in mulberry sericulture using personal interview method in two tehsils of Udaipur district of Rajasthan. It was found that among the constraints expressed by the farmers of mulberry sericulture, high input cost ranked first followed by lack of irrigation facilities whereas the constraint 'scattered field' was ranked as last according to the responses obtained from mulberry sericulturists.

3. METHODOLOGY

This chapter outlines the features of the study area, the method of sampling and collection of data, the analytical frame work employed. The concepts used in the study are defined and explained to facilitate a clear understanding of the issues related to the present study.

The methodology is presented under the following headings:

3.1 Description of the study area.

3.2 Technical aspect of mulberry cultivation and silkworm rearing

3.3 Sampling procedure and sources of data.

3.4 Analytical tools and techniques employed.

3.5 Definitions of terms and concepts used

3.1 Description of the study area

3.1 Location

Karnataka is the eighth largest state in India with an area of 1, 91,791 sq. km. It is situated between 11.5° and 19.0° North latitude and between 74° and 78° East longitude in the southern plateau. According to 2001 census, Karnataka had a total population of 44.61 million comprising 22.86 million male, 21.95 million female, with an overall literacy rate of 67.04 per cent. Rural population is about 3.48 million and urban population accounted for 17.92 million. The population density of the state is 275.5 per square km.

The average annual rainfall of the state is about 1139 mm, from both South-West and North-East monsoons. The temperature ranges from 21.5℃ to 31.7℃.

The geographical area of Karnataka state is 190.50 lakh ha, of which an area of 121.82 lakh ha falls under cultivable area constituting 64 per cent of the geographical area.

Major crops grown in the state are jowar, paddy, ragi, maize, bajra and wheat among cereals, greengram, tur and bengalgram among pulses; groundnut, sunflower, safflower and sesamum among oilseed crops; chilli, sugarcane, cotton and tobacco among commercial crops; onion, brinjal, potato and tomato among vegetable crops; mango, sapota, grape, guava pomegranate and banana among fruit crops, coconut and arecanut among the plantation crops.

Karnataka is also highly potential for its horticulture production and it ranks second in this aspect in India. Karnataka's agricultural products also include raw silk which has the highest production range among all other states in India. Karnataka state occupies first place in both mulberry area as well as in mulberry silk production. The details of mulberry and silk production in respect of area under mulberry, its spread, dependency of the population, production of raw silk etc. are furnished in Table 3.1.

3.1.1 Belgaum district

Belgaum district is located in the Northwestern part of the state. It lies between 15' 23° and 16' 58° North latitude and 74' 5° to 75' 28° East longitude. The district is situated at the height, ranging from 450 to 900 meters above mean sea level (MSL) and extends over an area of 13,379 sq. km. and ranks fifth in area among the districts of the State. The district is surrounded by Maharashtra state in the North, Bijapur district in the East, Dharwad and Uttar Kannada districts in the South, Goa state in the South West.

3.1.1.1 Population and Demography

The geographical area of Belgaum district is 13,44,382 ha spread in ten taluks with 20 towns, 35 hobalis and 1138 villages. The population of the district according to 2001 census was 42, 07,200 with 1000:959 male to female ratio. Out of total population in the district, 31.95 lakhs resides in rural areas and the rest in urban and semi urban areas, the overall population density of the district being 314 per sq. km. (1991-2001).

Table 3.1: Mulberry silk production status in Karnataka (2010-11)

Sl. No.	Particulars	Quantity
1	Area under mulberry including production of Mysore seed area (hectares)	62,697
2	Families dependent on sericulture (No.)	1,25,700
3	Sericulture villages (No.)	10,795
4	Bivoltine seed cocoon production (lakhs)	2991.35
5	DFL production (in lakhs)	820.77
6	Quantity of cocoon produced and transacted including production of Mysore seed area (MT)	52,708.57
7	Raw silk production (metric tons)	7338.10
8	Average cocoon yield per 100 DFL (in kgs)	48.63
9	Cocoon production per hectare (in kgs)	841
10	Raw silk production per hectare (in kgs)	117.04
11	State government grainages (No.)	58
12	Central Silk Board grainages (No.)	6
13	Technical service centers (No.)	246
14	Private seed cocoon grainages (No.)	231
15	Silk cocoon markets (No.)	66

Source: Department of Sericulture, Government of Karnataka, Bangalore.

Table 3.2: General features of Belgaum district (2010-11)

Sl. No.	Particulars	Extent
1.	Geographical area (Ha)	1344382
2.	Population (No.)	4778439
3.	Urban population (No.)	11,48,258
4.	Rural population (No.)	36,30,181
5.	Sex Ratio (%)	969
6.	Hoblies (No.)	35
7.	Gram panchayats (No.)	485
8.	Villages (No.)	1255
9.	Population Density (No./Sq.Km)	356
10.	Average annual rainfall (mm)	823

Source: District Statistical Information Office, Belgaum.

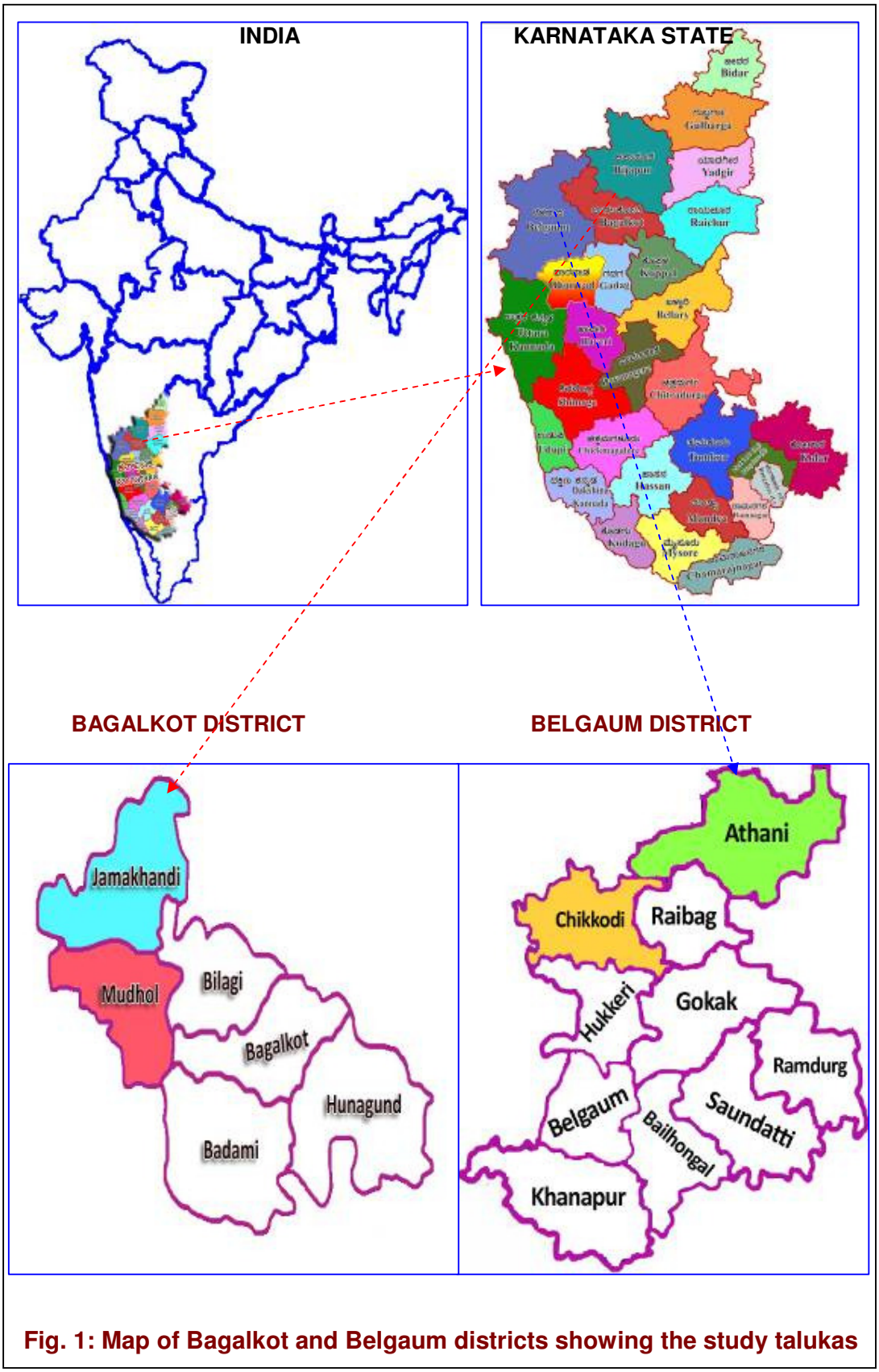

Fig. 1: Map of Bagalkot and Belgaum districts showing the study talukas

Fig. 1: Map of Bagalkot and Belgaum districts showing the study talukas

3.1.1.2 Climate, rainfall and soil type

Geographically, Belgaum district is classified in to three zones *Viz*., i) Northern Transitional Zone ii) Northern Dry Zone and iii) Hilly Zone. Belgaum, Bailhongal, Chikkodi and Hukkeri taluks fall under Northern transitional Zone, whereas, Athani, Raibag, Gokak, Ramdurg and Saundathi taluks come under Northern Dry Zone and Khanapur taluk comes under Hilly Zone.

There are three distinguishable agricultural seasons in the district namely *Kharif* (June-September), *Rabi* (October- January) and summer (February-May). The South-West monsoon commences by the end of the May or early June and it continues intermittently till the end of September.

The average annual rainfall in the entire district is 823 mm with major portion of the same being received from South-West monsoon. The district has been witnessing on an average, 53 normal rainy days annually. River Malaprabha, Ghataprabha and Krishna flows in the district.

Major portion of the district land area comprises of medium to deep black soils, whereas, some parts are having light black, red and black sandy soils. Raibag taluk soils are rich in soluble minerals, whereas, soils in other taluk have deficiency in soluble minerals.

3.1.1.3 Land use pattern in Belgaum district

Table 3.3 shows the land use pattern in the Belgaum district. The total geographical area of the Belgaum district is 13,44,382 hectares, out of which the net cultivable area is 1,13,710 hectares; the total irrigated area is 4,39,809 hectares. Out of which 47,509 hectares, 2,362 ha, 1,14,358 ha, 1,08,061 ha, 45,107 ha and 78,882 ha are irrigated by canals, tanks, open wells, bore wells, lift irrigation and other sources, respectively. The area not available for cultivation was 1, 13,710 hectares, fallow land was 4,434 hectares and 1, 90,424 hectares of land was under forests.

3.1.2 Bagalkot district

Bagalkot District is located in the Northern part of Karnataka which is the part of larger Deccan plateau. It lies between North latitude 16.12˚ and East longitude of 75.45˚. The district is situated at the height, ranging from 450 to 800 meters above mean sea level (MSL) and extends over an area of 6575 sq. km. and ranks twelth in area among the districts of the State. The District is bounded by Bijapur district towards north, Gadag district towards south, Raichur district towards east, Koppal district towards south east and Belgaum district towards west.

3.1.2.1 Population and Demography

The geographical area of Bagalakot district is 6,58,877 ha (Table 3.4) spread in six taluks with 12 towns, 18 hobalis and 623 villages. The population of the district according to 2001 census was 18,90,826 with 1000:977 male to female ratio. Out of total population in the district, 11.73 lakhs were in rural areas and the rest were in urban and semi urban areas, the overall population density of the district being 251 per sq. km. (1991-2001).

3.1.2.2 Climate, rainfall and soil type

There are three distinguishable agricultural seasons in the district namely *Kharif* (June-September), *Rabi* (October- January) and summer (February-May). The South-West monsoon commences by the end of the May or early June and it continues intermittently till the end of September.

The average annual rainfall in the entire district is 586 mm with a major portion of the same being received from South-West monsoon. The district has been witnessing on an average, 39 normal rainy days annually. River Krishna, Malaprabha and Ghataprabha flows in the district.

3.1.2.3 Land use pattern in Bagalkot district

Table 3.5 shows the land use pattern in the Bagalkot district. The total geographical area of the Bagalkot district was 6,58,877 hectares, out of which the net cultivable area was 53,642 hectares; the total irrigated area was 2,28,757 hectares.

Table 3.3: Land use pattern in Belgaum district (2010-11)

Sl. No.	Particulars	Area (hectares)
1	Geographical area	1344382 (100)*
2	Forests	190424 (14.16)
3	Land not available for cultivation	113710 (8.46)
4	Barren & uncultivable land	166574 (12.39)
5	Cultivable waste	40653 (3.02)
6	Permanent pasture land	24,807 (1.85)
7	Trees and plantation	3,085 (0.23)
8	Fallow land	4,434 (0.33)
9	Net area sown	833021 (61.96)
10	Net area irrigated	439809
11	Area irrigated by bore wells	108061
12	Area irrigated by wells	114358

Source: District Statistical Information Office, Belgaum.
* figures in the parentheses indicate percentage to the geographical area

Table 3.4: General features of Bagalkot district (2010-11)

Sl. No.	Particulars	Extent
1.	Geographical area (Ha)	658877
2.	Population (No.)	1890826
3.	Urban population (No.)	5,98,790
4.	Rural population (No.)	12,92,036
5.	Sex Ratio (%)	984
6.	Hoblies (No.)	18
7.	Gram panchayats (No.)	163
8.	Villages (No.)	623
9.	Population Density (No./Sq.Km)	251
10.	Average annual rainfall (mm)	586

Source: District Statistical Information Office, Bagalkot.

Table 3.5: Land use pattern in Bagalkot district (2010-11)

Sl. No.	Particulars	Area (hectares)
1	Geographical area	658877(100)
2	Forests	81126 (12.31)
3	Land not available for cultivation	53642 (8.14)
4	Barren & uncultivable land	24810 (3.77)
5	Cultivable waste	2035 (0.31)
6	Permanent pasture land	3429 (0.52)
7	Trees and plantation	274 (0.004)
8	Fallow land	50095 (7.60)
9	Net area sown	468276 (71.07)
10	Net area irrigated	228757 (66.72)
11	Area irrigated by bore wells	80357
12	Area irrigated by wells	11581

Source: District Statistical Information Office, Bagalkot.
* figures in the parentheses indicate percentage to the geographical area

Out of which 47509 hectares, 798 ha, 11,581 ha, 80,357 ha, 2924 ha and 85,588 ha were irrigated by canals, tanks, open wells, bore wells, lift irrigation and other sources respectively. The area not available for cultivation was 53,642 hectares, fallow land was 50,095 hectares and 81,126 hectares of land was under forests.

3.2 Technical aspect of mulberry cultivation and silkworm rearing

Production of mulberry is the key factor of the sericulture industry, since it is the only presently known food for silkworms. Mulberry leaves form the major component of the cost of cocoon production. Production of silk depends upon the quantity and quality of the cocoons produced by silkworms which inturn depend upon the quality and quantity of mulberry leaves fed to worms. Hence, cultivation of mulberry forms an integral and pivotal part of the sericulture industry. Indeed moriculture (cultivation of mulberry) is considered to be the most fundamental part of it. Mulberry can be raised on a variety of soils while, red and black soils are best suited. Mulberry leaves are fed to the silkworms and the by-product (stalks) is used as a fuel, every part of mulberry is useful.

Silkworm rearing is location specific. Areas with temperature ranging between 70^0F and 85^0F, humidity in the range of 60 to 80 per cent and the rainfall of about 600 mm are found suitable. About four to six harvests of cocoons (depending upon the output of mulberry leaf) is the normal feature in Karnataka. If staggered, the production process can be more continuous and supply will be more frequent. But for pathological reasons, most farmers do not stagger cocoon production. Also, the sprouting of mulberry leaves is not season bound however, the yield varies over the seasons; accordingly there are fluctuations in the output of silk cocoons. The generally vagrant supplies as opposed to a more or less even demand throughout the year trigger series of complications in the farm front. The temporal and special fluctuations have serious implications in crop pattern, crop mix, income stability, and output in the following seasons, similarly public policies, competition in the domestic and export markets etc also influence the production.

In the study area the farmers usually take 5 mulberry crops per year and generally not taken up during summer because of scarcity of irrigation water availability during the season. The leading mulberry variety in the study area was Victory-1(V1) and few farmers also cultivate M5 variety. These two are the high yielding mulberry varieties under irrigated condition. Whereas, in case of silkworm rearing they usually take up on an average 5 rearings in a year with an interval of 30 days for each rearing. This directly depends on yield of mulberry leaves. The leading silk worm breed in the study area was PM $\times$ CSR2 (cross breed hybrid).

3.2.1 Establishment of mulberry garden

Generally, mulberry garden required about six months for its establishment. Hence, labour units required and input quantities applied to the crop during six months period were collected for the purpose of analysis.

3.2.2 Mulberry cultivation during rearing period

The labour units and quantities of inputs and the corresponding costs required for rearing per acre of mulberry crop for each rearing was calculated and used for analysis. After completion of one rearing, the mulberry crop will be ready for next rearing in 30 to 45 days.

3.2.3 Cocoon production

Labour units and various inputs used in rearing of silkworm per acre per rearing (300 dfls) was collected for the purpose of analysis.

3.3 Sampling procedure and sources of data

3.3.1 Sampling procedure

The study has been conducted under the jurisdiction of University of Agricultural Sciences Dharwad. Belgaum and Bagalakot districts accounted the first and second largest districts with respect to area under mulberry (Table 3.6), respectively under both rainfed and irrigation conditions.

Table 3.7: Taluk-wise area under mulberry and production of silk cocoons in Belgaum district during 2010-11

Sl. No.	Taluk	Area under mulberry (hectares)	Cocoon production (MT)	Productivity (kg/ha)	Total farmers
1	Athani	92.74	57.13	616.02	240
2	Bailahongal	20.80	7.61	366.25	40
3	Belgaum	52.0	21.41	411.75	69
4	Chikkodi	73.60	41.06	557.93	169
5	Gokak	53.58	30.05	560.88	115
6	Hukkeri	55.68	20.06	360.38	141
7	Khanapur	7.20	1.24	173.47	14
8	Raibhag	33.0	15.87	481.09	72
9	Ramadurga	24.30	8.13	334.81	39
10	Soundatti	72.28	32.23	445.97	98
	Total	**485.18**	**234.83**	**484.02**	**997**

Source: Department of Sericulture, Belgaum.

Table 3.8: Taluk-wise area under mulberry and production of silk cocoons in Bagalakot district during 2010-11

Sl. No.	Taluk	Area under mulberry (hectares)	Cocoon production (MT)	Productivity (kg/ha)	Total Farmers
1	Badami	57.8	23.88	413.21	77
2	Bagalakot	40.0	8.71	217.97	40
3	Bilagi	41.3	18.12	438.74	50
4	Hunugunda	65.9	32.20	488.74	74
5	Jamkhandi	79.9	28.91	361.86	116
6	Mudhol	67.5	30.25	448.14	112
	Total	**352.4**	**142.09**	**403.21**	**469**

Source: Department of Sericulture, Bagalakot.

Hence, these two districts were selected for the study. Further, a multistage random sampling procedure was adopted to select the taluks, villages and farmers. In the first stage, Belgaum and Bagalakot districts were selected as these two districts were the major mulberry silk producing districts under the jurisdiction of University (Table 3.6). In the second stage, Athani and Chikkodi taluks in Belgaum district and Mudhol and Jamkhandi taluks in Bagalakot district were selected, as the area under mulberry was higher in these taluks (Table 3.7 and 3.8). In the next stage, five villages each from the four selected taluks were selected based on the mulberry area and also based on the discussion with the officials of the Sericulture Extension Departments in the respective taluks. The villages so selected in Belgaum district were, Aigali, Madabhavi, Arabala, Mangasuli and Hanumapura from Athani taluk, and Kabbura, Ummarani, Chikkodi,Kammathanahatti and Donawada from Chikkodi taluk. The villages selected in Bagalakot district were Marapura, Hebbala, Belagali, BudniP.D and Halagali from Mudhol taluk and Thungala, Navalagi, Banahatti, Chikkalagi and Gadyala from Jamkhandi taluk. For each selected village, a list of farmers growing mulberry were prepared. From the list, six sericulturists were selected at random from each village. Thus, the total sample size constituted 120 sericulturists, from whom the data were elicited on various aspects of mulberry cultivation and silkworm rearing.

3.3.2 Sources of data

The Sericulturists were interviewed personally by using a schedule prepared for the purpose. Primary data pertaining to sericulturists on socio-economic characteristics, land holdings, cropping pattern, asset position, cost and returns, marketing of cocoons and constraints involved in production of mulberry and silk cocoon were collected. Keeping in view the objectives of the study, the data pertaining to 2010-11 period were collected from the respondents during the months February-March, 2012.

The secondary data relating to area under mulberry and production of silk cocoon were collected from department of sericulture, Government of Karnataka and various other published sources.

3.4 Analytical frame work

For the quantitative assessment of the objectives set out in the study and for meaningful conclusions, the following analytical tools were employed to analyse the data collected under the study.

a) Compound growth rate analysis

b) Tabular analysis

c) Budgeting technique

d) Cobb-Douglas production function

e) Garrett's ranking technique

3.4.1 Growth rate analysis

The growth rates of mulberry area and cocoon production were computed for each district of Karnataka and also for traditional districts, non-traditional districts and for the state as a whole. The districts of the state were divided into two groups based on the area under mulberry or sericulture *viz*., traditional districts and non-traditional districts. Traditional districts are those which were practicing sericulture since many years and on a large area contributing substantially to the states economy. Non-traditional districts are that which were practicing sericulture on small area and which has been introduced in eighties and nineties.

In present study the undivided districts of Karnataka were considered because two districts namely, Chikkaballapur and Ramanagar were divided from Kolar and Bangalore rural districts in 2008, respectively. Whereas, Yadgir district was divided from Gulbarga in 2011.

The average annual growth rates were estimated using an exponential growth function of the form,

$$Y = A\, b^{t}\, e^{u} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

Where,

Y = Dependent variables *viz.*, area under mulberry, and cocoon production.

A = intercept

b = (1 + r)

r = average annual growth rate to be estimated.

t = time in years

e^{u} = error term

The growth rate analysis pertained to the period 2000-01 to 2010-11. The multivoltine

Cocoons include the pure multivoltine and improved crossbred silkworm races.

3.4.2 Tabular analysis

The primary data collected from 120 respondent farmers was subjected to simple tabular analysis. Tabular analysis including the computation of means, percentages etc., were employed to present the data in respect to demographic feature, socio-economic profile and cropping pattern adopted by sericulture farmers. The cropping intensity was calculated using following formula,

$$\text{Cropping intensity} = \frac{\text{Gross cropped area}}{\text{Net cropped area}} \times 100$$

3.4.3 Budgeting technique

The budgeting technique was used to compute the costs and returns in mulberry cultivation silkworm rearing.

It was noticed that some of the respondents sold part of their mulberry leaf produced and some purchased leaf for seed cocoon production. The total cost of mulberry leaves is calculated by multiplying average yield of leaves with average price at which farmer respondents sold part of their mulberry leaf produced or purchased leaf for seed cocoon production.

The input use and output obtained per 300 disease free layings (dfl) were computed.

The row system of mulberry was in practise in the study area. Under this the shoots were also harvested along with the leaves. The quantity of leaf fed to the silkworms therefore, also included the weight of the shoot portions which generally not consumed. The by-product, litter was also accounted in the analysis.

3.4.4 Cobb-Douglas production function

For evaluating the resource productivities and allocative efficiency of important resources used in mulberry cultivation and cocoon production by farmers, the Cobb-Douglas type production function analysis was employed to the farm level data with a view to determine the extent to which these resources explained the variability in its yield and to determine the extent of contribution each to the returns.

The production function specification was as follows in mulberry cultivation:

$$Y = a x_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} x_5^{b5} x_6^{b6} e^{u}$$

The function was converted into the linear form by making logarithmic transformations of all the variables as under:

$$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + u$$

Where,

Y = Output of mulberry crop produced (Rs. per acre)

a = Intercept term

U = Error term

X_1 = Organic manures (Rs. per acre)

X_2 = Fertilizers (Rs. per acre)

X_3 = Growth regulators (Rs. per acre)

X_4 = Irrigation (Rs. per acre)

X_5 = Human labour (Rs. per acre)

X_6 = Bullock labour (Rs. per acre)

b_i = Regression coefficient of the i^{th} independent variable (i= 1 to 6).

The production function specification was as follows in cocoon production:

$$Y= ax_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4}$$

The function was converted into the linear form by making logarithmic transformation of all the variables as under:

$$\text{Log } Y= \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + u$$

Where,

Y = Gross returns from selling of cocoons (Rs. per 300 dfls)

a = Intercept term

U = Error term

X_1 = mulberry leaves (Rs. per 300 dfls)

X_2 = dfls (Rs. per 300 dfls)

X_3 = Disinfectants (Rs. per 300 dfls)

X_4 = Human labour (Rs. per 300 dfls)

b_i = Regression coefficient of the i^{th} independent variable (i= 1 to 4).

To evaluate the goodness of fit of the regression equation fitted, the adjusted coefficients of multiple determination (R^2) were calculated by using the formula

$$\bar{R}^2 = 1 - (1- R^{-2}) (n-1) / n-k$$

Where,

$\bar{R}^2$ = adjusted coefficient of multiple determination

R^2 = Coefficient of multiple determination

n = Number of observations

k = Number of parameters

Marginal value products

If the resource or input factor is considered to be used most efficiently, then its marginal value product (MVP) is just sufficient to effect its cost. Equality of marginal value product to factor cost therefore is the basic condition that must be satisfied to obtain efficient resource use. In Cobb-Douglas production function, marginal value product (MVPs) of Xi, the i^{th} input factor is given by the following formula:

$$\text{MVP of Xi} = Y/ Xi \times bi \times Py$$

Where,

Y = Geometric mean of the yield of mulberry leaves and total cocoon production (Y)

Xi = Geometric mean of input Xi

b_1 = Regression coefficient of Xi

Py = Price of output

After computation of marginal value product of a variable, it is to be compared with its acquisition cost or opportunity cost. If the variable in the production function is taken in rupee term, acquisition cost of a unit of that input will be one rupee.

When the input is expressed in physical units, then the marginal value product must be compared with the actual acquisition cost of one physical unit of that input.

3.4.5 Garrett's ranking technique

Garrett's ranking technique was used to identify the constraints in mulberry cultivation, cocoon production and marketing of cocoons in study area. Garrett ranking is applied to rank a set of items or factors as perceived by the sample respondents based on their priority. The order of merit assigned by the respondents was converted into scores using the formula given by Garrett and Woodworth (1977).

$$\text{Per cent position} = \frac{100\ (R_{ij} - 0.5)}{N_j}$$

Where, R_{ij} = the rank of the i^{th} item by j^{th} individual and

N_j = the number of items ranked by the j^{th} individual.

By referring the Garrett's table, per cent position estimated was converted into score. Then, for each factor the scores of various respondents were added and the mean score was calculated. The factor with the highest mean score was considered to be the most important constraint. Thus, mean score for each constraint was ranked by arranging them in the descending order.

3.5 Definitions of terms and concepts used

Planting material: the planting material used (mulberry cuttings) was valued at the current market rate.

Cost of dfl: The cost of dfl was calculated at the actual price paid by each farmer plus the incidental costs incurred on dfl procurement.

Chawki rearing cost: The cost involved in rearing the early or first three stages of silkworms (after hatching from the eggs).

Cost of mulberry leaf: The actual quantity of mulberry leaf consumed for the silkworm was multiplied by the imputed cost (per kg) of leaf for each sericultrist. The purchased leaves, if any, were accounted at the actual cost.

Cost of disinfectants: It was the cost of all the chemicals used to disinfect the rearing house after each rearing is over. The actual purchase price of all the chemicals was considered as the total cost of disinfectants.

Human labour: Human labour was valued at the prevailing wage rate paid by each farmer on per man-day basis. The cost of family labour was imputed at the wage rate paid to the hired casual labour. The man-day equivalents of women and child labour were worked out by using the wage ratios.

Cost of paraffin paper or news paper: It was the actual purchase price of the news paper. The price of news paper was Rs. 10 to Rs. 12 per kg.

Stalks: It refers to the residual portion of mulberry plant which remained on the ground after leaves are harvested. Generally it is used as fuel; this can also be used as planting material. The prevailing rate for stalk was calculated and used.

Apportioned cost of rearing house and depreciation charges of rearing equipments: The apportioned cost of rearing house for a lifespan depending on the type of construction was included under this cost. The rearing equipments comprised rearing stands, mountages, uzi-nets, uzicide sprayer and leaf cutting knives. The depreciation charges were worked out by using straight line method. The life span refers to average expected life of the asset as furnished by the farmers.

$$\text{Annual depreciation} = \frac{\text{Purchase value} - \text{Junk value}}{\text{Life span of the asset}}$$

Land rent: It was estimated on the basis of rent paid to similar land in villages. The average land rent prevailing was Rs. 10500 per acre.

Land revenue: The actual payments made to the government were considered for calculation of land revenue. It was apportioned to actual area under mulberry crop. The average land revenue paid was Rs. 20.50 per acre per crop.

Apportioned annual establishment cost: The apportioned annual establishment cost was estimated by the average life span of mulberry garden. The establishment cost was estimated during the reference year using the average physical input required for one acre and the corresponding average prices, since, mulberry gardens were established during different years in the past. This procedure was adopted to bring the establishment cost to uniform comparable basis. This establishment cost included mainly, the labour cost on land preparation, cost of cuttings, planting and application of organic manures, fertilizers *etc.* during the establishment period.

Interest on working capital: This was computed at the rate of 8 per cent per annum on the cost of dfls, mulberry leaf, human labour, hired charges of mountages, disinfectants and disinfestations cost, news paper cost, cocoon picking (harvesting) cost, marketing cost for a period of one month which is the average period required to raise one cocoon crop.

Interest on fixed capital: The annual charge on fixed assets and equipments was charged at 11 per cent per annum. This was then apportioned based on the number of cocoon crops raised per year.

Cocoons: The main product of the silkworm rearing is the good and standard cocoons and these were valued at the actual prices realised by sericulturists at each sale of the produced cocoons.

Litter: The faecal pellets of silkworm and the leaves left over after every feeding were used as farm yard manure (FYM) and were valued at the prevailing price of FYM. Actual price of FYM per quintal was considered as the price of the litter per quintal.

Gross income: The gross income realised from silk cocoon production consisted of the value of total cocoons produced and the value of the litter as well as value of fodder.

Net income: The net income from silk cocoon production was estimated by deducting the total cost of cocoon production from the gross income.

Marketing cost: This included the cost of transportation of cocoons to the market, the market fee and other incidental expenses incurred in marketing of cocoons.

Traditional districts: Traditional districts are those which were practicing sericulture since many years and on a large area contributing substantially to the states economy. These districts include Bangalore rural, Kolar, Chikkaballapur, Ramanagar, Mandya, Mysore, Tumkur and Chamarajanagar.

Non-traditional districts: Non-traditional districts are that which were practicing sericulture on small area and which has been introduced in eighties and nineties.

dfls: dfls standards for disease free layings, each dfl consists of 250 to 300 eggs.

Organic manure: Total quality of organic manure applied per year per acre was ascertained and then was apportioned for each rearing season considerably five rearings per annum and the prevailing price per tonne was used to get the cost incurred.

4. RESULTS

The necessary data were collected from the respondents spread over Belgaum and Bagalkot districts of Karnataka. The data were subjected for analysis using various statistical tools and techniques in order to draw meaningful conclusions. The results of the study are thus presented in this chapter under the following subheads.

4.1 Trends in mulberry area, cocoon production and productivity of cocoons

4.2 General characteristics of the sample respondents

4.3 Economic aspects of mulberry cultivation

4.4 Economic aspects of silk cocoon production

4.5 Allocative and use efficiency of resources in sericulture.

4.6 Marketing cost of cocoons

4.7 Constraints in sericulture production

4.1 Trends in mulberry area, silk cocoon production and cocoon productivity

For the purpose of analyzing the growth in area under mulberry, cocoon production and its productivity, the districts were divided into traditional sericulture and non-traditional sericulture districts based on the extent of area under mulberry and contribution to the total state's silk cocoon production. The traditional areas owing to geographical, agro-climatic advantage tended to influence in terms of area and production of the state.

The annual compound growth rates of area under mulberry for the period of ten years from 2001-02 to 2010-11 in the different districts of Karnataka state were worked out and the results are presented in Table 4.1. It could be ascertained from the results that during this period the area under mulberry in the state has declined at the rate of 3.38 per cent every year. The growth in mulberry area in six traditional/major sericulture districts that contributed substantially to the state's mulberry area was also computed to know the present status. The traditional districts in terms of large area share were Kolar (39.35%), Bangalore Rural (22.26%), Mandya (16.26%), Chamrajnagar (10.52%), Tumkur (5.97%) and Mysore (5.63%), The corresponding average mulberry areas in the major districts for the ten year period were 29,304 ha, 16,578 ha, 12,108 ha, 7838 ha and 4448 ha and 4194 ha, respectively. These major districts together accounted for 88.21 per cent of the total mulberry area in the state. Out of six traditional districts five districts showed decline in mulberry area. The highest decline in area was observed in case of Tumkur, Mysore and Chamarajnagar districts at the rate of 16 to 16.50 per cent per annum and were significant at 1 per cent probability level. In other districts annual decline in area ranged between 0.31 per cent and 2.09 per cent. Among the major silk growing districts, the increase in the mulberry area was observed only in Mandya district at an annual rate of 6.78 per cent and also significant at 1 per cent probability level. Thus, the overall growth rate of traditional districts in terms of mulberry area was negative (-4.09%) and non-significant.

The rest twenty one non-traditional districts accounted the remaining 11.79 per cent of the state's mulberry area. Even in these non-traditional districts there was also a decline in the area under mulberry in the last ten year period and the decline was observed to be at the rate of 3.70 per cent per annum. The comparison across non-traditional districts with respect to mulberry area showed that the growth rates in area showed a decline and ranged between 0.25 to 22.14 per cent per annum. Among the non-traditional districts, there was an increased area under mulberry in Haveri (16.05% annually), Bijapur (6.73% per annum) and Bidar (5.91% per annum) districts. Only ten districts showed a positive growth rate in respect of area and the remaining all districts showed negative growth rate.

The annual growth rates of cocoon production in traditional and non-traditional districts and for the state as a whole for the period 2001-02 to 2010-11 have been presented in the Table 4.1. Consequent to decline in the area under mulberry over a period of ten years, the total cocoon production in state also has declined annually at the rate of 1.17 per cent and decline was non-significant. Almost fifteen districts showed negative growth rate in respect of cocoon production during the study period.

Among the traditional sericulture districts, highest annual decline in the production was witnessed in case of Chamarajanagar (26.45%) followed by an annual decrease in cocoon production by 19.09 per cent in Mysore and 14.41 per cent in Tumkur district and significant at 1 per cent probability level. Mandya, Bangalore rural and Kolar districts were the only traditional districts which showed positive growth rate in cocoon production. However, a marginal annual increase in growth (0.027%) intotal cocoon production in the traditional districts was largely contributed by increased production of cocoon in Mandya (5.25%) and significant at 5 per cent probability level, which also registered an area increase (6.78 per cent per annum) during the study period. This was also contributed by incurred cocoon production during the period in Bangalore rural (2.97 per cent per annum) and Kolar (0.34 per cent per annum) districts although these districts witnessed a decreased area under mulberry over the study period and in case in cocoon production in these districts was non-significant. Among the traditional districts, Kolar contributed 36.89 per cent of the cocoon production followed by Bangalore rural (33.50%), Mandya (16.95%), Tumkur (6.32%), Chamarajnagar (3.25%) and Mysore (3.10%) in that order.

In the non-traditional districts Haveri (17.63%), Chitradurga (17.15%) and Raichur (12.89%) districts have shown highest growth rates in cocoon production and also significant at 1 per cent probability level and contributed 16.05 per cent, 24.24 per cent and 1.23 per cent of the production in non-traditional districts. However, of the total production contributed by non-traditional sericulture districts, Bangalore urban and Chitradurga contributed around 25 per cent of cocoon production each followed by Bellary (11.79%), Hasan (8.43%) and Haveri (5.98%) districts. Production growth rate in respect of cocoon among non-traditional districts showed a highest decline of 20 per cent to 22 per cent each in Udupi, Kodagu and Dakshin Kannada districts followed by Dharwad (13.93%), Hasan (9.17%). However, the overall growth rate for cocoon production in non-traditional districts was decreased by 5.70 per cent annually during ten year study period and this decline was non-significant. The production share of these non-traditional districts constituted an insignificant proportion to the total for the state due to smaller area under mulberry cultivation and there by production. Therefore, a high annual growth rate need not imply a corresponding higher increase in silk cocoon production in absolute terms.

The annual growth rates of cocoon productivity in the traditional districts and non-traditional districts and for the state as whole for the period 2001-02 to 2010-11 have been also presented in the Table 4.3 and 4.4. The per hectare cocoon productivity registered marginally increase in the state and has grown at the rate of 1.73 per cent annually during the period from 2001-02 to 2010-11. Among the traditional districts, Bangalore rural (7.53 per cent annually and significant at 5 per cent probability level) and Tumkur (2.50 per cent annually) have shown substantial increase in per hectare productivity while, other districts in the traditional area showed a declining trend w.r.t. productivity which ranged between 1.42 to 12.27 per cent annually. Almost seventeen districts showed negative growth rate in respect of per hectare cocoon productivity. The traditional sericulture districts together showed overall positive growth rate in respect of per hectare cocoon productivity (1.01%).

In non-traditional districts, Gadag (9.94%), Raichur (7.21%), Belgaum (5.69%) and Bagalkot (5.12%) have shown increasing trend in terms of growth per hectare of cocoon productivity over the study period. On the other hand, the non-traditional districts such as Udupi, Dakshin Kannada, Chitradurga, Chikkamagalur, Shimoga, Dharwad, Hassan Bijapur, Bellary, Davanagere, Koppal, Uttara Kannada and Bangalore urban witnessed declining growth in per hectare productivity and it ranged as high as 15.55 per cent to as low as 0.35 per cent. The overall cocoon productivity in the non-traditional districts showed a declining trend (0.41%) during the ten year period.

The six traditional sericulture districts accounted for 88.21 per cent of the total mulberry area in the state (84,420 ha) and 91.76 per cent of the state's (55,742 metric tonn) production. The remaining area and production is shared by non-traditional sericulture districts of the state. Overall, total area under mulberry in the state is declined in the last ten year period under study from 2001-02 to 2010-11. However, the rate of decline was comparatively lesser in case of non-traditional districts (-3.07%) than in traditional districts (-4.09%). Similarly, with respect to cocoon production, the annual production declined (-5.70%) in the non-traditional districts while, it was found to be marginally increasing (0.027%) in the traditional districts.

Table 4.1: Average annual growth rates of area under mulberry and production of cocoon in Karnataka (2001-02 to 2010-11)

Sl. No.	District	Average mulberry area in ha	Percentage area	CGR in area (%)	Average cocoon production in MT	Percentage cocoon production	CGR in production (%)	Average productivity in kg/ha	CGR in productivity (%)
I. Traditional Districts									
1	Bangalore Rural	16578	22.26	-2.09	17136.8	33.50	2.97	1033.71	7.53*
2	Chamrajnagar	7837.7	10.52	-16.16**	1660.14	3.25	-26.45**	211.81	-12.27*
3	Kolar	29304	39.35	-0.31	18868.1	36.89	0.339	643.88	-1.54
4	Mandya	12108	16.26	6.78**	8670.56	16.95	5.25*	716.10	-1.42
5	Mysore	4193.7	5.63	-16.47**	1584.64	3.10	-19.09**	377.86	-3.13
6	Tumkur	4447.9	5.97	-16.5**	3230.83	6.32	-14.41**	726.37	2.5
	Total	**74469.3**	**100.00**	**-4.09**	**51151.1**	**100.00**	**0.027**	**686.87**	**1.01**
II. Non-traditional Districts									
7	Bangalore Urban	1626.5	16.35	-6.76**	1128.36	24.58	-7.09**	693.74	-0.35**
8	Bagalkot	385.6	3.88	5.29	111.54	2.43	10.69*	289.26	5.12
9	Belgaum	526.2	5.29	-0.97	259.97	5.66	4.66	494.05	5.69*
10	Bellary	871.7	8.76	0.31	541.12	11.79	-2.17	620.76	-2.48*
11	Bidar	257.9	2.59	5.91*	96.89	2.11	7.6**	375.69	1.59
12	Bijapur	197.4	1.98	6.73	58.29	1.27	4.03	295.29	-2.53
13	Chikkamagalur	143.3	1.44	-5.47*	24.74	0.54	-10.6**	172.64	-5.42*

Contd....

Sl. No.	District	Average mulberry area in ha	Percentage area	CGR in area (%)	Average cocoon production in MT	Percentage cocoon production	CGR in production (%)	Average productivity in kg/ha	CGR in productivity (%)
14	Chitradurga	2014.8	20.25	-13.13**	1113.58	24.25	17.15**	552.70	-5.46
15	Dakshin Kannada	94	0.94	-10.13*	7.68	0.17	-20.48**	81.70	-11.52*
16	Davangere	327.1	3.29	-0.25	149.6	3.26	-2.65	457.35	-2.39
17	Dharwad	103.2	1.04	-9.21**	33.73	0.73	-13.93**	326.84	-5.2**
18	Gadag	166.1	1.67	0.46	65.51	1.43	10.45**	394.40	9.94**
19	Gulbarga	334	3.36	-1.08	115.55	2.52	0.384	345.96	1.48
20	Hassan	1223.6	12.30	-5.73	386.86	8.43	-9.17*	316.17	-3.64
21	Haveri	591	5.94	16.05**	274.67	5.98	17.63**	464.75	1.35
22	Kodagu	94.3	0.95	-22.14**	8.64	0.19	-22.08**	91.62	0.08
23	Koppal	165.1	1.66	0.03	44.74	0.97	-1.91	270.99	-1.95
24	Raichur	282.2	2.84	5.29	56.3	1.23	12.89**	199.50	7.21
25	Shimoga	252.9	2.54	4.68	65.98	1.44	-0.76	260.89	-5.2
26	Udupi	57.3	0.58	-7.81	4.25	0.09	-22.15**	74.17	-15.55**
27	Uttara Kannada	236.6	2.38	-6.27**	43.24	0.94	-7.11**	182.76	-0.9
	Total	**9950.8**	**100.00**	**-3.7**	**4591.24**	**100.00**	**-5.7**	**461.39**	**-0.41**
	Karnataka	**84420.1**		**-3.38***	**55742.3**		**-1.17**	**660.30**	**1.73***

* - Significance at 1% level ** - Significant at 5% level

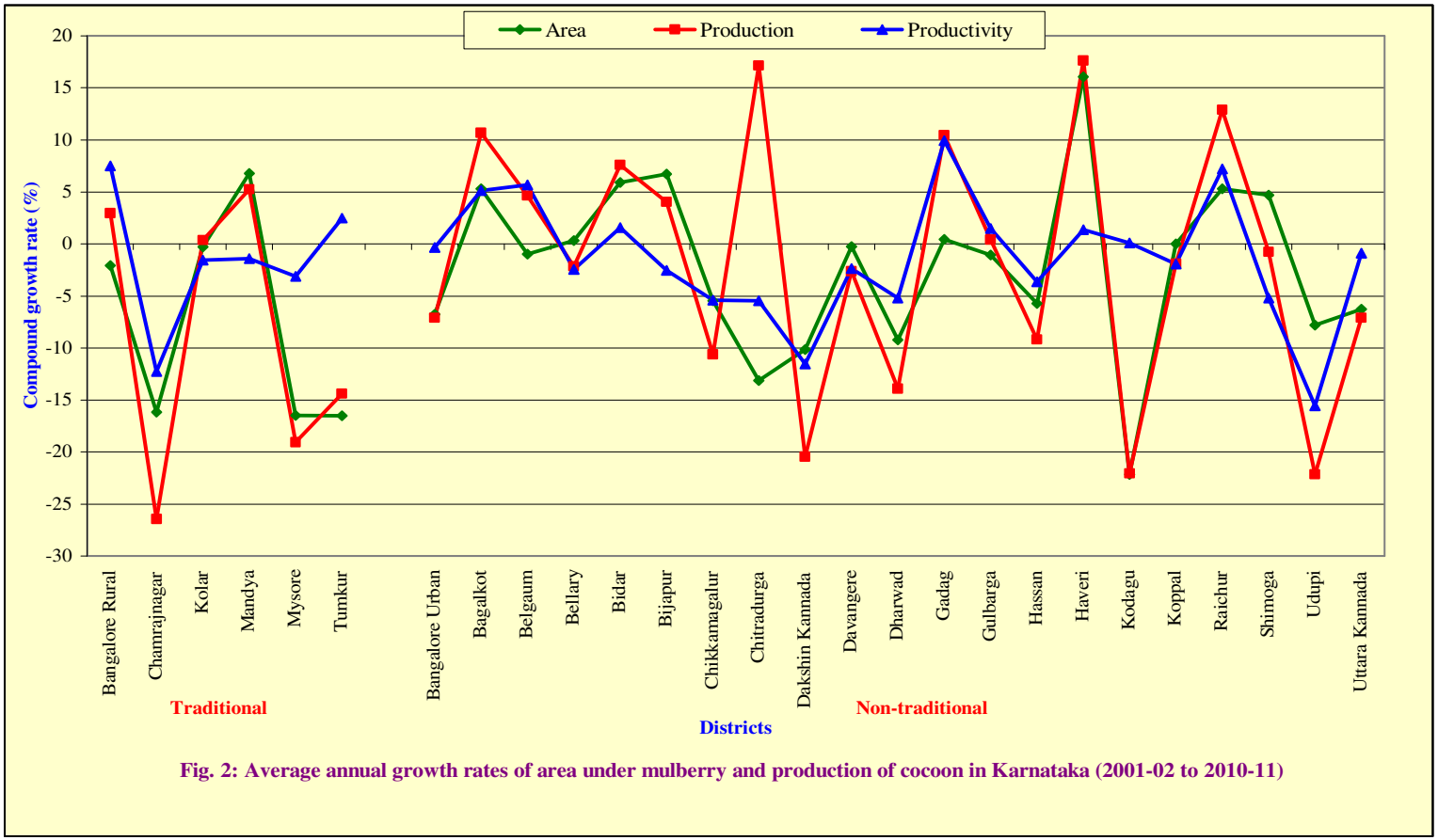

Fig. 2: Average annual growth rates of area under mulberry and production of cocoon in Karnataka (2001-02 to 2010-11)

Fig. 2: Average annual growth rates of area under mulberry and production of cocoon in Karnataka (2001-02 to 2010-11)

Table 4.2: Composition of mulbery area cocoon production and its productivity in Karnataka (average 2001-02 to 2010-11)

Area	Mulbery area,ha	Per cent area	Cocoon prodoction, MT	Per cent cocoon production	Cocoon productivity, Kg/ha
Traditional districts	74469.30	88.21	51151.09	91.76	686.87
Non-traditional districts	9950.80	11.79	4591.24	8.24	461.39
Total	**84420.10**	**100.00**	**55742.33**	**100.00**	**660.30**

On the other hand, cocoon productivity was found to be increasing in the traditional districts at the rate of 1.01 per cent per annum with an average productivity of 686.87 kg per ha while, in case of non- traditional districts cocoon productivity (-0.41 per cent per annum) it was found to be decreasing with an average productivity of 461.39 kg per ha.

4.2 General characteristics of the sample respondents

The general and socio-economic characteristics of sample farmers in the study districts namely, Belgaum and Bagalkot Districts in Karnataka was analyzed to get insight about farmers in respect of age-wise distribution, occupational pattern, level of literacy and educational achievement, family composition, type and size, ownership of land, years of experience in mulberry cultivation and rearing of silkworms *etc.* The study of general characteristics of sample farmers therefore is expected to provide a bird's eye view of the overall general features of farmers across the study districts. The results in Table 4.3 indicated that the majority of the respondent farmers in both the districts together belonged to the age groups between 31-40 years (36.66%) and 41-50 years (35.83%), these groups together accounted for as large as 72.49 per cent of them were in the age group from 31-50 years. The remaining 22.50 per cent were above 50 years of age. The age wise distribution of respondent farmers involved in sericulture in selected study districts revealed almost a similar feature about 35 to 37 per cent of them were to the age group between 31 to 40 and 41 to 50 years each. On an average 20.00 and 22.50 per cent of farmers aged above 50 in Belgaum and Bagalkot districts. Only 5.00 per cent of them were below 30 years age across districts. The overall average age of mulberry growers in the sample districts was observed to be 47 years. As for as occupation was concerned, 78.33 per cent of sample respondents of the study districts as a whole undertook agriculture as their main occupation while, the remaining 21.67 per cent of them pursued sericulture as their main occupation and as source of income. There was not much variation in the occupational pattern of sample farmers between districts where, 77 per cent and 80 per cent farmers, respectively in Belgaum and Bagalkot districts had agriculture as main occupation followed by 23 and 20 per cent of them pursued sericulture as main occupation in that order.

With regard to educational achievements, 80.83 per cent of sample farmers were observed to be literates and the remaining 19.17 per cent were illiterates. Among the literates, about 19 per cent farmers across study districts found to have completed collegiate education. A comparison of educational status of farmers among the districts showed that proportion of literates in case of Belgaum were relatively more (87%) when compared to Bagalkot district (75%). Besides this, the proportion of farmers having collegiate education were more in Belgaum district (23.33%) compared to Bagalkot (15%) district. Contrary to this, proportion of illiterates farmers were more in case of Bagalkot (25%) over farmers of Belgaum (13.33%) district.

The average size and family composition of mulberry farmers depicted almost a similar status between male (50 to 53%), female (33 to 34%) and children (14 to 16%) members in case of Belgaum and Bagalkot. However, female members accounted considerably a lower (33.42%) proportion of total members of the family than constituted by male (52.08%) counterparts. This trend was applicable to farmers in both districts. The results thus implied low female work force per farm household and could be of concern. The average size of family across districts and overall for the study area was 7 to 8 members. The type of the family observed among sample respondents was more infavour of nucleus type in Belgaum (86.67%) and Bagalkot (78.33%). Among the farmers who adopted joint family system, farmers in Bagalkot out numbered (21.67%) when compared to Belgaum (13.33%) farmers.

The average land holding under mulberry crop was 1.30 acre which accounted about 14 per cent of farm size among the sample farmers. The average operational land holding size of the sample respondents across districts together was 9.02 acres. Out of this farm size 63.17 per cent (5.95 acre) was under irrigated condition and the remaining 32.50 per cent (3.07 acre) was under rainfed cultivation and the remaining 4.33 per cent hectares was fallow land.

Table 4.3: General characteristics of sample respondents

Sl. No.	Particulars	Unit	Belgaum n=60	Bagalkot n=60	Over all n=120
1	**Age (average)**	Years	46	48	47
a	Below 30	No.	4 (6.60)	2 (3.33)	6 (5.00)
b	31-40	No.	22 (36.66)	22 (36.66)	44 (36.66)
c	41-50	No.	22 (36.66)	21 (35.00)	43 (35.83)
d	Above 50	No.	12 (20.00)	15 (25.00)	27 (22.50)
2	**Occupation**				
a	Agriculture as main occupation	No.	46 (76.66)	48 (80.00)	94 (78.33)
b	Sericulture as main occupation	No.	14 (23.33)	12 (20.00)	26 (21.67)
3	**Education**				
a	Illiterates	No.	8 (13.33)	15 (25.00)	23 (19.17)
b	Primary school	No.	17 (28.33)	20 (33.33)	37 (30.83)
c	High school	No.	21 (35.00)	16 (26.66)	37 (30.83)
d	College	No.	14 (23.33)	9 ((15.00)	23 (19.17)
4	**Family composition**				
a	Male	No.	3.75 (50.27)	4.01 (53.47)	3.88 (52.08)
b	Female	No.	2.51 (33.65)	2.46 (32.80)	2.49 (33.42)
c	Children	No.	1.20 (16.08)	1.03 (13.73)	1.08 (14.50)
	Average family size	No.	7.46 (100)	7.50 (100)	7.45 (100)
5	**Type of family**				
a	Joint family	No.	8 (13.33)	13 (21.66)	21 (17.50)
b	Nucleus family	No.	52 (86.66)	47 (78.33)	99 (82.50)
6	**Average area under mulberry**	**acre**	**1.30 (13.43)**	**1.32 (14.32)**	**1.30 (13.79)**
7	**Land holdings**				
a	Irrigated land	acre	6.40 (67.36)	5.50 (59.00)	5.95 (63.17)
b	Dry land	acre	2.92 (30.78)	3.25 (35.13)	3.07 (32.50)
c	Permanent Fallow land	acre	0.37 (3.86)	0.50 (5.40)	0.40 (4.33)
d.	Operation holding	acre	9.32 (96.38)	8.75 (94.59)	9.02 (95.76)
8	**Total farm size**	**acre**	**9.67 (100)**	**9.25 (100)**	**9.42 (100)**
9	Experience in mulberry cultivation and cocoon production	Years	13	9	11
10	Mulberry variety	-	Victory1 (V1)	Victory1 (V1)	Victory1 (V1)
11	Silkworm breed	-	PM x CSR2	PM x CSR2	PM x CSR2

The overall average holding size of the farmers in both districts together was 9.42 acres. However, there was not much variability in respect of ownership of land among the farmers between the districts and it was 9.67 acres by farmers in Belgaum and 9.25 acres in Bagalkot district. On an average, the operational land holding accounted to about 96.38 per cent and 94.59 per cent of the total holding size in case of Belgaum and Bagalkot districts, respectively. The remaining (4 to 5%) area was permanently fallow and was not available for cultivation. The area cultivated under mulberry by the farmers in each district (about 1.30 acre) and overall for both districts together (about 1.30 acre) remained the same and across the districts and the proportion varied between 13.43 per cent and 14.32 per cent of the operational area. The pattern of operated land held under irrigated and dry conditions revealed that a large proportion of the operated holding was under irrigation in both the districts and the same was relatively more in Belgaum (68.63%) than in Bagalkot (62.86%). The remaining 31.37 and 37.14 per cent of the operated area was under rainfed production. On an average, farmers in Belgaum district were involved for long (13 years) in mulberry cultivation and rearing of silkworms when compared Bagalkot (9 years) farmers. The farmers and both districts cultivated Victory 1 mulberry variety and PM $\times$ CSR2 was the silkworm reared by farmers.

4.2.1 Cropping pattern of sample farms

The analysis of present cropping pattern followed by farmers provide useful information on the relative importance of crops in the cropping mix by farmers in the study districts and the significance of mulberry cultivation in the total cropped area among the farmers. This intern would provide the contribution of sericulture as a source of income to the farm households. Such a study becomes important to understand farmer's decisions to bring changes in land use and crop mix patterns at the farm level particularly when factors that mainly originate from the market induce such changes. The cropping pattern depicting area under different crops on selected sample mulberry growers in both districts is presented in Table 4.4.

The main cereals cultivated by farmers were maize, sorghum, bajra and wheat and among the pulses, farmers cultivated green gram, horse gram and bengalgram. The major commercial crops were sugarcane and cotton. While, among oil seeds groundnut and soybean were cultivated. Turmeric, citrus, banana and beetle vine were the perennial horticultural crops cultivated in both districts. The gross cropped area was relatively more in case of Belgaum farmers and accounted 12.05 acres when compared to 10.06 acres by farmers of Bagalkot district with an overall cropped area of 10.55 acres for both district together. Cereals and pulses occupied a major cropped area in both the districts and were marginally more in case of Belgaum (64.07%) when compared to Bagalkot (60.14%). The overall area under cereals and pulses together in both districts remained at 59.91 per cent followed by commercial crops (18.10%). The proportion of area allocation remained almost the same in the study districts with respect to commercial crops (around 18.10%) and oilseeds (around 5.02%). Of the commercial crops, sugarcane occupied major area of 17.82 per cent across districts followed by only a very small area under cotton (0.28%) crop. The area allocated under horticulture crops was marginally more among farmers of Bagalkot (4.87%) over Belgaum (3.65%). *Kharif* was a major season in both districts. The season wise proportion of cropped area did not show any variation between districts and on an average it was as high as 64 per cent during *kharif*, only 22.37 per cent in *rabi* season while, it was around 14 per cent under perennial crops in the study districts. Among the cereals and pulses, maize occupied major area (27.01%) across districts followed by hybrid sorghum (6.64%) during *kharif* followed by *rabi* sorghum which accounted 13.74% area followed by wheat (4.08%) during *rabi* season. However, among the perennial crops the area allocated under mulberry cultivation by farmers across districts was 12.32 per cent. A comparison between districts indicated that Bagalkot farmers allocated marginally more area (13.22%) under mulberry when compared to farmers of Belgaum district (10.62%).

The cropping intensity of almost 200 per cent was observed in both the study districts and was marginally more in case Belgaum (210%) when compared to Bagalkot (197%) district. This could be largely due to irrigation facility available in the study districts.

Table 4.4: Cropping pattern of sample farmers during cropping year 2010-11

Sl. No.	Crops	Belgaum		Bagalkot		Overall	
		Area (acre)	Per cent area	Area (acre)	Per cent area	Area (acre)	Per cent area
Kharif							
1	Sugar cane	2.03	16.85	1.73	17.20	1.88	17.82
2	Maize	4.03	33.44	2.80	27.83	2.85	27.01
3	Hybrid sorghum	0.70	5.81	0.73	7.26	0.70	6.64
4	Ground nut	0.40	3.32	0.33	3.28	0.40	3.79
5	Cotton	0.03	0.25	0.03	0.30	0.03	0.28
6	Soybean	0.15	1.24	0.10	0.99	0.13	1.23
7	Turmeric	0.28	2.32	0.38	3.78	0.33	3.13
8	Bajra	0.20	1.66	0.20	1.99	0.20	1.90
9	Green gram	0.18	1.49	0.18	1.79	0.18	1.71
10	Horse gram	0.03	0.25	0.03	0.30	0.03	0.28
	Sub total	**8.03**	**66.64**	**6.51**	**64.71**	**6.73**	**63.79**
Rabi							
11	Maize	0.08	0.66	0.20	1.99	0.15	1.42
12	*Rabi* sorghum	1.75	14.52	1.15	11.43	1.45	13.74
13	Bengal gram	0.35	2.90	0.33	3.28	0.33	3.13
14	Wheat	0.40	3.32	0.43	4.27	0.43	4.08
	Sub total	**2.58**	**21.41**	**2.11**	**20.97**	**2.36**	**22.37**
	Perennial crops						
15	Mulberry	1.28	10.62	1.33	13.22	1.30	12.32
16	Fruit crops(citrus, banana)	0.10	0.83	0.08	0.80	0.10	0.95
17	Forage crop(gini grass)	0.03	0.25	0.00	0.00	0.03	0.28
18	Beetle vine	0.03	0.25	0.03	0.30	0.03	0.28
	Sub total	**1.44**	**11.95**	**1.44**	**14.31**	**1.46**	**13.84**
	Gross cropped area	**12.05**	**100.00**	**10.06**	**100.00**	**10.55**	**100.00**
	Net sown area	**9.33**		**8.75**		**9.03**	
	Commodity group						
	Cereals & Pulses	7.72	64.07	6.05	60.14	6.32	59.91
	Oilseeds	0.55	4.56	0.43	4.27	0.53	5.02
	Commercial crops	2.06	17.10	1.76	17.50	1.91	18.10
	Horticulture crops	0.44	3.65	0.49	4.87	0.49	4.64
	Mulberry	1.28	10.62	1.33	13.22	1.30	12.32
	Cropping intensity (%)	**209.86**		**196.46**		**198.45**	

4.2.2 Distribution of farmers based on mulberry area

The sample respondents in both districts were distributed according to extent of area under mulberry cultivation. It could be inferred from the results presented in Table 4.5 that on the whole, both districts together cultivated 159.20 acres under mulberry. Of this, as large as 48.33 per cent farmers in these districts cultivated mulberry between 0.50 and 1.00 acre with a total share of 35.68 per cent (56.80 acres) area in this range followed by 38.33 per cent of them operating mulberry area between 1.00 and 2.00 acres with a largest share of 50.50 per cent (80.40 acres). While, less than 10 per cent farmers cultivated only a small (2.83%) proportion of the total mulberry area and it accounted only 4.50 acres. On the other hand, only 6.00 per cent farmers cultivated mulberry on more than 2.00 acres of land. Similar results were found across districts in respect of allocation of mulberry area where a larger proportion of them with considerable area cultivated the crop in the range between 0.50 to 2.00 acres. It was observed that 85 per cent of the farmers cultivated 84.08 per cent area under mulberry in Belgaum district. While, 88.33 per cent of the farmers cultivated 88.23 per cent area under mulberry in Bagalkot district.

4.3 Economic aspects of mulberry cultivation

Mulberry is a perennial crop, once established and well maintained garden yields economically for about 15 years. In view of all these, an attempt has been made to analyse in detail the per acre cost of establishment, use of different inputs, annual labour requirement in mulberry cultivation, cost of cultivation, returns from mulberry crop. For the purpose of drawing meaningful inferences, the cost of production of mulberry leaves are divided in two broad categories *viz*., the establishment costs and the production costs.

4.3.1 Operation wise labour use pattern in establishment of mulberry garden

Proper establishment of mulberry garden for optimum bio-mass production is most critical for the profitability of sericulture enterprise. Sericulture is a labour intensive and the efficiency with which labour is used determines the success of the enterprise. The labour requirements along with use of animal and machine powers according to the major operations to establish an acre of mulberry garden by the sample respondents is presented in Table 4.6.

On an average in Belgaum district, the total human labour required per acre for the establishment of mulberry garden was 50.56 man days and that of bullock labour and machine power were 3.15 pair days and 3.02 machine hours, respectively. Out of the total labour requirement, 27.15 per cent (13.71 man days) of labour were used for undertaking weeding at different stages, followed by 24.37 per cent (12.35 man days) of total human labour used for planting of mulberry cuttings. The remaining 18.98 per cent (9.60 man days) and 15.07 per cent (7.62 man days) of human labour were used for irrigation and for transportation and application of organic manure, respectively. Whereas, 7.14 per cent (3.62 man days) of human labour was used for transportation of mulberry cuttings/saplings. The fertilizer application and spraying of plant protection chemicals required about 3.87 and 3.40 per cent and of human labour, respectively. On the other hand out of the total bullock power used in the establishment of mulberry garden, 49.04 per cent (1.54 pair days) of it was used for opening up of ridges and furrows whereas, 30.90 and 20.06 per cent (0.97 and 0.64 pair days, respectively) of the bullock power was used for harrowing and ploughing operations. Whereas, entire 3.02 machine hours were used for ploughing operation.

Similar labour distribution pattern was observed even among the farmers in Bagalkot district. The total human labour required per acre for the establishment of mulberry garden was 50.18 man days and that of bullock labour and machine power were 2.57 pair days and 3.29 machine hours, respectively. Out of the total labour requirement, 26.90 per cent (13.34 man days) of labour were used for undertaking weeding at different stages, followed by 26.52 per cent (12.64 man days) of total human labour used for planting of mulberry cuttings. The remaining 17.75 per cent (9.46 man days) and 14.06 per cent (7.70 man days) of human labour were used for irrigation and for transportation and application of organic manure, respectively. Whereas, 7.34 per cent (3.50 man days) of human labour was used for transportation of mulberry cuttings/saplings, the fertilizer application and spraying of plant protection chemicals required about 4.07 and 3.36 per cent and of human labour, respectively.

Table 4.5: Distribution of farmers based on mulberry area

Sl. No.	Area under mulberry	Belgaum				Bagalkot				Overall			
		No. of farmers	% farmers	Area (acre)	% area	No. of farmers	% farmers	Area (acre)	% area	No. of farmers	% farmers	Area (acre)	% area
1	< 0.5 acre	5	8.33	2.5	3.18	4	6.67	2	2.48	9	7.50	4.5	2.83
2	0.5-1.0 acre	29	48.33	28.4	36.18	29	48.33	28.4	35.19	58	48.33	56.8	35.68
3	1.0-2.0 acre	22	36.67	37.6	47.90	24	40.00	42.8	53.04	46	38.33	80.4	50.50
4	>2.0 acre	4	6.67	10	12.74	3	5.00	7.5	9.29	7	5.83	17.5	10.99
	Total	**60**	**100.00**	**78.5**	**100.00**	**60**	**100.00**	**80.7**	**100.00**	**120**	**100.00**	**159.2**	**100.00**
	Average (acre)			**1.3**				**1.34**				**1.32**	

Table 4.6: Operation wise labour use pattern in establishment of mulberry garden

(Per acre)

Sl. No.	Particulars	Belgaum			Bagalkot			Overall		
		HL	**BL**	**ML**	**HL**	**BL**	**ML**	**HL**	**BL**	**ML**
1.	Ploughing		0.64 (20.06)	3.02 (100.00)		0.45 (17.19)	3.29 (100.00)	-	0.55 (18.95)	3.15 (100.00)
2.	Harrowing		0.97 (30.90)			0.85 (33.20)		-	0.91 (31.93)	-
3.	Transportation of cuttings/saplings	3.62 (7.14)			3.50 (7.34)			3.56 (7.42)	-	-
4.	Transportation and applying of FYM	7.62 (15.07)			7.70 (14.06)			7.66 (13.88)	-	-
5.	Opening ridges and furrows		1.54 (49.04)			1.27 (49.61)		-	1.40 (49.12)	-
6.	Labour for planting	12.35 (24.37)			12.64 (26.52)			12.49 (26.04)	-	-
7.	Fertilizer application	1.96 (3.87)			1.94 (4.07)			1.95 (4.07)	-	-
8.	Irrigation	9.60 (18.98)			9.46 (17.75)			9.53 (17.78)	-	-
9.	Weeding	13.71 (27.15)			13.34 (26.90)			13.52 (27.35)	-	-
10.	Spraying	1.72 (3.40)			1.60 (3.36)			1.66 (3.46)	-	-
11.	**Total**	**50.56 (100.00)**	**3.15 (100.00)**	**3.02 (100.00)**	**50.18 (100.00)**	**2.57 (100.00)**	**3.29 (100.00)**	**50.37 (100.00)**	**2.86 (100.00)**	**3.15 (100.00)**

Note: Figures in parentheses indicate to the percentages to the total
HL: Human labour (man days), BL: Bullock labour (bullock pair days), ML: Machine labour (machine hours)
Establishment period of mulberry garden is six months

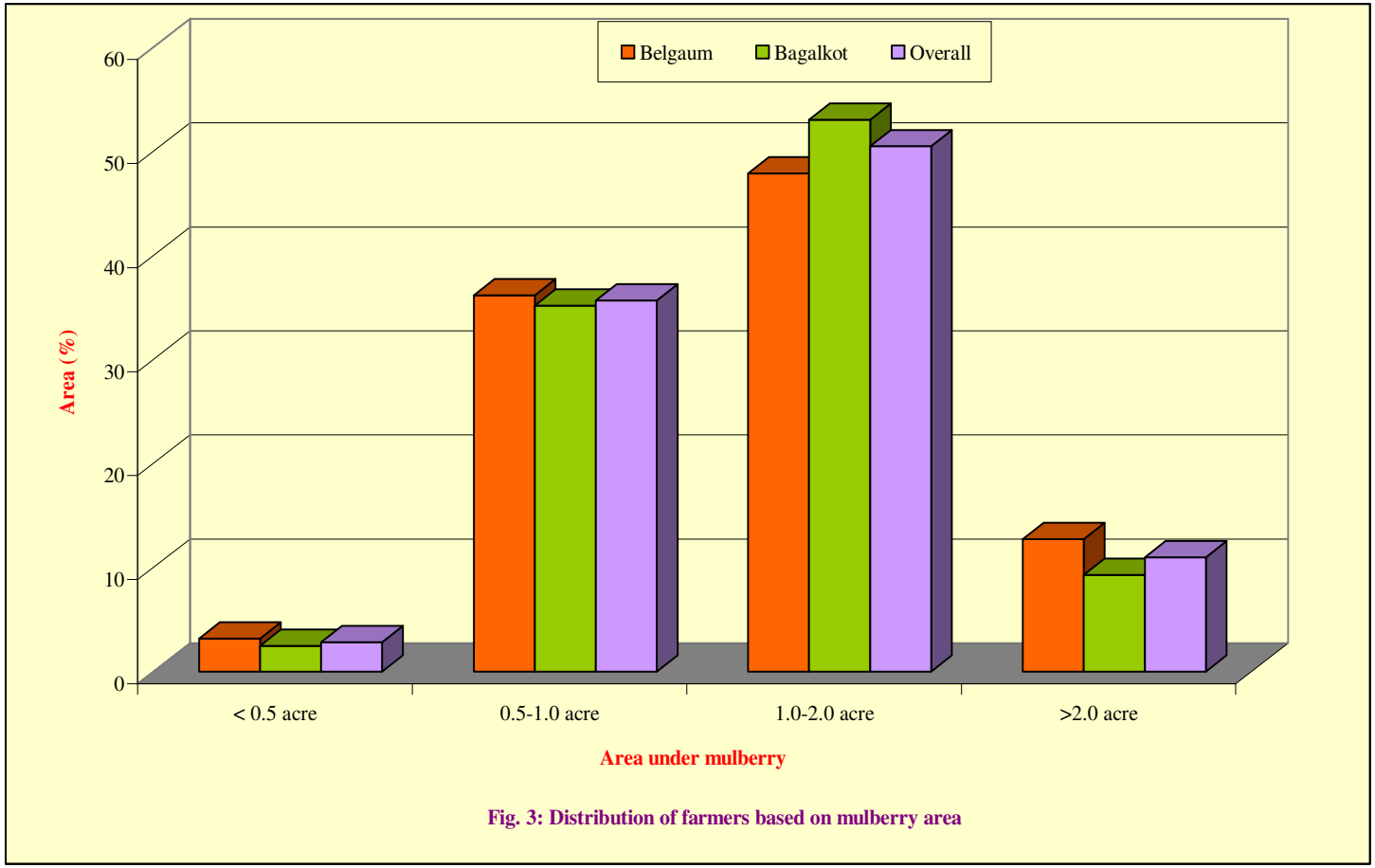

Fig. 3: Distribution of farmers based on mulberry area

On the other hand out of the total bullock power used in the establishment of mulberry garden, 49.61 per cent (1.27 pair days) of it was used for opening up of ridges and furrows whereas, 33.20 and 17.19 per cent (0.85 and 0.45 pair days) of the bullock power was used for harrowing and ploughing operations. Whereas, entire 3.29 machine hours were used for ploughing operation.

The labour use pattern by farmers in both the districts together showed that the total human labour required for the establishment of mulberry garden was 50.37 man days and that of bullock labour and machine power were 2.86 pair days and 3.15 machine hours, respectively. Out of the total labour requirement, a large proportion of it in the range of 26.00 to 27.00 per cent was used for undertaking weeding and planting of mulberry cuttings. Whereas, for irrigation application and to undertake transportation and application of organic manure the labour in the range between 14.00 to 18 per cent was used for these operations. Whereas, 7.42 per cent of human labour was used for transportation of mulberry cuttings/saplings, the fertilizer application and spraying of plant protection chemicals required about 4.07 and 3.46 per cent and of human labour, respectively. On the other hand out of the total bullock power used in the establishment of mulberry garden, 49.12 per cent of it was used for opening up of ridges and furrows whereas, 31.93 and 18.95 per cent of the bullock power was used for harrowing and earthing up operations. The entire 3.15 hours of machine labour was used for earthing up operation.

The results on labour utilization by farmers for mulberry garden establishment thus clearly indicated that there was almost similar pattern of labour, animal and machine power utilization was observed across districts for different operations.

4.3.2 Input and labour cost in the establishment of mulberry garden

The establishment costs are those costs which are incurred during the first year on the establishment of a mulberry garden. The information on the physical inputs including labour required and the corresponding money values for the establishment of mulberry garden during the reference year is furnished in Table 4.7.

The major item of cost in the establishment of mulberry garden was on human labour since cultivation of mulberry is labour intensive production. The total cost of establishment of mulberry garden in Belgaum district by farmers was worked out to be Rs. 30344.34 per acre. Of this, the cost of human labour for various operation accounted to about 22.49 per cent (Rs. 6826.21/acre). This was followed by cost of planting of mulberry cuttings which took the next highest share in the total cost and was worked out at Rs. 5513.28 per acre. The costs incurred on organic manure and fertilizers were Rs. 3779.96 and Rs. 3741.25 per acre which worked out to be around 12.50 per cent of the total cost. The cost on bullock labour and transportation charges of mulberry cuttings required Rs. 1418.01 per acre where each represented about 4.67 per cent of the total cost. The cost on machine labour (Rs. 1209.36/acre) was around four per cent of the total cost while, cost on weedicides was 1.41 per cent to the total. However, cost of labour, bullock and machine power together accounted highest at 31.14 per cent of the total cost followed by cost of mulberry cuttings (18.16%), organic manure (12.45%) and fertilizer (12.32%) costs as prime costs in the establishment of mulberry garden.

In Bagalkot district the major item of cost in establishment of mulberry garden was on human labour. The cost incurred on human labour was Rs. 6816.07 per acre and accounted for 23.75 per cent of the total cost of establishment. Next to human labour the major cost was the cost on planting materials amounting to Rs. 5052.91. This was followed by the cost on fertilizers which amounted to Rs. 3569.37. The other costs in the order of their importance were Rs. 3228.92 for organic manures (11.25%), transportation charges of cuttings Rs. 327.59 (4.62%), machine labour Rs. 1316.03 (4.58%), bullock labour Rs. 1160.10 (4.04%) and weedicides at Rs. 510.95 (1.78%). Thus the total cost of establishment of mulberry garden including all the costs amounted to Rs. 28687.68 per acre. However, cost of labour, bullock and machine power together accounted highest at 32.37 per cent of the total cost followed by cost of mulberry cuttings (17.61%) and fertilizer (12.44%) and organic manure (11.25%) costs as prime costs in the establishment of mulberry garden.

Table 4.7: Establishment cost of mulberry garden

(Per acre)

Sl. No.	Items	Unit	Belgaum				Bagalkot				Overall			
			Quantity	Price per unit	Total cost	Per cent to total cost	Quantity	Price per unit	Total cost	Per cent to total cost	Quantity	Price per unit	Total cost	Per cent to total cost
1.	Cost of cuttings/saplings	No.	5224.58	1.05	5513.28	18.16	5215.50	0.97	5052.91	17.61	5220.04	1.008	5283.09	17.90
2.	Cost of FYM	Tone	6.75	564.16	3779.96	12.45	5.77	565.00	3228.92	11.25	6.26	564.58	3504.34	11.87
3	Fertilizers	Kgs	342	53.4	3741.25	12.32	333.65	53.4	3569.37	12.44	338.51	53.4	3655.31	12.38
4.	Transportation charges of cuttings	Rs	-	-	1418.01	4.67	-	-	1328.01	4.62	-	-	1373.01	4.65
5.	Weedicides	Lt	0.61	570.18	430.0	1.41	0.70	635.39	510.95	1.78	0.662	604.23	470.0	1.59
6.	Growth regulators	Lt	0.350	54.16	18.95	0.06	0.202	54.16	10.94	0.03	0.208	54.16	11.28	0.03
7.	Human labour	MD	50.56	135.42	6826.21	22.49	50.18	135.42	6816.07	23.75	50.37	135.42	6821.14	23.11
8.	Bullock labour	BP	3.15	450	1418.35	4.67	2.57	450	1160.10	4.04	2.86	450	1289.23	4.36
9.	Machine labour	M.HR	3.02	400	1209.36	3.98	3.29	400	1316.03	4.58	3.15	400	1262.69	4.27
10.	Miscellaneous(including irrigation charges)	Rs	-	-	65.25	0.20	-	-	59.73	0.20	-	-	62.49	0.21
11.	Interest on working capital @10% p.a	Rs	-	-	2247.72	7.40	-	-	2125.61	7.40	-	-	2186.03	7.40
	Total		**5973.02**	**2281.77**	**30344.34**	**100**	**5945.512**	**2347.74**	**28687.68**	**100**	**5960.57**	**2316.19**	**29511.44**	**100**

In overall the major item of cost in establishment of mulberry garden was on human labour. The cost incurred on human labour was Rs. 6821.14 per acre accounting for 23.11 per cent of the total cost of establishment. Next to human labour the major cost was the cost on planting materials amounting of Rs. 5283.09 accounting for 17.90 per cent of the total cost of establishment. Next to planting material cost, the major cost was the cost on chemical fertilizers which amounted to Rs. 3655.31, accounted for 12.38 per cent of the total cost. The costs in the order of their importance were Rs. 3504.34 for organic manures (11.87 per cent of the total cost), transportation charges of cuttings Rs. 1373.01 (4.65 per cent of the total cost), bullock labour Rs. 1289.23 (4.36 per cent of the total cost), machine labour Rs. 1262.69 (4.27 per cent of the total cost), weedicides Rs. 470.0 (1.59 per cent of the total cost), miscellaneous cost including irrigation charges Rs. 62.49 (0.21 per cent of the total cost) and growth regulators Rs. 11.28 (0.03 per cent of the total cost). Thus, the total cost of establishment of mulberry garden including all the costs amounted to Rs. 29511.44 per acre.

Thus, the analysis of the results on inputs and labour costs in the establishment of mulberry garden between districts revealed that there was more or less uniformity in the distribution of out lays spent for labour operations and on quantities of physical inputs applied. Although farmers in Belgaum incurred relatively higher cost when compared Bagalkot farmers this was largely attributed to marginal differences in the quantities of inputs used.

4.3.3 Cost and returns from mulberry cultivation

4.3.3.1 Input use pattern in mulberry cultivation per acre per rearing

The results on quantities of inputs required for cultivation of mulberry garden corresponds to their utilization in each rearing season by sample respondents and is presented in Table 4.8. The quantities of inputs are related to the inputs applied to mulberry crop by respondent farmers during every rearing season after the establishment of mulberry garden.

The results on quantities of inputs utilized per rearing by farmers showed that there was only a marginal variability in the inputs applied in the production of bio-mass (mulberry leaves) in Belgaum and Bagalkot districts. The quantity of different fertilizers in the form of urea, Di-ammonium phosphate, murriate of potash, single superphosphate and complex used was marginally more incase of Bagalkot farmers (164.95 kg/acre) when compared to farmers of Belgaum (152.76 kg/acre) district. On the other hand farmers in Belgaum tended to use more (3.04 tonne/acre) of organic manure than Bagalkot (2.79 tonne/acre) farmers. On an average, the farmers in both district together used three tons of organic manure, fertilizer at the rate of 158.87 kg/acre, 0.73 liters of growth regulators per care and 0.16 kg of bio-fertilizers.

4.3.3.2 Operation wise labour use pattern per rearing in mulberry cultivation.

The labour requirements according to the major operations in the cultivation of one acre of mulberry garden per rearing season by the sample respondents are presented in Table 4.9.

On an average in Belgaum district, the total human labour required per acre for the cultivation of mulberry garden was 29.33 man days and that of bullock labour was 2.88 pair days. Out of the total labour requirement, 33.36 per cent (9.78 man days) of labour were used for undertaking weeding operation stages, followed by 27.20 per cent (7.98 man days) of total human labour used for transportation and spreading of manure. The remaining 22.15 per cent (6.49 man days) and 6.79 per cent (1.99 man days) of human labour were used for irrigation and for gap filling, respectively. Whereas, 4.62 per cent (1.35 man days) of human labour was used for inter cultivation, the fertilizer application and spraying of plant protection chemicals required about 4.10 and 1.78 per cent and of human labour, respectively. On the other hand out of the total bullock power used in the cultivation of mulberry garden, 59.92 per cent (1.72 pair days) of it was used for earthing up whereas, 40.08 per cent (1.15 pair days) of the bullock power was used for intercultivation operations.

In Bagalkot district on an average, the total human labour required per acre for the cultivation of mulberry garden was 27.38 man days and that of bullock labour was 2.62 pair days.

Table 4.8: Input use pattern per rearing in mulberry cultivation

(Per acre/rearing)

Sl. No.	Particulars	Unit	Belgaum	Bagalkot	Overall
			Quantity	Quantity	Quantity
1	Organic manure	tonne	3.04	2.79	2.91
2	Urea	kg	45.30	46.44	45.87
3	DAP	kg	59.38	64.98	62.18
4	MOP	kg	23.65	26.18	24.92
5	SSP	kg	14.16	17.91	16.04
6	Complex	kg	10.27	9.44	9.86
7	Growth regulators	lit	0.75	0.72	0.73
8	Bio fertilizers	kg	0.0	0.33	0.16

Table 4.9: Labour use pattern per rearing in mulberry cultivation by operation

(Per acre/rearing)

Sl. No.	Particulars	Belgaum		Bagalkot		Overall	
		HL	BL	HL	BL	HL	BL
1.	Earthing up		1.72 (59.92)		1.71 (65.30)	-	1.72 (62.48)
2.	Manuring	7.98 (27.20)		7.34 (26.81)		7.66 (27.02)	-
3.	Fertilizer application	1.20 (4.10)		1.16 (4.26)		1.18 (4.17)	-
4.	Gap filling*	1.99 (6.79)		1.94 (7.10)		1.96 (6.94)	-
5.	Intercultivation	1.35 (4.62)	1.15 (40.08)	1.87 (6.85)	0.91 (34.70)	1.61 (5.70)	1.03 (37.52)
6.	Weeding	9.78 (33.36)		8.34 (30.46)		9.06 (31.96)	-
7.	Irrigation	6.49 (22.15)		6.31 (23.04)		6.40 (22.58)	-
8.	Spraying	0.52 (1.78)		0.40 (1.48)		0.46 (1.64)	-
	Total	**29.33 (100.00)**	**2.88 (100.00)**	**27.38 (100.00)**	**2.62 (100.00)**	**28.36 (100.00)**	**2.75 (100.00)**

Note: Figures in parentheses indicate to the percentages
HL – Human labour (mandays) BL – Bullock labour (pairdays)
* Once in a hear during monsoon season out of five rearing season

Out of the total labour requirement, 30.46 per cent (8.34 man days) of labour were used for undertaking weeding, followed by 26.81 per cent (7.34 man days) of total human labour used for transportation and spreading of manure. The remaining 23.04 per cent (6.31 man days) and 7.10 per cent (1.94 man days) of human labour were used for irrigation and for gap filling, respectively. Whereas, 4.62 per cent (1.35 man days) of human labour was used for intercultivation/earthing up, the fertilizer application and spraying of plant protection chemicals required about 4.26 and 1.48 per cent and of human labour, respectively. On the other hand out of the total bullock power used in the cultivation of mulberry garden, 65.30 per cent (1.71 pair days) of it was used for earthing up whereas, 34.70 per cent (0.91 pair days) of the bullock power was used for intercultivation operations.

Overall the total human labour required was 28.36 man days and that of bullock labour was 2.75 pair days. Out of the total labour requirement, 31.96 per cent (9.06 man days) of labour were used for undertaking weeding, followed by 27.02 per cent (7.66 man days) of total human labour used for transportation and spreading of manure. The remaining 22.58 per cent (6.40 man days) and 6.94 per cent (1.96 man days) of human labour were used for irrigation and for gap filling, respectively. Whereas, 5.70 per cent (1.61 man days) of human labour was used for intercultivation/earthing up, the fertilizer application and spraying of plant protection chemicals required about 4.17 and 1.64 per cent and of human labour, respectively. On the other hand out of the total bullock power used in the cultivation of mulberry garden, 62.48 per cent (1.71 pair days) of it was used for earthing up whereas, 37.52 per cent (1.03 pair days) of the bullock power was used for intercultivation operations.

4.3.3.3 Cost of cultivation of mulberry crop per acre/rearing

Considerable cost is involved for acquiring various resources and also for the maintenance of the mulberry crop. Table 4.10 presents information on the costs incurred in mulberry under two broad heads namely, operational costs and fixed costs on per acre basis. The different items of costs as percentage of their respective totals provided the relative importance of each cost and are also presented in the same table.

The operational costs per acre/rearing included the costs on human labour, bullock labour, organic manure, fertilizers, irrigation, growth regulators and bio-fertilizers along with interest on working capital computed at 8 per cent per annum. While, the fixed costs included land revenue, apportioned establishment cost, cost on depreciation of rearing house and equipments and rental value of land along with interest on fixed capital assessed at the rate of 11 per cent annually.

The operation wise and input wise break up of cost of mulberry cultivation in Belgaum district indicated that the total cost incurred in the mulberry cultivation was worked out to be Rs. 12,921.31/acre. A large proportion of the total cost was constituted by variable cost component at Rs. 10042.17/acre accounting 77.71 per cent to the total. The remaining Rs. 2,879.14 was the fixed cost (22.28%). Among the variable costs, the cost on human labour shared a large proportion (29.82%) of the total cost at Rs. 3,854.07/acre during each rearing followed by 14.28 per cent (Rs. 1845.49/acre) on organic manure, 12.87 per cent (Rs. 1664.13/acre) on chemical fertilizers, 10.05 per cent (Rs. 1299.03/acre) on bullock labour, approximately 2.30 to 2.50 per cent each on irrigation and growth regulators.

The operation wise and input wise break up of cost of mulberry cultivation in Bagalkot district indicated that the total cost incurred in the mulberry cultivation was worked out to be Rs. 12,478.27/acre. Similarly, as observed in case of Belgaum, a large proportion of the total cost was constituted by variable cost component at Rs. 9758.80/acre accounting 78.20 per cent of the total cost. The remaining Rs. 2719.47 was fixed cost with a share of 21.79 per cent. Among the variable costs, the cost on human labour shared a large proportion (29.23%) of the total cost at Rs. 3648.54/acre during each rearing followed by 14.16 per cent (Rs. 1767.21/acre) on organic manure, 14.37 per cent (Rs. 1793.21/acre) on chemical fertilizers, 9.48 per cent (Rs. 1183.78/acre) on bullock labour, approximately 2.40 to 2.60 per cent each on irrigation and growth regulators.

There were no cases where the farmers in both Belgaum and Bagalkot operated leased in land for mulberry cultivation. The estimate of rental value of owned land was obtained in consultation with the respondents and this represented what the respondents would pay if they had rented in the same types of lands.

Table 4.10: Cost of cultivation of mulberry

(Per acre/ per rearing)

Sl. No.	Name of the operations	Unit	Belgaum	% to the total	Bagalkot	% to the total	Overall	% to the total
A. Variable costs								
1.	Human labour	Rs.	3854.07	29.82	3648.54	29.23	3751.31	29.53
2.	Bullock labour	Rs.	1299.03	10.05	1183.78	9.48	1241.41	9.77
3.	FYM	Rs.	1845.49	14.28	1767.21	14.16	1806.35	14.22
4.	Fertilizers	Rs.						
	a. Urea		253.71	1.96	260.09	2.08	256.90	2.02
	b. DAP		890.80	6.89	974.76	7.81	932.78	7.34
	c. MOP		279.17	2.16	309.00	2.47	294.09	2.31
	d. SSP		82.17	0.63	103.92	0.83	93.04	0.73
	e. Complex		158.28	1.22	145.44	1.16	151.86	1.19
	Total		**1664.13**	**12.87**	**1793.21**	**14.37**	**1728.67**	**13.61**
5.	Irrigation	Rs	308.45	2.38	301.81	2.41	305.13	2.40
6.	Growth regulators	Rs	327.14	2.53	328.05	2.62	327.59	2.57
7.	Bio fertilizers	Rs	0.0	0.00	13.33	0.10	6.67	0.05
7.	Interest on working capital	Rs	743.86	5.75	722.87	5.79	733.37	5.77
	Total variable costs	**Rs**	**10042.17**	**77.71**	**9758.8**	**78.20**	**9900.5**	**77.95**
A. Fixed cost								
1.	Land revenue	Rs	20.45	0.15	20.56	0.16	20.51	0.16
2.	Depreciation	Rs	48.5	0.37	45.32	0.36	46.91	0.36
3.	Rental value of land	Rs	2160.5	16.72	2039.5	16.34	2100.00	16.53
4.	Interest on fixed capital	Rs	245.24	1.89	231.59	1.85	238.42	1.87
5.	Apportioned establishment cost	Rs	404.59	3.13	382.50	3.06	393.48	3.09
	Total fixed cost		**2879.14**	**22.28**	**2719.47**	**21.79**	**2799.32**	**22.04**
C. Total cost (A+B)		**Rs**	**12921.31**	**100**	**12478.27**	**100**	**12699.82**	**100**

The apportioned rental value of land was the major item of fixed cost amounting to Rs. 2160.50 per crop of each rearing which accountinted for 16.72 per cent of the total cost in Belgaum. Whereas, in Bagalkot district it was Rs. 2039.5 and accounted for 16.34 per cent of the total cost. Land revenue, depreciation, interest on fixed capital, apportioned annual establishment cost, together accounted for only 5.54 per cent of the total cost of mulberry cultivation per acre per rearing in case of Belgaum district. While, the same in case of Bagalkot district accounted for each acre/rearing was 5.43 per cent of the total cost of mulberry cultivation.

On the whole, the operation wise and input wise break up of cost of mulberry cultivation was worked out to be Rs. 12699.82/acre. A large proportion of the total cost was constituted by variable cost component at Rs. 9900.50/acre accounting 77.95 per cent to the total. The remaining Rs. 2799.32 was the fixed cost (22.04%). Among the variable costs, the cost on human labour shared a large proportion (29.53%) of the total cost at Rs. 3751.31/acre during each rearing followed by 14.22 per cent (Rs. 1806.35/acre) on organic manure, 13.61 per cent (Rs. 1728.67/acre) on chemical fertilizers, 9.77 per cent (Rs. 1241.41/acre) on bullock labour, approximately 2.40 to 2.50 per cent each on irrigation and growth regulators.

For overall, the rental value of land was Rs. 2100.00 per crop/rearing accounting for 16.53 per cent of the total cost. Land revenue, depreciation, interest on fixed capital, apportioned annual establishment cost, together in case of Bagalkot district accounted to 5.43 per cent of the total cost of mulberry cultivation.

4.3.4 Returns from mulberry cultivation

The average yield per acre of mulberry garden was 5.34 tonnes, 5.33 tonnes and 5.34 tonnes of mulberry leaves in Belgaum, Bagalkot districts and at overall level, respectively. It was difficult to estimate the returns from mulberry cultivation. However, in the sample villages, on an average the mulberry leaves sold at one rupee sixty five paise per Kg, Hence, this price was used to arrive at the gross return from mulberry leaves which amounted to Rs. 8817.0, Rs. 8805.25 and Rs. 8811.41 in Belgaum, Bagalkot districts and at overall level, respectively. On an average, the quantity of the by-product obtained from an acre was 3.12 cart loads, 3.19 cart loads and 3.15 cart loads valued at Rs. 655.2, Rs. 669.9 and Rs. 661.5 in Belgaum, Bagalkot districts and overall for both district together, respectively. Thus, the gross returns from mulberry cultivation was Rs. 9742.2, Rs. 9475.15 and Rs. 9472.91 in Belgaum, Bagalkot districts and at overall level, respectively. Thus, results clearly indicated that the farmers in both districts realized similar bio-mass production (mulberry leaves) by volume. The farmers with similar agronomic practices and input management pattern on the variety (Victory-1) cultivated in both districts obtained almost yields on par.

4.4 Economic aspects of silk cocoon production

The costs and net returns from silk cocoon production were estimated on per acre per rearing basis for the reference year. In this section the results of the analysis pertaining to the economic aspects of silk cocoon production; included variable costs and fixed costs in silk cocoon production and returns from silk cocoon production.

4.4.1 Cost of silk cocoon production per rearing per acre of mulberry garden (300 dfls)

The operation wise and input wise break up of cost of silk cocoon production in Belgaum district indicated that the total cost incurred in the silk cocoon production was worked out to be Rs. 32498.13. A considerable size of the total cost was constituted by variable cost and Rs. 29440.02 accounting 90.58 per cent to the total. The remaining Rs. 3058.11 was the fixed cost (9.41%). Among the variable costs, the cost on human labour shared a large proportion (43.83%) of the total cost at Rs. 14245.11 during each rearing followed by 26.17 per cent (Rs. 8505.00) on mulberry leaves, 7.22 per cent (Rs. 2347.17) on marketing cost, 5.02 per cent (Rs. 1632.99) on dfls/Chawki worms and 3.88 per cent on total disinfectants. The remaining costs like transportation cost of dfls/chawki worms (Rs. 418.74) and paraffin paper (Rs. 309.63) news paper (Rs. 255.21). The apportioned fixed costs amounted to Rs. 3058.11 accounting for 9.41 per cent to the total cost of silk cocoon production.

Table 4.11: Returns from mulberry cultivation per crop

(Per acre/rearing)

Sl. No.	Items	Unit	Belgaum		Bagalkot		Overall	
			Quantity	Value	Quantity	Value	Quantity	Value
1.	Main product, Mulberry leaves	Kg	5343.97	8817.0	5336.52	8805.25	5340.25	8811.41
2.	By product, Stalks	Cart loads	3.12	655.2	3.19	669.9	3.15	661.5
3.	Gross return	Rs	-	9742.2	-	9475.15	-	9472.91

Table 4.12: Cost of silk cocoon production per rearing of silkworms (300 dfls)

(Per acre/rearing)

Sl. No.	Item	Costs (Rs)					
		Belgaum	**% to total**	**Bagalkot**	**% to total**	**Overall**	**% to total**
A.	**Variable costs**						
1.	dfls/Chawki worms	1632.99	5.02	1650.24	4.77	1641.6	4.86
2.	Transportation cost of dfls/Chawki worms	418.74	1.28	445.17	1.28	431.97	1.28
3.	Human labour	14245.11	43.83	15840.39	45.86	15277.77	45.28
4.	Disinfectants						
	a) Bed disinfectants	442.71	1.36	393.45	1.13	418.08	1.23
	b) Lime dust	646.08	1.98	625.44	1.81	635.76	1.88
	c) Bleaching powder	173.76	0.53	144.03	0.41	158.91	0.47
	Total disinfectants	1262.55	3.88	1162.92	3.36	1212.75	3.59
5.	Paraffin paper	309.63	0.95	332.88	0.96	321.24	0.95
6.	News paper	255.21	0.78	250.14	0.72	252.69	0.74
7.	Mulberry leaves	8505	26.17	9117.9	26.39	8811.45	26.11
8.	Marketing cost	2347.17	7.22	2310.45	6.68	2328.75	6.90
9.	Interest on working capital	463.62	1.42	460.79	1.33	447.19	1.32
	Total variable cost	**29440.02**	**90.58**	**31570.79**	**91.40**	**32060.37**	**91.06**
B.	**Fixed costs**						
1.	Depreciation of rearing room and equipments	2992.29	9.20	2904.87	8.41	2948.58	8.73
2.	Interest on fixed capital	65.82	0.20	63.90	0.81	64.86	0.19
	Total fixed cost	**3058.11**	**9.41**	**2968.77**	**8.59**	**3013.44**	**8.93**
C.	**Total cost (A+B)**	32498.13	100.00	34539.49	100.00	33738.84	100.00

The operation and input wise break up of cost of silk cocoon production in Bagalkot district indicated that the total cost incurred in the silk cocoon production was worked out to be Rs. 34539.49. A large proportion of the total cost was constituted by variable cost component at Rs. 31570.79 and accounted 91.40 per cent to the total. The remaining Rs. 2968.77 was the fixed cost (8.59%). Among the variable costs, the cost on human labour shared a large proportion (45.86%) of the total cost at Rs. 15840.39 during each rearing followed by 26.39 per cent (Rs. 9117.90) on mulberry leaves, 6.68 per cent (Rs. 2310.45) on marketing cost, 4.77 per cent (Rs. 1650.24) on dfls/chawki worms and 3.36 per cent on total disinfectants. The remaining costs like, transportation cost of dfls/chawki worms (Rs. 415.17) and paraffin paper (Rs. 332.88) news paper (Rs. 250.14). The apportioned fixed costs amounted to Rs. 2968.77 and accounted for 8.59 per cent to the total cost of silk cocoon production. A comparison of costs in Belgaum and Bagalkot indicated that the magnitude of costs and their proportions for most inputs remained on par. However, costs incurred by farmers on human labour and mulberry leaves were relatively more in Bagalkot (Rs. 15840.39/ac and 9117.90/ac) when compared to Belgaum (Rs. 14245.11/ac and 8505.00/ac) farmers in that order.

On an average the operation wise and input wise break up of cost of silk cocoon production indicated that the total cost incurred in silk cocoon production was Rs. 33738.84. A sizable proportion of the total cost was constituted by variable cost at Rs. 32060.37 which accounted 91.06 per cent to the total. The apportioned fixed costs amounted to Rs. 3013.44 accounting for 8.93 per cent to the total cost of silk cocoon production. Among the variable costs, the cost on human labour shared a large proportion (45.28%) of the total cost at Rs. 15277.77 during each rearing followed by 26.11 per cent (Rs. 8811.45) on mulberry leaves, 6.90 per cent (Rs. 2328.75) on marketing cost, 4.86 per cent (Rs. 1641.60) on dfls/ Chawki worms and 3.59 per cent on total disinfectants. The remaining costs like transportation cost of dfls/Chawki worms (Rs. 431.97) and paraffin paper (Rs. 321.24) news paper (Rs. 252.69).

4.4.2 Returns from silk cocoon production per rearing acre of mulberry garden

The results on per acre gross and net returns from silk cocoon production for each rearing 300 dfls are presented in Table 4.13. The major yields consisted of cocoon yield (both of good and low quality) and by-product yield composed of crop waste which is used as fodder for animals and the manure/litter.

It could be seen from the results that on an average, farmers in Belgaum realized relatively more cocoon yield (200.70 kg) as main product per rearing when compared to farmers in Bagalkot (187.29 kg) with an overall average of 193.98 kg for both districts together. However, the gross returns realized by farmers on both main and by-products *i.e.*, from the sale of cocoon and by-products remained the same in both the districts and valued at Rs. 38931.09 per acre in case of Belgaum and Rs. 38440.32 per acre in case of Bagalkot. Although Bagalkot farmers realized marginally low yield when compared to farmers of Belgaum, it was compensated by relatively better cocoon market price and this lead similar gross returns in both districts. The share of gross returns contributed by main product *i.e.*, cocoon yield accounted about 90 per cent to the total gross returns in both districts. While, the remaining 10 per cent of the gross returns was contributed by by-products namely, fodder and manure per litter. In Belgaum district, the farmers realized an income of Rs. 2267.50 per acre from sale of manure/litter and Rs. 1712.50 per acre from crop waste which is used as fodder for animal. The corresponding by-products' returns obtained by farmers in Bagalkot district were Rs. 2185.50 per acre and Rs. 1564.30 per acre, respectively. The proportion of low quality cocoon to the gross returns was insignificant and composed only less than one per cent of the gross returns across districts.

The total cost of silkworm rearing was less in case of Belgaum farmers (Rs. 32498.13/rearing) when compared to farmers of Bagalkot district (Rs. 34539.49/ rearing) and was mainly due to relatively low human labour cost and cost of mulberry leaves as feeding material. As a result of this, the net return obtained by farmers in Belgaum was marginally more at Rs. 6432.96 per acre over the net returns of Rs. 3900.83 per acre by Bagalkot farmers. The analysis of gross returns per kg of cocoon was found to be marginally more in case Bagalkot (Rs. 204.78/kg) over Belgaum (Rs. 193.57/kg). This was mainly attributed to difference in the sale price of cocoon by farmers in two districts.

Table 4.13: Returns from silk cocoon production per rearing (300 dfls) of silkworms

(Per acre)

Sl. No.	Item	Belgaum			Bagalkot			Overall		
		Price (Rs.)	Quantity	Value (Rs.)		Quantity	Value (Rs.)		Quantity	Value (Rs.)
Outputs										
1.	Main product									
	a. Cocoon yield (kgs)	173.77*	200.7	34876 (89.58)	184.80*	187.29	34612 (90.04)	179.03*	193.98	34729 (89.295)
	b. Low quality cocoon yield (kgs)	9.47	7.86	74.49 (0.19)	11.42	6.84	78.12 (0.20)	10.79	6.51	70.29 (0.18)
2.	By product									
	a. Crop waste/fodder (quintal)	135.91	12.6	1712.5 (4.39)	186.89	8.37	1564.3 (4.06)	151.18	10.47	1582.9 (4.10)
	b. Manure / litter (tonne)	614.49	3.69	2267.5 (5.82)	728.50	3.00	2185.5 (5.68)	667.26	3.33	2222.00 (5.75)
Returns										
	Gross returns (Rs)	-	-	38931.09 (100.00)	-	-	38440.32 (100.00)	-	-	38604.96 (100.00)
	Total costs (Rs)	-	-	32498.13	-	-	34539.49	-	-	33738.84
	Net returns (Rs)	-	-	6432.96	-	-	3900.83	-	-	4866.12
	Gross returns per kg of cocoons (Rs)	-	-	193.57	-	-	204.78	-	-	198.58
	Cost per kg of cocoons (Rs)	-	-	161.92	-	-	184.41	-	-	173.92
	Net returns per kg of cocoons (Rs)	-	-	32.05	-	-	20.82	-	-	25.08
	B:C ratio	-	-	1.19	-	-	1.11	-	-	1.14

Note: Figures in parentheses percentage to the total * - Including 10 rupees of incentives given by State Govt. of Karnataka

Table 4.14: Annual costs and returns of silk cocoon production per acre of mulberry garden based on size of holding/enterprise

Classi-fication	n			Avg. area under mulberry crop (Acres)			Operational costs											
							dfl/chawki worms (Rs.)			Mulberry (Rs.)			Human labour (Rs.)			Other operational costs (Rs.)		
	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall
<1 acre	34	33	67	0.90	0.92	0.91	9219.35	9305.60	9262.40	44935.00	47995.50	46467.25	75309.55	83285.95	80472.85	22284.50	21811.30	28647.75
1-2 acres	22	24	46	1.70	1.78	1.74	8118.90	8205.20	8161.00	41946.40	45010.90	43478.65	70800.55	78776.95	75963.85	25360.75	24887.55	31724.00
>2 acres	4	3	7	2.50	2.50	2.50	7082.45	7168.70	7125.50	45125.00	48189.00	46657.25	72300.58	80276.95	77463.85	23342.00	22868.80	29705.25
Average	**60**	**60**	**120**				**8140.23**	**8226.50**	**8182.97**	**44002.13**	**47065.13**	**45534.38**	**72803.56**	**80779.95**	**77966.85**	**23662.42**	**23189.22**	**30025.67**

Classi-fication	n			Total operational cost (Rs.)			Total fixed cost (Rs.)			Total cost of silk cocoon production (Rs.)			Yield of coons (kgs)			Cost of cocoon per kg (Rs.)		
	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall
<1 acre	34	33	67	151748.40	162402.35	164850.25	19293.05	18846.35	19069.70	171041.45	181248.70	184469.95	1066.50	987.00	958.15	165.77	176.80	171.03
1-2 acres	22	24	46	146226.60	156880.60	159327.50	15819.30	15372.60	15595.95	162045.90	172253.20	174923.45	880.35	935.50	906.65	171.57	182.60	176.83
>2 acres	4	3	7	147850.00	158503.45	160951.85	15954.55	15507.85	15731.20	163804.55	174011.30	176683.05	1049.50	970.00	941.15	172.27	183.30	177.53
Average	**60**	**60**	**120**	**148608.33**	**159262.13**	**161709.87**	**17022.30**	**16575.60**	**16798.95**	**165630.63**	**175837.73**	**178692.15**	**998.78**	**964.17**	**935.32**	**169.87**	**180.90**	**175.13**

Classi-fication	n			Value of cocoons (Rs.)			Value of byproducts (Rs.)			Gross return (Rs.)			Net returns (Rs.)			Gross returns per rupee of investment (B:C ratio)		
	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall	Belgum	Bagalkot	Overall
<1 acre	34	33	67	176793.71	174501.60	163872.39	28902.50	27751.50	28027.00	205696.20	202253.10	191899.39	34654.75	21004.40	7429.40	1.20	1.11	1.04
1-2 acres	22	24	46	151041.65	170822.30	160322.92	20460.00	19309.00	19584.50	171501.64	190131.30	179907.41	9455.70	17878.10	4983.95	1.05	1.10	1.02
>2 acres	4	3	7	180797.37	177801.00	167082.36	26575.00	25424.00	25699.50	207372.36	203225.00	192781.85	43567.80	29213.70	16098.80	1.26	1.16	1.09
Average	**60**	**60**	**120**	**169544.24**	**174374.97**	**163759.22**	**25312.50**	**24161.50**	**24437.00**	**194856.73**	**198536.47**	**188196.22**	**29226.08**	**22698.73**	**9504.05**	**1.17**	**1.12**	**1.05**

The cost per kg of cocoon production is marginally less in case of Belgaum farmers (Rs. 161.92/kg) when compared to Bagalkot farmers (Rs. 184.51/kg). Hence, the net return from per kg of cocoons realized by the farmers of Belgaum was more (Rs. 32.05/kg) when compared to farmers of Bagalkot (Rs. 20.82/kg). Thus, the return obtained per rupee of cost (BC ratio) was marginally high in case of Belgaum farmers (1.19) when compared to Bagalkot farmers (1.11).

4.4.3 Annual costs and returns of silk cocoon production per acre of mulberry garden based on size of holding (enterprise)

The sample respondents in both the districts were distributed according to size of mulberry land holding. It could be inferred from the results presented in Table 4.14 that on the whole, a large number (48.09%) of farmers were cultivated mulberry with an area below one acre, followed by 38.33 per cent of them operating mulberry in an area between 1.00 and 2.00 acres of land. On the other hand, only 6.00 per cent of the farmers cultivated mulberry on more than 2 acres of land.

On an average, land holding under mulbberym, the break up of cost of silk cocoon production indicated that the total cost incurred in silk cocoon production was Rs. 1,84,469.95 per annum in case of less than one acre of land holding under mulberry, whereas it was Rs. 1,74,923.45 per annum in case of mulberry acerage between 1 to 2 acres. On the other hand, the cost of silk cocoon production in case of mulberry land holding of >2 acres was Rs. 1,76,683.05 per acre per annum.

It could be seen from the results that on an average, the gross returns realized by silk cocoon production was Rs. 1,91,899.39 per annum in case of farmers with less than one acre under mulberry. Whereas, farmers between 1 to 2 acres under mulberry cultivation realized gross returns of Rs. 1,79,907.41 per annum. On the other hand, the returns from silk cocoon production in case of >2 acres of mulberry land holding group was more *i.e.*, Rs. 1,92,781.85 per annum when compared to all other groups of enterprise.

As a result of this, the net return obtained per year by >2 acres of mulberry land holding group was relatively high (Rs. 16,098,.80/acre/annum) when compared to <1 acre mulberry land holding group (Rs. 7,429.40/acre/annum) and between 1 to 2 acres of mulberry land holding group it was Rs. 4,983.95 per acre per annum. Thus, the returns obtained per rupee of cost (B:C) was marginally high in the case of mulberry land holding group of >2 acres (1.09) when compared to mulberry land holding size <1 acre (1.04) and mulberry land holding size between 1 to 2 acres (1.02).

Hence, the profitable and efficient size of land under mulberry was >2 acres. The main reason for this is as the holding size increased, it resulted into optimum utilization due to economies of scale.

4.4.4 Annual costs and returns of silk cocoon production per acre from four, five and six crops

The sample respondents in both the districts were distributed according to number of crops taken in a year per acre of mulberry land. It could be inferred from the results presented in Table 4.15 that on the whole, a large number of farmers (80%) took four crops per year followed by 11.66 per cent of the farmers reared six crops per year. On the other hand, 8.33 per cent of the farmers took five crops per year.

On an average, based on the number of crops taken during a year, the cost of silk cocoon production indicated that the total cost of silk cocoon production was highest in case of six crops per year group *i.e.*, Rs. 1,72,068.08 per acre followed by five crops per year at Rs. 1,48,450.89 per acre. On the other hand, the cost of silk cocoon production was less in case of four crops per year at Rs. 1,29,894.55 per acre.

It could be seen from the results that on an average, the gross returns per acre obtained by silk cocoon production was more in case of six crops per year (Rs. 1,96,885.29) followed by five crops per year (Rs. 1,69,861.82). On the other hand, the gross returns was less in case of four crops per year (Rs. 1,29,894.55).

As a result of this, the net returns obtained by farmers who reared six crops per year was more (Rs. 24,817.21) followed by Rs. 21,410.92 in case of five crops per year group. Whereas, in the case of four crops the net returns per year was Rs. 18,734.56 per annum.

Although, the gross and net returns were high in the case of six crops per year, per crop net returns was more in case of four crops per year group at Rs. 4,683.64 per crop, followed by Rs. 4,282.18 in case of five crops per year. On the contrary, per crop net returns was low cost in case of six crops per year at Rs. 4,136.00 per crop.

Hence, the highly profitable and efficient number of rearings per annum was four crops per year. The reason for this quoted by farmers was the high crop loss during summer season due to high temperature and poor irrigation water availability in the study districts. This resulted in the production of poor quality mulberry and as well as quantity of biomass production.

4.5 Allocative and use efficiency of resources in mulberry cultivation and in cocoon production

4.5.1 Production elasticities and resource use efficiency in mulberry cultivation

The resource use efficiency in mulberry cultivation has been analyzed by computing the production elasticities and also by comparing marginal value product of a resource to marginal factor cost or acquisition cost. This analysis helped to determine whether the factors of production were used optimally.

While studying the economic aspects of mulberry cultivation, it was noticed that organic manures, fertilizers, growth regulators, irrigation, human labour and bullock labour constituted the important factors in mulberry cultivation. Whereas, in studying the economic aspects of cocoon production, it was noticed that mulberry leaves, dfls, disinfectants, human labour, paraffin paper and news paper were the important factors of production.

The resource use-efficiency in mulberry cultivation and cocoon production has been analyzed in terms of Cobb-Douglas type of production function (regression coefficients) and marginal value product. The same are shown in Table 4.16 and 4.18.

4.5.2 Production function analysis in mulberry cultivation

An attempt was made to analyse contribution of each factor to the mulberry biomass production using production function approach. It was found from the Table 4.16 that in Belgaum district the regression coefficient of organic manure (0.154**) was positive and also turned out to be statistically significant at five per cent probability level while, bullock labour (0.075*) was positive and also turned out to be statistically significant at one per cent probability levels of significance. Thus, indicated their significance in increasing mulberry yield. The growth regulator was negative (-0.002**) and also turned out to be statistically significant at five per cent probability levels of significance. The fertilizers (0.035) and irrigation (0.024) were also positive but non-significant. The human labour (-0.0868) had negative regression coefficient and was non-significant. The coefficient of multiple determination (R^2) was quite high (0.90) observed in case of Belgaum.

While in case of Bagalkot district, the regression coefficients of organic manure (0.260*), fertilizers (0.460*) and irrigation (0.034*) were positive and also turned out to be statistically significant at five per cent probability levels of significance. The growth regulator (-0.0536*), human labour (-0.252*) and bullock labour (-0.030*) were negative and also turned out to be statistically significant at five per cent probability levels of significance. The coefficient of multiple determination (R^2) was quite high (0.91) and indicated that a large proportion of variation in the mulberry yield was explained by the independent variables included in the model.

Production function analysis carried out for both districts together revealed that the regression coefficient of organic manure (0.210*) was positive and also turned out to be statistically significant at five per cent probability levels of significance. Fertilizers (0.070**) and bullock labour (0.060**) were positive and also turned out to be statistically significant at one per cent probability levels of significance.

Table 4.16: Regression coefficient of production function of mulberry crop

(In rupees)

Sl. No.	Particulars	Parameters	Co-efficient		
			Belgaum	**Bagalkot**	**Overall**
1	Intercept	a	8.76 (0.070)	7.11 (0.250)	7.94 (0.114)
2	Organic manure	X_1	0.154* (0.061)	0.260* (0.048)	0.210 * (0.016)
3	Fertilizers	X_2	0.035 (0.032)	0.460* (0.079)	0.070 ** (0.018)
4	Growth regulators	X_3	-0.002 * (0.001)	-0.053* (0.036)	-0.003 ** (0.001)
5	Irrigation	X_4	0.024 (0.042)	0.034* (0.033)	-0.020 (0.021)
6	Human labor	X_5	-0.086 (0.049)	-0.252* (0.055)	-0.040 (0.021)
7	Bullock labor	X_6	0.079** (0.022)	-0.030* (0.032)	0.060 ** (0.013)
8.	Coefficient of determination	R^2	0.90**	0.91**	0.95**
9.	F value	-	86.92	92.47	406.58

Note: Figures in parentheses are standard error
**- indicates significant at 1% level
* - indicates significant at 5% level

The growth regulator (-0.003**) was negative and also turned out to be statistically significant at one per cent probability levels of significance. The irrigation (-0.020) had negative regression coefficient and was found to be non-significant. The coefficient of multiple determinations (R^2) was also quite high (0.95) as was observed across the districts.

4.5.3 Marginal value productivity of various resources in mulberry cultivation

Based on the estimated production elasticities the marginal value product (MVP) per unit of factor cost for different resources under mulberry cultivation was calculated and is shown in Table 4.17.

In case of Belgaum district, the positive marginal values productivities of organic manure, fertilizers, irrigation and bullock labour indicated the possibilities of further increase in the use of these inputs in the production of mulberry leaves. The MVPs of growth regulators and human labour were negative thereby indicated the over use of resources under production and hence advocate to reduce the use of these resources so that the marginal values productivities of these factors become positive.

Whereas, in Bagalkot district, the positive MVP to MFC ratios in respect of organic manure, fertilizers and irrigation indicated the possibility of further increase in the use of these inputs in the production of mulberry leaves. The MVP to MFC ratios for growth regulators, human labour and bullock labour were negative thereby, indicated over use and therefore use of these resources required to be reduced so that the marginal value productivities of these factors become positive.

Resource optimization for both districts together showed the positive MVP to MFC ratios for organic manure, fertilizers and bullock labour indicated the possibilities of further increasing the use of these inputs in the production of mulberry leaves. The MVP to MFC ratios in respect of growth regulators, irrigation and human labour were negative thereby indicating the possibilities of reducing the use of these resources so that the marginal values productivities of these factors become positive.

4.5.4 Production function analysis in cocoon production

It was found from the Table 4.18 that in Belgaum district the regression coefficient of mulberry leaves (2.523*) and human labour (0.504*) was positive and also turned out to be statistically significant at five per cent probability levels of significance while, dfls (0.291**) was positive and also turned out to be statistically significant at one per cent probability levels of significance. The disinfectants (-0.130**) was negative and also turned out to be statistically significant at one per cent probability levels of significance. The coefficient of multiple determination (R^2) was quite high (0.98) and indicated that a large proportion of variation in the cocoon yield was explained by the independent variables included in the function.

In Bagalkot district the regression coefficient of dfls (0.544*) and human labour (2.675*) was positive and also turned out to be statistically significant at five per cent probability levels of significance while, mulberry leaves (1.842**) was positive and also turned out to be statistically significant at one per cent probability levels of significance. The disinfectants (0.121) was also positive but non-significant. The coefficient of multiple determination (R^2) was quite high (0.95).

Overall, the regression coefficient of dfls (1.275*) and human labour (0.324*) was positive and also turned out to be statistically significant at five per cent probability levels of significance. The Mulberry leaves (1.935). The disinfectants (-0.222) had negative regression coefficient and was non-significant. The coefficient of multiple determination (R^2) was quite high (0.94).

4.5.5 Marginal value productivity of various resources in cocoon production

Based on the estimated production functions the marginal value productivity (MVPs) for different resources was also shown in Table 4.19.

In Belgaum district, the positive marginal values productivities of mulberry leaves, dfls, Human labour and paraffin paper and news paper indicated the possibilities of further increasing the use of these inputs in the production of cocoons.

Table 4.17: MVP and MFC ratios of resources for mulberry crop cultivation

Sl. No.	Particulars	Parameters	Belgaum		Bagalkot		Overall	
			MVPs	MVPs: MFC	MVPs	MVPs: MFC	MVPs	MVPs: MFC
1	Intercept	a	-	-	-	-	-	-
2	Organic manure	b_1	0.29	0.29	0.37	0.37	0.35	0.35
3	Fertilizers	b_2	0.26	0.26	2.06	2.06	0.39	0.39
4	Growth regulators	b_3	-30.43	-30.43	-0.33	-0.33	-0.88	-0.88
5	Irrigation	b_4	0.19	0.19	0.15	0.15	-0.10	-0.10
6	Human labor	b_5	-0.10	-0.10	-0.18	-0.18	-0.03	-0.03
7	Bullock labor	b_6	0.39	0.39	-0.06	-0.06	0.19	0.19

Note: MVP= Marginal value product
MFC = Marginal factor cost

Table 4.18: Regression coefficients of production function of cocoon production

Sl. No.	Particulars	Parameters	Co-efficient		
			Belgaum	Bagalkot	Overall
1	Intercept	a	3.31 (2.900)	9.08 (4.900)	3.73 (4.350)
2	Mulberry leaves	X_1	2.523* (0.350)	1.842** (0.550)	1.935 (0.562)
3	dfls	X_2	0.291** (0.090)	0.544* (0.207)	1.275* (0.155)
4	Disinfectants	X_3	-0.130** (0.045)	0.121 (0.368)	-0.222 (0.116)
5	Human labour	X_4	0.504* (0.078)	2.687* (0.272)	0.324* (0.126)
6.	Coefficient of determination	R^2	0.98	0.95	0.94
7.	F value	-	570.74	232.45	384.86

Note: Figures in parentheses are standard error
**- indicates significant at 1% level
* - indicates significant at 5% level

Table 4.19: MVP and MFC ratios of resources for cocoon production

(In rupees)

Sl. No.	Particulars	Parameters	Belgaum		Bagalkot		Overall	
			MVPs	MVPs: MFC	MVPs	MVPs: MFC	MVPs	MVPs: MFC
1.	Intercept	a	-	-	-	-	-	-
2.	Mulberry leaves	b_1	6.30	6.30	8.55	8.55	6.59	6.59
3.	dfls	b_2	4.24	4.24	12.86	12.86	23.65	23.65
4.	Disinfectants	b_3	-7.26	-7.26	3.26	3.26	-8.66	-8.66
5.	Human labour	b_4	0.93	0.93	6.11	6.11	0.67	0.67
6.	Paraffin paper and news paper	b_5	16.00	16.00	-35.55	-35.55	18.36	18.36

Note: MVP= Marginal value product
MFC = Marginal factor cost

The MVPs of disinfectants were negative thereby, indicating the possibilities of reducing the use of these resources so that the marginal values productivities of these factors become positive.

In Bagalkot district, the positive marginal values productivities of Mulberry leaves, dfls disinfectants and human labour indicated the possibilities of further increasing the use of these inputs in the production of cocoons.

Overall the positive marginal values productivities of Mulberry leaves, dfls, human labour and news paper indicated the possibilities of further increasing the use of these inputs in the production of cocoons. The MVPs of disinfectants were negative thereby, indicating the possibilities of reducing the use of these resources so that the marginal values productivities of these factors become positive.

4.5.6 Annual household farm income from silk cocoon production

The annual household income obtained from rearing of silk cocoons on an acre of mulberry garden is presented in Table 4.20. Annual household farm income from silk cocoon production was calculated considering five rearings per year as carried out by farmers in both Belgaum and Bagalkot districts. The same was computed based on the estimated per rearing income obtained by sample farmers from silk cocoon production in both districts as presented previously in Table 4.15.

It could be seen from the results that on an average, farmer in Belgaum realized relatively more cocoon yield (1003.50 kg) as main product per annum when compared farmers in Bagalkot (936.45 kg) with an overall average of 969.90 kg for both districts together.

. However, the gross returns realized by farmers on both main and by-products *i.e.*, from the sale of cocoon and by-products remained the same in both the districts and valued at Rs. 194655.45 per acre in case of Belgaum and Rs. 192201.60 per acre in case of Bagalkot.

The share of gross returns contributed by main product *i.e.*, cocoon yield accounted about 90 per cent to the total gross returns in both districts. While, the remaining 10 per cent of the gross returns was contributed by by-products namely, fodder and manure/litter. In case of Belgaum district the farmers realized an income of Rs. 11337.50 per acre from sale of manure/litter and Rs. 8562.50 per acre from crop waste which is used as fodder for animal. The corresponding by-products' returns obtained by farmers in Bagalkot district were Rs. 10927.50 and Rs. 7821.50 per acre, respectively.

The total cost of silkworm rearing was less in case of Belgaum farmers (Rs. 162490.65/acre/annum) when compared to farmers of Bagalkot district (Rs. 172697.45/acre/annum) and was mainly due to relatively more human labour requirement and mulberry leaves as feeding material. As a result of this, the net return obtained by farmers in Belgaum was marginally more at Rs. 32164.80 per acre per annum over the net returns of Rs. 19504.15 per acre per annum by Bagalkot farmers. However the net return obtained by the farmers in across the districts was Rs. 24330.60.

4.6 Marketing of silk cocoons

4.6.1 Marketing functions

The availability of market and marketing facilities provided to the farmers play an important role in determining the profitability of enterprises. However, in respect of marketing of cocoons and the facilities to the farmers it could be ascertained that the local markets that existed for cocoon produce unable to get the adequate arrivals for under taking business transactions on daily basis. Hence, as result of this the farmers often were forced to take small quantity of their production to distant markets and their by indecently faced more marketing cost per unit of the produce marketed. The whole process of marketing of silk cocoons in the study area involved packing, transportation and selling functions. Better packing always helped in maintaining the quality and in reducing the losses transit on account of spoilage. Packing of silk cocoons was generally done in gunny bags of capacity of 40 to 50 Kg and 80 to 100 kg.

Table 4.20: Annual household income from silk cocoon production

(Per acre)

Sl. No.	Item	Belgaum		Bagalkot		Overall	
		Quantity	**Value (Rs.)**	**Quantity**	**Value (Rs.)**	**Quantity**	**Value (Rs.)**
Outputs							
	Main product						
1	a. Cocoon yield (kgs)	1003.50	174380.00	936.45	173060.00	969.90	173645.00
	b.Low quality cocoon yield (kgs)	39.30	372.45	34.20	390.60	32.55	351.45
	By product						
2	a. Crop waste/fodder (quintal)	63.00	8562.50	41.85	7821.50	52.35	7914.50
	b. Manure / litter (tonn)	18.45	11337.50	15.00	10927.50	16.65	11110.00
Returns							
1	Variable cost (Rs)	147200.10		157853.95		153627.05	
2	Fixed cost (Rs)	15290.55		14843.85		15067.20	
3	Total cost (Rs)	162490.65		172697.45		168694.20	
4	Gross return (Rs)	194655.45		192201.60		193024.80	
5	Net return (Rs)	32164.80		19504.15		24330.60	

Table 4.21: Quantity of cocoon produce marketed by sample farmers

District	Particulars	Unit	Markets					Total
			Athani	Mudol	Gokak	Bangalore	Ramanagaar	
Belgaum	No .of farmers	No	36	10	6	6	2	60
		% farmers	60.00	16.67	10.00	10.00	3.33	100.00
	Quantity sold	kg	16328	3265	3065	1244	751	24653.00
		% quantity	66.23	13.24	12.43	5.05	3.05	100.00
	Average price	**Rs.**	**152.94**	**155.00**	**170.16**	**181.66**	**180.25**	
	Distance to market	km	37.63	77.00	55.00	593.34	620.00	
Bagalkot	No .of farmers	No	11	41	0	6	2	60
		% farmers	18.33	68.33	0.00	10.00	3.33	100.00
	Quantity sold	kg	5135	12866	0	807	1566	20374.00
		% quantity	25.20	63.15	0.00	3.96	7.69	100.00
	Average price	**Rs.**	**161.90**	**153.60**	**-**	**186.66**	**185.50**	
	Distance to market	km	56.11	21.54		627.5	645.25	

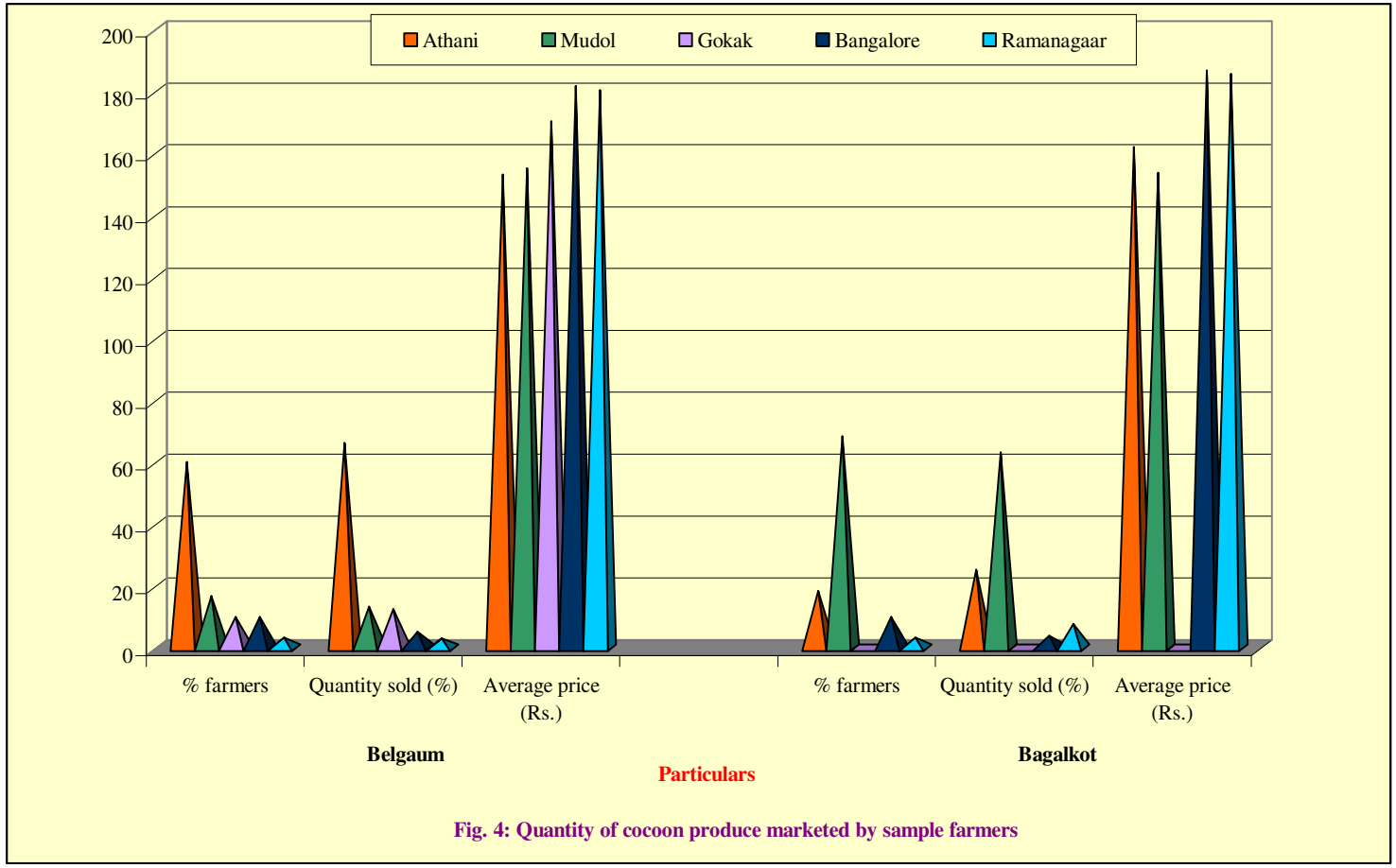

Fig. 4: Quantity of cocoon produce marketed by sample farmers

Fig. 4: Quantity of cocoon produce marketed by sample farmers

After harvesting of silk cocoons, cleaning of silk cocoons was done but no scientific grading of any kind was practiced by the producers. After this, the silk cocoons were packed in gunny bags.

4.6.2 Marketing channel

The results on quantity of cocoon output marketed by sample farmers are presented in Table 4.21. It could be observed from the results that majority of the farmers preferred local markets in both districts. For the farmers of Belgaum district, Athani constituted a most important market where 60 per cent of the farmers disposed–off as high as 66.23 per cent of cocoon produced in this market and the average distance the market was about 38 kms from villages. This was followed by Mudhol market located at an average distance of 77 kms where, 16.67 per cent farmers sold 13.24 per cent of the total produce. Another market in Belgaum where 10 per cent farmers sold 12.43 per cent cocoon produce at Gokak market located at an average distance of 55.00 kms followed by Bangalore market located at an average distance of 593 kms where, 10.0 per cent farmers sold 5.05 per cent of the total produce and at Ramanagar market located at an average distance of 620 kms where, 3.33 per cent farmers sold only 3.05 per cent of the total produce.

Whereas, for the farmers of Bagalkot district, Mudhol constituted a most important market where 68.33 per cent of the farmers disposed off as high as 63.15 per cent of cocoon produced in this market and the average distance the market was about 21 kms from villages. This was followed by Athani market located at an average distance of 56 kms where, 18.33 per cent farmers sold 25.20 per cent of the total produce. Another market in Bagalkot where 10 per cent farmers sold 3.96 per cent cocoon produce at Bangalore market located at an average distance of 629 kms followed by Ramanagar market located at an average distance of 645 kms where, 3.33 per cent farmers sold 7.69 per cent of the total produce. On the other hand any of the Bagalkot farmers were not sold their produce at Gokak market even though it is located nearer to the Bagalkot district. When market price of cocoon prevailing in each market was analyzed and it was observed that the price prevailing for the farmers of Belgaum in the local markets was Rs. 152.94, Rs. 155.00 and Rs. 170.16 in case of Athani, Mudhol and Gokak markets, respectively.

On the other hand, for the Bagalkot farmers, the price prevailed in local markets like Athani was Rs. 161.90 and Rs. 153.60 in Mudhol market. Whereas, it was marginally more in case of Bangalore and Ramanagar markets. The price prevailed in Bangalore and Ramanagar markets for the farmers of both the district was in the range between Rs. 180.00 to Rs. 186.00. Hence, large proportion of farmers marketed their small quantity of produce at local markets.

4.6.3 Cost of marketing of silk cocoons

Marketing charges

In the markets, producers have to pay different marketing charges such as market fee, hamali and weighing charges. But all these activities were arranged by the cocoon markets established in different production areas. For this, farmers have to pay only one per cent of the value of the cocoons sold.

The costs of marketing of silk cocoons in Athani, Mudhol, Bangalore and Ramanagar markets were taken and average of cost of marketing of silk cocoons for 100 kg is given in the Table 4.22.

It can be seen from the Table 4.21 that the total cost required to sell 100 kg of cocoons in the study area. The total marketing cost per 100 kg of cocoons in the farmers of Belgaum (Rs. 1164.20) was is comparatively less than the farmers of Bagalkot (Rs. 1239.35). The significant item of cost across the districts was transport charges for output which accounted for around 25.00 Per cent of the total marketing cost. The next important item was the cost of packing material which accounted for around 18.00 per cent of the total marketing cost. The marketing fee shared a large proportion around 14.00 per cent of the total marketing cost across the districts.The loading and unloading cost including hamali shared a proportion around 10.00 per cent of the total marketing cost in both the districts. The next item was grading and packing charges which accounted for around 5.00 per cent of the total marketing cost across the districts.

Table 4.22: Marketing Cost of silk cocoons per 100 kg of cocoons

Sl. No.	Item of cost	Belgaum	Per cent to total cost	Bagalkot	Per cent to total cost	Overall	Per cent to total cost
		Rs		Rs		Rs	
1.	Packing material	207.02	17.78	230.14	18.57	218.20	18.18
2.	Grading and packing charges	59.51	5.11	63.83	5.15	61.55	5.13
3.	Transportation charges	292.60	25.13	307.16	24.78	298.36	24.85
4.	Loading and un loading (Hamali)	123.61	10.62	127.61	10.30	125.56	10.46
5.	Market fee @ 1%	163.73	14.06	174.80	14.10	169.03	14.08
6.	Commission charges	27.65	2.38	34.44	2.78	30.93	2.58
7.	Personal expenditure	290.07	24.92	301.37	24.32	296.86	24.93
	Total	**1164.19**	**100**	**1239.35**	**100**	**1200.50**	**100**
	Marketing Cost per kg of cocoon (Rs)	11.64		12.40		12.00	

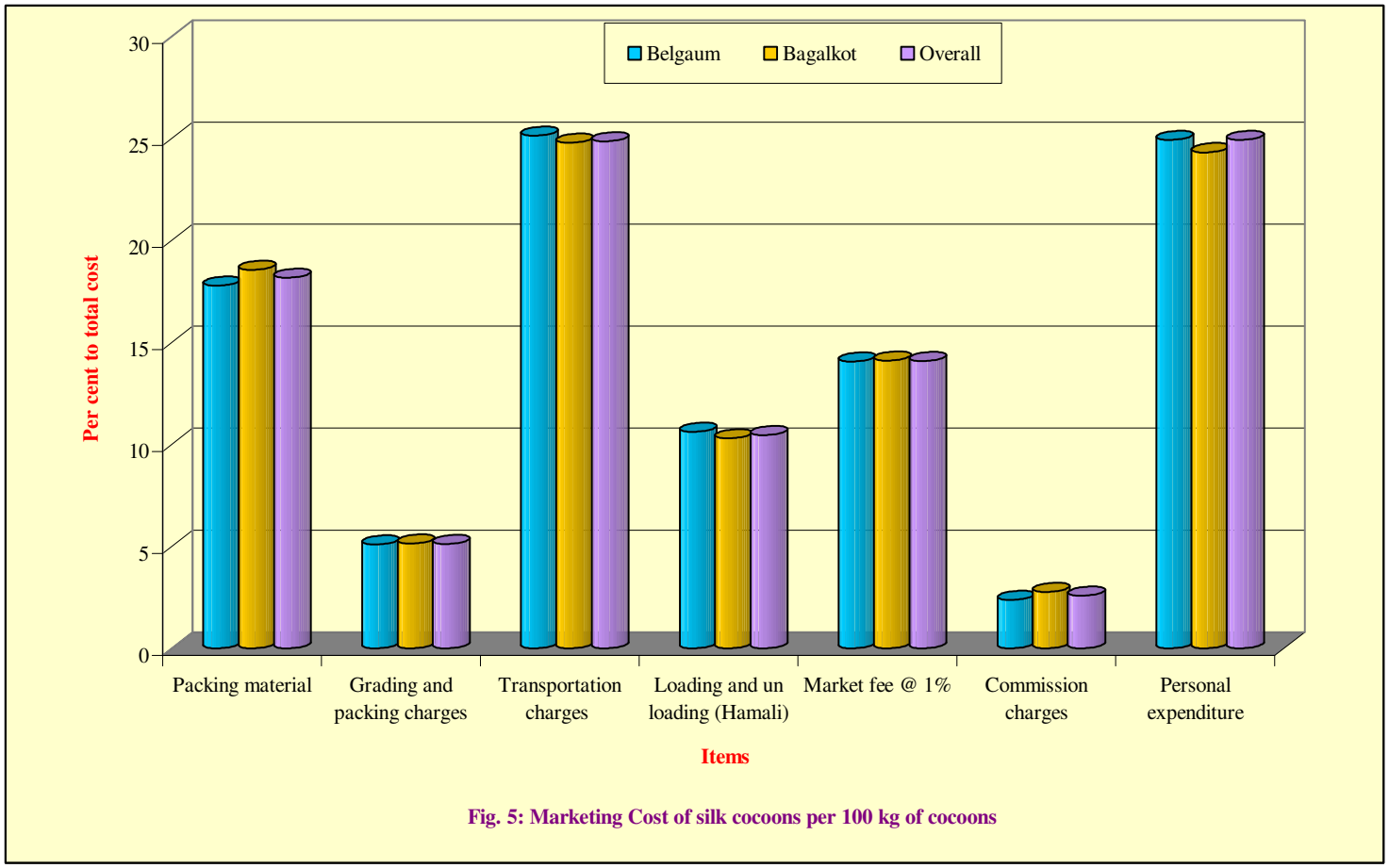

Fig. 5: Marketing Cost of silk cocoons per 100 kg of cocoons

Fig. 5: Marketing Cost of silk cocoons per 100 kg of cocoons

Commission charges contributed significantly low share to the total marketing cost around 2.50 per cent of the total marketing cost in both the districts. On the other hand the personal expenditure also share a major proportion of the total marketing cost around 24.50 per cent of the total marketing cost across the districts.

4.7 Constraints associated with sericulturists

4.7.1 Problems of farmers in mulberry cultivation

Various problems and constraints faced by farmers in practicing sericulture in the study area were analyzed. These problems and constraints were grouped into mulberry cultivation, production of cocoon and marketing constraints.

Based on the information furnished by sample farmers, the constraints being faced by them in sericulture in the study area were ranked and prioritized by using the Garret's ranking.

It was observed from Table 4.23 that, in Belgaum district, irrigation problem in summer was the major constraint in mulberry cultivation with 73.14 garret score, followed by skilled labour shortage (53.40 score), incidence of pest and diseases is more (50.40 score), non-availability of good quality mulberry cuttings (50.00 score), un favarorable climate (48.30 score), inputs are costly (41.80 score) and soil type is not suitable (28.50 score).

Whereas, in Bagalkot district also irrigation problem in summer was the major constraint in mulberry cultivation with 76.00 garret score, followed by skilled labour shortage (58.00 score), un favarorable climate (50.00 score), non-availability of good quality mulberry cuttings (49.00 score), inputs are costly (44.00 score), incidence of pest and diseases is more (42.00 score) and soil type is not suitable (35.00 score).

Irrigation problem in summer was ranked first in overall study area with the highest garret score of 74.62 score, followed by skilled labour shortage (55.80 score), non-availability of good quality mulberry cuttings (49.70 score), un favarorable climate (49.70 score), incidence of pest and diseases is more (46.40 score), inputs are costly (42.65 score) and soil type is not suitable (31.60 score).

4.7.2 Problems of farmers in cocoon production

From Table 4.24, it was noticed that in case of cocoon production constraints high temperature during summer was the major constraint with the highest garret rank of 73.14 in Belgaum district, followed by shortage and high rates of labour (61.00 score), difficulty in obtaining dfls (60.80 score), non-availability of inputs in time (56.00 score), non-availability of good quality leaf (55.60 score), pest and diseases of silkworm (49.20 score), difficulty in procuring stands, trays etc (45.00 score), difficulty in procuring stands, trays etc (37.60 score), lack of technical guidance (37.20 score) and improper disinfections (26.20 score).

Where as in Bagalkot district also high temperature during summer was the major constraint with the highest garret rank of 82.00,followed by shortage and high rates of labour (63.60 score), pest and diseases of silkworm (63.00 score), difficulty in obtaining dfls (54.40 score), difficulty in procuring stands, trays etc (49.00 score), non-availability of good quality leaf (48.60 score), improper disinfections (43.80 score), non-availability of inputs in time (41.80 score), lack of technical guidance (36.40 score) and high cost of silkworm rearing equipments (28.40 score).

In the overall study area high temperature during summer was the major constraint with the highest garret rank of 77.20, followed by shortage and high rates of labour (62.30 score), difficulty in obtaining dfls (57.60 score), pest and diseases of silkworm (56.10 score), non-availability of good quality leaf (52.10 score), non-availability of inputs in time (48.90 score), difficulty in procuring stands, trays etc (47.00 score), lack of technical guidance (36.80 score), improper disinfections (35.00 score) and high cost of silkworm rearing equipments (33.00).

4.7.3 Problems of farmers in marketing of cocoons

Table 4.25 revealed that in case of marketing constraints fluctuating prices was the major constraint with the highest garret rank of 79.00 in Belgaum district, followed by lack of market facility (65.00 score).

Table 4.23: Problems of farmers in mulberry cultivation

Sl. No.	Particulars	Belgaum		Bagalkot		Overall	
		Score	Rank	Score	Rank	Score	Rank
1.	Shortage of irrigation water during summer	73.14	1	76.00	1	74.62	1
2.	Shortage of skilled labour	53.40	2	58.00	2	55.8	2
3.	Non availability of good quality mulberry cuttings locally	50.00	4	49.00	4	49.7	3
4.	Un favorable climate	48.30	5	50.00	3	49.3	4
5.	High incidence of pest and diseases	50.40	3	42.00	6	46.4	5
6.	Costly inputs	41.80	6	44.00	5	42.65	6
7.	Non-suitability of soil type	28.50	7	35.00	7	31.6	7

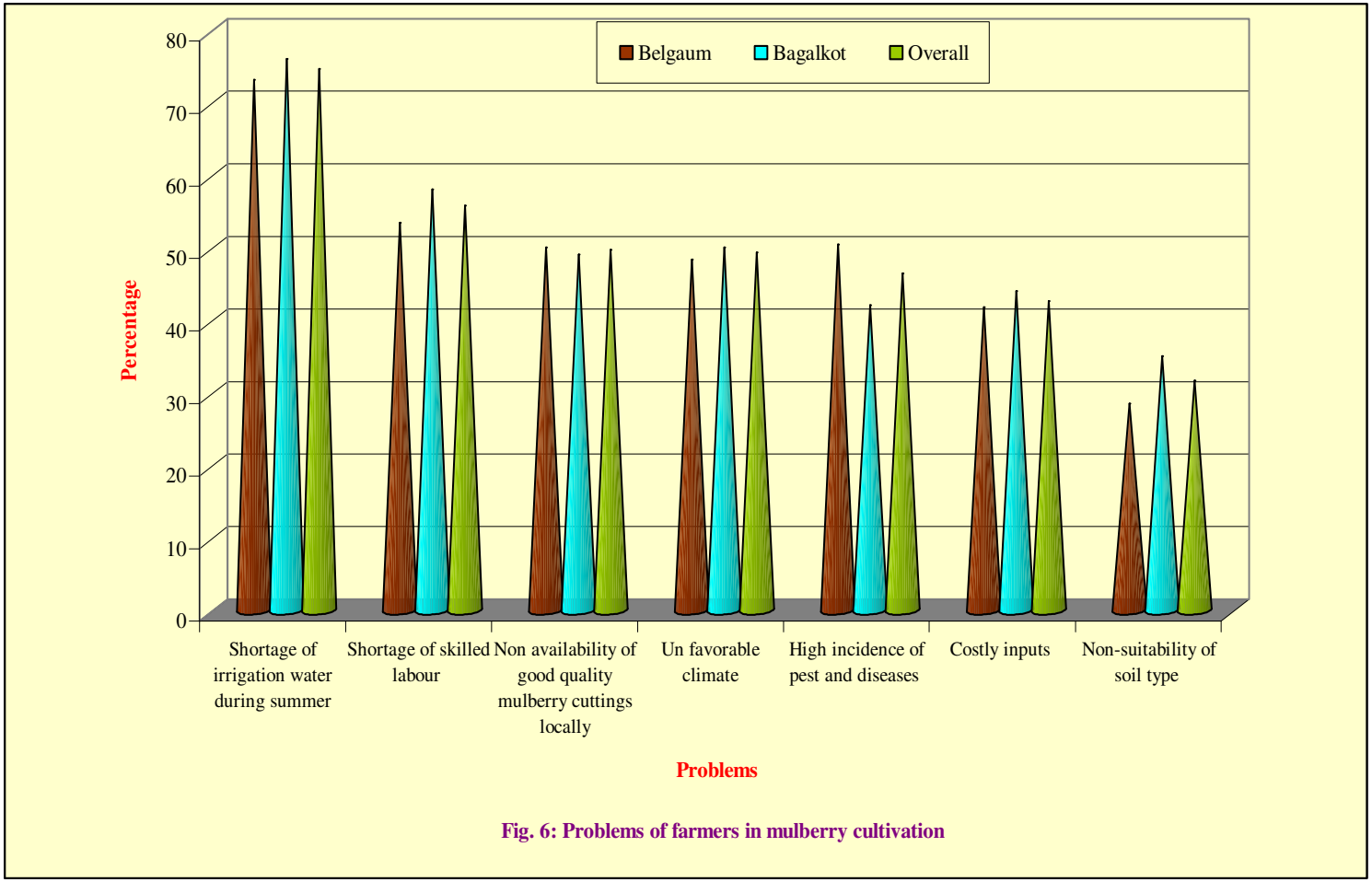

Fig. 6: Problems of farmers in mulberry cultivation

Table 4.24: Problems of farmers in cocoon production

Sl. No.	Particulars	Belgaum		Bagalkot		Overall	
		Score	Rank	Score	Rank	Score	Rank
1.	High temperature during summer	72.40	1	82.00	1	77.20	1
2.	Shortage of labour and high wage rates	61.00	2	63.60	2	62.30	2
3.	Difficulty in obtaining dfls	60.80	3	54.40	4	57.60	3
4.	Pest and diseases of silkworm	49.20	6	63.00	3	56.10	4
5.	Non availability of good quality leaf	55.60	5	48.60	6	52.10	5
6.	Non availability of inputs in time	56.00	4	41.80	8	48.90	6
7.	Difficulty in procuring stands, trays etc	45.00	7	49.00	5	47.00	7
8.	Lack of technical guidance	37.20	9	36.40	9	36.80	8
9.	Non-availability and improper knowledge in the use of disinfectants	26.20	10	43.80	7	35.00	9
10.	High cost of silkworm rearing equipments	37.60	8	28.40	10	33.00	10

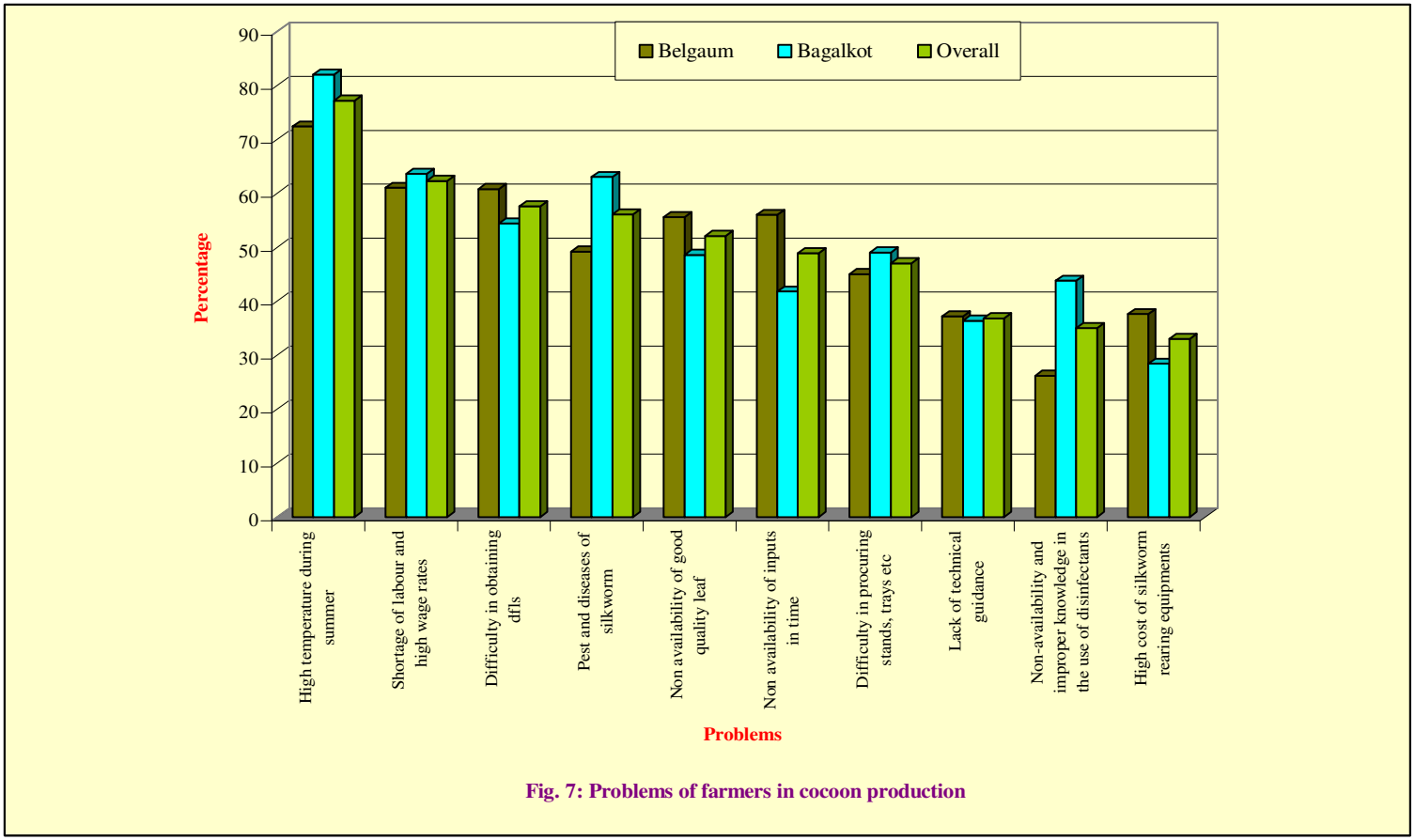

Fig. 7: Problems of farmers in cocoon production

Fig. 7: Problems of farmers in cocoon production

Table 4.25: Problems of farmers in marketing of cocoons

Sl. No.	Particulars	Belgaum		Bagalkot		Overall	
		Score	Rank	Score	Rank	Score	Rank
1.	High price fluctuation in the market	79.00	1	77.00	1	78.00	1
2.	Lack of local market facility	65.00	2	68.00	2	66.00	2
3.	Marketing credit is not advanced against the security of the cocoons	59.00	3	49.00	5	54.00	3
4.	Lack of storage/Warehousing facility	44.00	4	50.00	4	47.00	4
5.	Prices received are not remunerative	42.00	6	51.00	3	46.00	5
6.	Payment is not done promptly	43.00	5	34.00	8	39.00	6
7.	High middlemen involvement	37.00	7	39.00	6	38.00	7
8.	Unauthorized charges	32.00	8	36.00	7	34.00	8

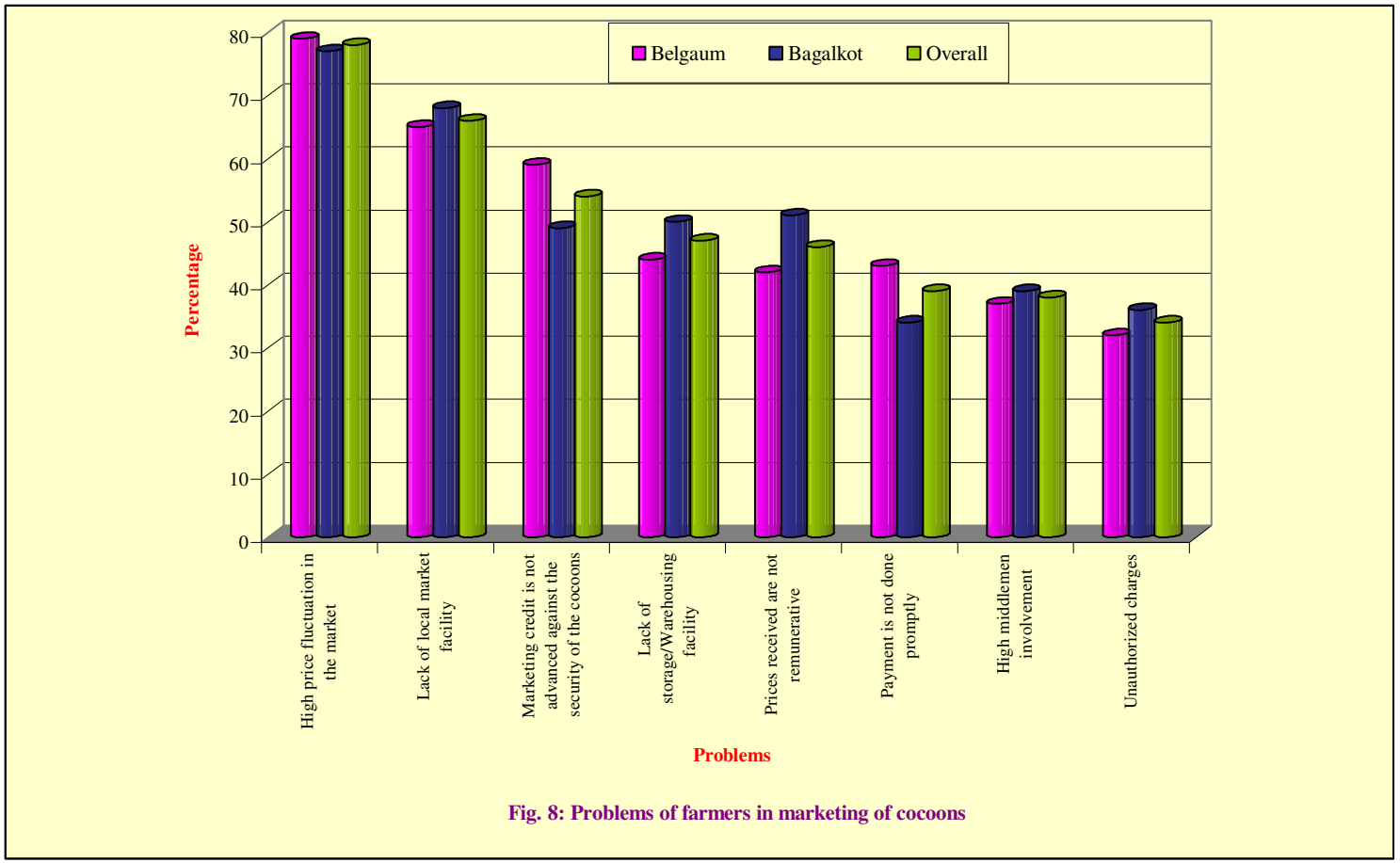

Fig. 8: Problems of farmers in marketing of cocoons

Fig. 8: Problems of farmers in marketing of cocoons

Loan is advanced against the security of the cocoons (59.00 score), lack of storage or warehousing facility (44.00 score), payment is not done promptly (43.00 score), prices received are not remunerative (42.00 score), high middlemen involvement (37.00 score) and unauthorized charges (32.00 score).

Where as in Bagalkot district also fluctuating prices was the major constraint with the highest garret rank of 77.00, followed by lack of market facility (68.00 score), prices received are not remunerative (51.00 score), lack of storage or warehousing facility (50.00 score), loan is advanced against the security of the cocoons (49.00 score), high middlemen involvement (39.00 score), unauthorized charges (36.00 score) and payment is not done promptly (34.00 score).

In the overall study area also fluctuating prices was the major constraint with the highest garret rank of 78.00, followed by lack of market facility (66.00 score), loan is advanced against the security of the cocoons (54.00 score), lack of storage/Warehousing facility (47.00 score), prices received are not remunerative (46.00 score), payment is not done promptly (39.00 score), high middlemen involvement (38.00 score) and unauthorized charges (34.00 score).

5. DISCUSSION

The major objectives of the study were to assess trends in mulberry cultivation and production of cocoon and to evaluate the cost, returns and profits in mulberry cultivation to analyse productivity of the resources used in mulberry cultivation and silk cocoon production. The study also focused on marketing costs involved in cocoon marketing and problems in sericulture production.

The present chapter seeks to explain the causes responsible for the variations witnessed in the above variables as indicated in the previous chapter. Such an analysis, it is hoped, would help in identifying some of the policy measures which could be implemented to over come the constraints explained by the sericulturists in mulberry cultivation, silk cocoon production and marketing operations.

The discussion is presented under the following heads for the purpose of analytical clarity.

5.1 Trends in mulberry area, cocoon production and productivity of cocoons

5.2 General characteristics of the sample respondents

5.3 Economic aspects of mulberry cultivation

5.4 Economic aspects of silk cocoon production

5.5 Allocative and use efficiency of resources in sericulture.

5.6 Marketing cost of cocoons

5.7 Constraints in sericulture production

5.1 Trends in mulberry area, cocoon production and productivity of cocoons

Annual growth rate in respect of mulberry area, cocoon production and its productivity in the traditional, non-traditional and for the state as a whole for the study period 2001-02 to 2010-11 are presented in Table 4.3.

It could be ascertained from the results that during the period of study (2001-02 to 2010-11) the area under mulberry in the state has declined at the rate of 3.38 per cent every year. The growth in mulberry area in six traditional or major sericulture districts that contributed substantially to the state's mulberry area was also decreased (4.09%) during same period. This may be attributed to the severe shortage of irrigation water during summer season and prevalent of drought situation in rainfed areas in recent years. Some traditional districts like Mysore, Chamrajnagar and Tumkur districts showed substantial decline of around 16.50 per cent in growth rates in area, which was mainly attributed to the raising of mulberry as a dry land crop. A major proportion of the mulberry area in the state is contributed by traditional districts and hence the overall growth rate of state mulberry area has shown parallel tendency of decline over the period owing to decline in the area growth in these traditional districts. Further, sericulture in the traditional districts was undertaken on a large area and on a commercial scale. Unfavourable market prices for cocoon results into poor profitability to the farmers. In addition to this, since it being labour intensive and practiced on a commercial scale farmers largely depend on hired labour and any increase in the labour wage rates serves the enterprise unprofitable. Thus, induce the farmers towards large scale reduction in area. The decline in area under mulberry cultivation over the past few years could be apparently due to the lowering water table in the traditional silk producing districts, which is prompting several farmers to switch over to horticulture crops which have less water requirement. Also, with rising urbanization, farmers are selling their lands to real estate developers in the silk producing regions which has consequently reduced the area under mulberry acreage.

Consequent to decline in the area under mulberry over a period of ten years, the total cocoon production in state also has declined annually at the rate of 1.17 per cent. The traditional districts showed a poor positive but non-significant growth in respect of production at the rate of 0.02 per cent annually. A major proportion of the cocoon output in the traditional districts is accounted by the multivoltine and hence the declining growth rate of total cocoon in these districts was largely contributed by production of multivoltine.

The districts of Kolar, Bangalore Rural, Mandya, Mysore, Tumkur and Chamrajnagar together accounted for 91.76 per cent of the total cocoon produced in Karnataka. The non-traditional districts which were also showing higher negative growth rates in area. These districts together accounted only a small proportion of the total state mulberry area and cocoon production . This decline in area and production in the non-traditional districts was magnitude to the fact that sericulture is practiced as a subsidiary using farm labour not as main occupation. The farmers have tendency of shifting towards other alternative crop based enterprises due to poor market for cocoon outputs in these districts. The lag in price between local markets and specialized markets (Bangalore, Ramanagar, Sidlagatta and Kolar) with state could another reason for decline in area and production. This, negative growth rate in cocoon production may be attributed to reduced area due to the pest attack and disease outbreak, importing of cheap silk from other countries especially from China, which inturn resulted in decreased market for domestic silk. The findings of the present study area and production in agreement with the study conducted by Anil Kumar Yadav (2008) where area of mulberry and production of silk cocoons declined at the compound growth rate of 5.74 and 4.26 per cent per annum respectively. The present study was disagreement with the study conducted by Raveendra *et al.* (1997) where the total cocoon production trend registered an annual compound growth rate of 36.98 per cent.

The per hectare cocoon productivity registered a marginally increase in the state and has grown at the rate of 1.73 per cent annually during ten year study period. Although production of silk is stagnating, the industry has managed to achieve marginal improvement in productivity. The increased productivity was observed on account of introduction of high yielding mulberry varieties (V1), silkworm breeds (CSR-2) and introduction of new technologies in silkworm rearing. The findings of the present study on productivity of silk cocoon is opposite with the study conducted by Anil Kumar Yadav (2008) where the results revealed that declined in productivity at the compound growth rate of 3.96 per cent per annum. Hence, the hypothesis was disproved in respect of area and production but was proved in case of cocoon productivity.

5.2 General characteristics of the sample respondents

Majority (77.46%) of the farmers in the study area were up to the age 50 years while, 41.66 per cent of them were up to 40 years age and the remaining 35.83 per cent between 41 to 50 years. This indicated that most of the farmers were young and in the middle age groups and hence farmers in this age can with stand risks and able to adopt new innovations and modern farming practices. Among the sample farmers, for majority (78.33%) of them agriculture was main occupation along with sericulture as subsidiary while, for 22 per cent of farmers sericulture was a main occupation. Thus, farmers in the study districts tended to take up sericulture as subsidiary mainly with family labour along with other crop enterprises.

As for as education is concerned, 80.83 per cent of the respondents were literates and even had higher educational level up to college and above (19.17%) across districts. This was quite high when compared to district like Gulbarga (65.65%) which is considered as backward district in respect of literacy (According to 2011 census) performance.

The average size of family in sample districts appeared to be higher (7.45 Nos.) than the state average (5.10 Nos.). The proportions of adult men were more when compared to women. Whereas, 14 per cent family members were dependent. As high as 82.50 per cent adopted nucleus and only 17.50 per cent joint family type indicated popularity of nucleus family type among farmers in recent years. Only about 14 per cent of the operational holding was under mulberry crop who popularly cultivated Victory-1 (V-1) variety under irrigated condition. As high as 63.17 per cent of the total operational holding (9.42 acres) was found to be cultivated under irrigation and 32.50 per cent under rainfed.

5.2.1 Cropping pattern of sample farms

Mulberry cultivation was the third important enterprise that occupied 12.32 per cent area next only to maize (27.01%) and sugar cane (17.82%) across study districts. This showed the scope for the extending the area and importance of mulberry cultivation in the study districts. This could be expanded further by promoting farmers through training and demonstrations to take up mulberry cultivation in the districts on mulberry cultivation practices and rearing of silkworms.

The available irrigation facilities were utilized more for mulberry crop along with other commercial crop like sugarcane which was also one of the paying crops in the study area. The highest area under maize during *kharif* season attributed to higher productivity and stable and high market price. Sorghum, wheat and pearl millet were also grown by farmers as rainfed crops in these districts and they constituted major staple crops as sources of food for consumption and also as fodder for animals.

The overall distribution of farmers across districts according to the extent of area under mulberry cultivation interestingly indicated that as large as 48.33 per cent farmers cultivated the crop between 0.50 and 1.00 acre and the share in area in this range was of 35.68 per cent of the total. Whereas, 38.33 per cent of them cultivated it between 1.00 and 2.00 acres and the share in area in this range was over 50 per cent. Similar trend of area distribution was observed in both districts when analysed. This indicated that majority of the farmers considered mulberry area between 0.50 to 2.00 acres as economically viable unit for cultivation. The smaller average area per household under mulberry was by farmers in the study districts indicated that mulberry and silk rearing was subsidiary along with other crops.

5.3 Economic aspects of mulberry cultivation

5.3.1 Operation wise labour use pattern in establishment of mulberry garden

The labour use pattern by farmers in both the districts together showed that the total human labour required for the establishment of one acre of mulberry garden was 50.37 man days. Out of the total labour requirement, a large proportion of it in the range of 26.00 to 27.00 per cent cross districts was used for undertaking weeding and planting of mulberry cuttings. Whereas for irrigation application, to undertake transportation and for application of organic manure the labour used was in the range between 14.00 to 18.00 per cent. The results on labour utilization by farmers for mulberry garden establishment thus clearly indicated that there was almost similar utilization pattern of labour, animal and machine power across districts for different operations.

Increased labour use on weeding operation was particularly due to long gestation period of establishment of mulberry garden. It is usually took on an average six months to give economic yield. Therefore, during this time period farmers required to take several weeding operations to control weeds and to boost the growth of mulberry biomass. Whereas, planting of mulberry cuttings also required more number of human labours (26.00%).

In addition to human labour, bullock labour and machine labour was used in establishment of mulberry garden. Out of the total bullock power(about 3 pair days) used in the establishment of mulberry garden, 49.12 per cent of it was used for opening up of ridges and furrows whereas, 31.93 and 18.95 per cent of the bullock power was used for harrowing and ploughing operations, respectively. The entire 3.15 hours of machine labour was used for ploughing operation.

5.3.2 Input and labour cost in the establishment of mulberry garden

The major item of cost in the establishment of mulberry garden was on human labour as cultivation of mulberry is labour intensive production. The total cost of establishment of mulberry garden in Belgaum district was Rs. 30344.34 per acre and in Bagalkot district it was Rs. 28687.68 per acre. Of this, the cost on human labour in both the districts for various operations accounted between 22 and 23 per cent, respectively. The share of cost of planting material across districts accounted 17 to 18 per cent of the total cost of establishment. However, cost of labour, bullock and machine power together accounted between 31 and 32 per cent of the total cost in the study districts.

On the whole, the major item of cost in establishment of mulberry garden was on human labour. The cost incurred on human labour accounted for 23.11 per cent of the total cost of establishment. Next to human labour the major cost was the cost on planting materials at 17.90 per cent of the total cost of establishment. Thus, the total cost of establishment of mulberry garden amounted to Rs. 29511.44 per acre. Which appeared little high, when compared with the findings given by Chandrashekar Reddy (1985) where the cost of establishment of mulberry garden was Rs. 3587.33 per acre.

Thus, the analysis of the results on inputs and labour costs in the establishment of mulberry garden between districts revealed that there was more or less uniformity in the distribution of outlays spent for labour operations and on quantities of physical inputs applied among the farmers of two districts. Although farmers in Belgaum incurred marginally higher cost when compared to Bagalkot farmers this was largely attributed to marginal differences in the quantities of inputs used.

5.3.3 Cost and returns from mulberry cultivation during rearing

5.3.3.1 Input use pattern in mulberry cultivation per acre per rearing

The quantities of inputs utilized per acre per rearing by farmers showed that there was only a marginal variability in the inputs applied in the production of bio-mass (mulberry leaves) in Belgaum and Bagalkot districts. The quantities of different fertilizers in the form of urea, DAP, MOP, SSP and complex used were marginally more in case of Bagalkot farmers (164.95 kg/acre) when compared to farmers of Belgaum (152.76 kg/acre) district. On the other hand farmers in Belgaum tended to use more (3.04 tonn/acre) of organic manure than Bagalkot (2.79 tonn/acre) farmers. On an average, the farmers in both district together used three tons of organic manure, fertilizer at the rate of 158.87 kg/acre. Which appeared little low as the recommended NPK is higher (300:150:150) compared to actually applied by the farmer.

5.3.3.2 Operation wise labour use pattern per rearing in mulberry cultivation

In Belgaum district, the total human labour required per acre for the cultivation of mulberry garden was 29.33 man days and that of bullock labour was 2.88 pair days. Out of the total labour requirement, 33.36 per cent of labours were used for undertaking weeding at different stages, followed by 27.20 per cent of total human labour used for transportation and spreading of manure. On the other hand out of the total bullock power used in the cultivation of mulberry garden, 59.92 per cent of it was used for earthing up whereas, 40.08 per cent of the bullock power was used for intercultivation operations.

In Bagalkot district on an average, the total human labour required per acre for the cultivation of mulberry garden was 27.38 man days and that of bullock labour was 2.62 pair days. Out of the total labour requirement, 30.46 per cent of labour were used for undertaking weeding at different stages, followed by 26.81 per cent of total human labour used for transportation and spreading of manure. In Bagalkot district on an average, the total human labour required per acre for the cultivation of mulberry garden was 27.38 man days and that of bullock labour was 2.62 pair days. Out of the total labour requirement, 30.46 per cent of labour was used for undertaking weeding at different stages, followed by 26.81 per cent of total human labour used for transportation and spreading of manure.

For both districts together the total human labour required was 28.36 man days and that of bullock labour was 2.75 pair days. Out of the total labour requirement, 31.96 per cent of labour was used for undertaking weeding at different stages, followed by 27.02 per cent of total human labour used for transportation and spreading of manure. On the other hand out of the total bullock power used in the cultivation of mulberry garden, 62.48 per cent of it was used for earthing up whereas, 37.52 per cent of the bullock power was used for inter cultivation operations.

Mulberry requires higher dosage of fertilizers applied in splits and better irrigation facility from time to time for good quality of mulberry leaves with higher quantity bio-mass. The competition of weeds necessitated more human labour for undertaking weeding at different stages to control weeds. Besides, mulberry cultivation being more of labour intensive nature required more human labour.

5.3.3.4 Cost of cultivation of mulberry crop per acre per rearing

Cost of cultivation of mulberry in Belgaum and Bagalkot districts for each rearing were worked out to be Rs. 12921.31 and Rs. 12478.27 per acre. The share of variable cost in both the districts remained the same between 77 and 78 per cent. Among the variable costs, the cost on human labour was maximum in both districts and accounted between 29 and 30 per cent. The remaining 22 to 23 per cent accounted for fixed cost.

When the cost of mulberry cultivation was analysed for both districts together, the total cost per acre per rearing was Rs. 12699.82 and of this variable cost accounted 77.95 per cent to the total cost. The remaining 22.04 per cent accounted to the fixed cost. Among the variable costs, the cost on human labour shared a highest proportion (29.53%) to the total cost at Rs. 3751.31 per acre during each rearing. The total variable cost when estimated on per acre basis was very high in Belgaum and Bagalkot when compared to Rs. 5226.00 per hectare reported by Hanumappa (1986) in Dharwad district.

The estimate of rental value of owned land was obtained in consultation with the respondents and this represented what the respondents would pay if they had rented-in the same type of land. The rental value of land was the major item of fixed cost in both districts with a share 16 to 17 per cent of the total cost.

Overall the total cost of mulberry cultivation, including both variable and fixed cost was estimated at Rs. 12699.82 per acre. This cost appeared bit high, because of variable cost. Where the results of Ramakrishna (1987) share cost of cultivation of mulberry garden estimated at Rs. 11183.86 per acre in T.S.Hally of Karnataka.

The returns in mulberry cultivation through mulberry leaves, stalks etc were either assumed or imputed ones in nature. This was because leaf was not sold but used by the producer himself in cocoon production and the byproducts were wholly used by the farm families themselves.

5.3.3.5 Returns from mulberry cultivation

It was observed that respondents produced mulberry leaves primarily for silkworm rearing. Hence, it was difficult to estimate the returns from mulberry cultivation. However, in the sample villages, on an average the mulberry leaves sold at were Rs. 1.65 per Kg, Hence, this price was used to arrive at the gross return from mulberry leaves which amounted to Rs. 8817.0, Rs. 8805.25 and Rs. 8811.41 in Belgaum, Bagalkot districts and overall for both districts, respectively. However including stalks the gross return from mulberry cultivation was Rs. 9742.2, Rs. 9475.15 and Rs. 9472.91 in Belgaum, Bagalkot districts and at overall level, respectively.

Thus, results clearly indicated that the farmers in both districts realized similar bio-mass production (mulberry leaves) by volume. The farmers with similar agronomic practices and input management pattern on the variety (Victory-1) cultivated in both districts obtained almost yields on par. The gross returns per acre obtained from mulberry cultivation were found in the study area was relatively high due to time element when compared with returns of Rs. 3497.72 per acre per rearing estimated by Ramakrishna (1987).

5.4 Economic aspects of silk cocoon production

5.4.1 Cost of silk cocoon production per rearing per acre of mulberry garden (300 dfls)

For the purpose of analysis, it is assumed that the unit producing the mulberry leaves is a service unit which produced basic raw material to the cocoon production unit. There is an integration of these activities. Generally, each rearing involved 300 dfls for each acre of mulberry cultivated for production of required biomass.

The cost of silk cocoon production per acre (300 dfls) per rearing in Belgaum and Bagalkot districts were worked out to be Rs. 32498.13 and Rs. 34539.49. The share of variable cost in both the districts remained the same between 90 and 91 per cent. Among the variable costs, the cost on human labour shared was highest in both the districts and accounted between 43 and 45 per cent of the total cost followed by cost of mulberry leaves which accounted about 26 per cent. The remaining 8 to 9 per cent accounted for fixed cost.

The overall operation wise and input wise break up of cost of silk cocoon production indicated that the total cost incurred in silk cocoon production was Rs. 33738.84 which was very high when compared with the study of Chandrappa *et al.* (2001) where the recurring expenditure per crop was Rs. 15,977.42 for shoot feeding of which the expenditure on leaf and labour were maximum and Umesh *et al.* (2001) reported the total cost of cocoon production per crop of 500 dfl's is Rs. 15865.08.

Besides, the present study result is marginally less when compared to study conducted by Srinivasa *et al.* (2001) reported that the total cost of production of cocoons was Rs. 37427.46 per acre per crop for multivoltine rearers.

A sizable proportion of the total cost was constituted by variable cost at Rs. 32060.37 which accounted 91.06 per cent to the total cost and similar observation of 93 per cent variable cost share was reported by Murthy (1977) in his study conducted in Bangalore district and relatively high when compared with 83 per cent by Chandra Reddy (1987).

Among the variable costs, the cost on human labour shared a large proportion of 45.28 per cent to the total cost during each rearing followed by 26.11 per cent on cost of mulberry leaves which was very high when compared with the study of Umesh *et al.* (2001) where the cost incurred for human labour in shoot feeding method was 19.38 per cent and the results of Purushothaum *et al.* (2009) where the major economic factor contributing for the total cost in sericulture was labour which was 32.54 per cent for silkworm rearing.

Human labour was mainly employed in the indoor activities for preparation of rearing house and handling of rearing equipments during rearing, disinfection, feeding of silkworms, bed-cleaning, sorting of ripe and diseased worms, mounting of ripe worms in mountages, harvesting and sorting of cocoons. The outdoor activities utilizing labour were leaf harvest, leaf transport, chawki rearing and cocoon marketing. The method of leaf harvest followed in the study area, during first instar of silkworm rearing was by hand picking of individual leaves. Since many gardens were at a distance from the rearing house, bullock labour was used to transport leaf material. It was also used in transporting rearing equipments during their shortage and for moving cocoons to the nearest bus transporting point.

Marketing costs emerged as the third largest operational cost owing to long distance travelled by farmers to market their produce in different local and specialized markets such as Athani, Mudhol, Gokak, Bangalore and Ramnagar markets where most of the cocoons were marketed. The remaining 22 per cent of the cost was distributed for disinfectants, transportation cost of dfls and purchase of paraffin and news papers, *etc.*

5.4.2 Returns from silk cocoon production per rearing per acre of mulberry garden

The returns in cocoon production were partly in the form of cash returns which had accrued from the sale of main product and partly in the form of imputed returns on byproducts which were entirely used by the farm households themselves. The main product namely cocoons were sorted after harvest into good quality cocoons and substandard cocoons, the later consisting of flimsy, stained and double cocoons together known as “waste” or “jalli goodu”. The proportion of substandard cocoons generally increased with the extent of disease in a crop and was minimal in a healthy crop. These cocoons being unsuitable for reeling or seed purpose were often sold off-hand for a single negotiated price for the entire quantity mostly to lone buyers.

The quantities of litter-manure and bed-fodder produced were dictated by the quantity of layings reared and leaf fed to the worms. The sale of surplus leaf presented the average quantity of leaf that had been lent-out by the sample farms and which also was reimbursed in kind in the study districts.

Table 4.15 revealed that, the results on per acre gross and net returns from silk cocoon production for each rearing with 300 dfls. It could be seen from the results that on an average, farmer in Belgaum realized relatively more cocoon yield (200.70 kg) as main product per rearing when compared farmers in Bagalkot (187.29 kg) with an overall average of 193.98 kg for both districts together. Which appeared significantly high when compared with the results of Chandrappa *et al.* (2001) reported in his study that the average cocoon yields were 52.10 kg for 100 dfls in shoot feeding method of rearing, Rao *et al.* (2001) reported the average yield obtained by the Chittoor and Eluru farmers was 42.99 and 38.50 kg per 100 dfls respectively and Gururaj *et al.* (2007) who also reported an yield of 52.22 kg per 100dfls (156.66 kg/300 dfls).

The gross returns realized by farmers on both main and byproducts *i.e.*, from the sale of cocoon and byproducts remained the same in both the districts and valued at Rs. 38931.09 per acre in case of Belgaum and Rs. 38440.32 per acre in case of Bagalkot.

Although Bagalkot farmers realized marginally low yield when compared to farmers of Belgaum, it was compensated by relatively better cocoon market price and this lead similar gross returns in both districts. The share of gross returns contributed by main product *i.e.*, cocoon yield accounted about 90 per cent to the total gross returns in both districts. While, the remaining 10 per cent of the gross returns was contributed by byproducts namely, fodder and manure/litter. The proportion of low quality cocoon to the gross returns was insignificant and composed only less than one per cent of the gross returns across districts.

The total cost of silkworm rearing was less in case of Belgaum farmers that Rs. 32498.13 per rearing for 300 dfls on an acre of mulberry crop when compared to farmers of Bagalkot district (Rs. 34539.49/acre) .This was mainly due to relatively more human labour (45.00%) requirement and mulberry leaves (about 26 to 39%) as feeding material in Bagalkot district.

The net return obtained per rearing by farmers in Belgaum was marginally more at Rs. 6432.96 per 300 dfls over the net returns of Rs. 3900.83 per 300 dfls by Bagalkot farmers with an overall net return of Rs. 4866 per 300 dfls for both districts together. Which was significantly less when compared with the results of Umesh *et al.* (2001) reported in his study that on an average, rearers have realized a net returns of Rs. 14655.23 under shoot feeding for every crop of 500 dfl's (Rs. 8793.13/ 300 dfls) .

The analysis of gross returns per kg of cocoon was found to be marginally more in case Bagalkot (Rs. 204.78/kg) over Belgaum (Rs. 193.57/kg). This was mainly due to difference in the sale price of cocoon by farmers in two districts. The cost per kg of cocoon production is marginally less in case of Belgaum farmers when compared to Bagalkot farmers. Hence, the net return from per kg of cocoons realized by the farmers of Belgaum was more when compared to farmers of Bagalkot. Thus, the return obtained per rupee of cost (BC ratio) was marginally high in case of Belgaum farmers (1.19) when compared to Bagalkot farmers (1.11). Where as Umesh *et al.* (2001) reported that for every rupee invested in cocoon production the returns obtained of Rs. 1.82 in shoot feeding and Chandrappa *et al.* (2001) reported in his study that the returns per rupee invested was higher at Rs. 1.76. Besides, Rao *et al.* (2001) reported the higher cost benefit ratio at Rs. 1:1.70 and 1:1.22, respectively for Chittoor and Eluru areas and Purushothaum *et al.* (2009) showed that cost-benifit ratio for sericulture enterprise which was worked out at 1:1.94. Hence, the hypothesis was proved in respect to returns in silkworm rearing.

5.4.3 Annual costs and returns of silk cocoon production per acre of mulberry garden based on size of holding (enterprise)

The sample respondents in both the districts were distributed according to size of mulberry land holding. It could be inferred from the results presented in Table 4.14 that on the whole, a large number (48.09%) of farmers were cultivated mulberry with an area below one acre, followed by 38.33 per cent of them operating mulberry in an area between 1.00 and 2.00 acres of land. On the other hand, only 6.00 per cent of the farmers cultivated mulberry on more than 2 acres of land.

On an average, land holding under mulbberym, the break up of cost of silk cocoon production indicated that the total cost incurred in silk cocoon production was Rs. 1,84,469.95 per annum in case of less than one acre of land holding under mulberry, whereas it was Rs. 1,74,923.45 per annum in case of mulberry acerage between 1 to 2 acres. On the other hand, the cost of silk cocoon production in case of mulberry land holding of >2 acres was Rs. 1,76,683.05 per acre per annum.

It could be seen from the results that on an average, the gross returns realized by silk cocoon production was Rs. 1,91,899.39 per annum in case of farmers with less than one acre under mulberry. Whereas, farmers between 1 to 2 acres under mulberry cultivation realized gross returns of Rs. 1,79,907.41 per annum. On the other hand, the returns from silk cocoon production in case of >2 acres of mulberry land holding group was more *i.e.*, Rs. 1,92,781.85 per annum when compared to all other groups of enterprise.

As a result of this, the net return obtained per year by >2 acres of mulberry land holding group was relatively high (Rs. 16,098,.80/acre/annum) when compared to <1 acre mulberry land holding group (Rs. 7,429.40/acre/annum) and between 1 to 2 acres of mulberry land holding group it was Rs. 4,983.95 per acre per annum.

Thus, the returns obtained per rupee of cost (B:C) was marginally high in the case of mulberry land holding group of >2 acres (1.09) when compared to mulberry land holding size <1 acre (1.04) and mulberry land holding size between 1 to 2 acres (1.02).

Hence, the profitable and efficient size of land under mulberry was >2 acres. The main reason for this is as the holding size increased, it resulted into optimum utilization due to economies of scale. These results are in accordance with the reports reported by Chandrashekara Reddy (2008).

5.4.4 Annual costs and returns of silk cocoon production per acre from four, five and six crops

The sample respondents in both the districts were distributed according to number of crops taken in a year per acre of mulberry land. It could be inferred from the results presented in Table 4.15 that on the whole, a large number of farmers (80%) took four crops per year followed by 11.66 per cent of the farmers reared six crops per year. On the other hand, 8.33 per cent of the farmers took five crops per year.

On an average, based on the number of crops taken during a year, the cost of silk cocoon production indicated that the total cost of silk cocoon production was highest in case of six crops per year group *i.e.*, Rs. 1,72,068.08 per acre followed by five crops per year at Rs. 1,48,450.89 per acre. On the other hand, the cost of silk cocoon production was less in case of four crops per year at Rs. 1,29,894.55 per acre.

It could be seen from the results that on an average, the gross returns per acre obtained by silk cocoon production was more in case of six crops per year (Rs. 1,96,885.29) followed by five crops per year (Rs. 1,69,861.82). On the other hand, the gross returns was less in case of four crops per year (Rs. 1,29,894.55).

As a result of this, the net returns obtained by farmers who reared six crops per year was more (Rs. 24,817.21) followed by Rs. 21,410.92 in case of five crops per year group. Whereas, in the case of four crops the net returns per year was Rs. 18,734.56 per annum.

Although, the gross and net returns were high in the case of six crops per year, per crop net returns was more in case of four crops per year group at Rs. 4,683.64 per crop, followed by Rs. 4,282.18 in case of five crops per year. On the contrary, per crop net returns was low cost in case of six crops per year at Rs. 4,136.00 per crop.

Hence, the highly profitable and efficient number of rearings per annum was four crops per year. The reason for this quoted by farmers was the high crop loss during summer season due to high temperature and poor irrigation water availability in the study districts. This resulted in the production of poor quality mulberry and as well as quantity of biomass production. The present findings are in line with the results of Hanumappa (1986).

5.5 Allocative and use efficiency of resources in cocoon production

5.5.1 Production function analysis in mulberry cultivation

In case of Belgaum district the regression coefficients of organic manure was positive and also turned out to be statistically significant at five per cent probability level while, bullock labour was positive and also turned out to be statistically significant at one per cent levels of significance. While, in case of Bagalkot district, the regression coefficients of organic manure, fertilizers and irrigation were positive and also turned out to be statistically significant at five per cent levels of significance. Production function analysis carried out for both districts together revealed that the regression coefficient of organic manure was positive and also turned out to be statistically significant at five per cent levels of significance. Fertilizers and bullock labour were positive and also turned out to be statistically significant at one per cent levels of significance. Thus, indicated their significance in increasing mulberry yield.

The non-significant positive coefficients of other factors indicated that these did not significantly affect the yield of mulberry and the use of these inputs was below optimum. The negative and non-significant coefficients showed that the respective factors were used in excess of crop requirement.

High R^2 value observed was due to the fact that the mulberry leaves production to a great extent was dependent upon these inputs included in the function. The coefficient of multiple determinations (R^2) was also quite high (0.95) as was observed across the districts indicated that the six variables included in the function together explained 95 per cent of the variation in the yield of mulberry crop. The study by Murthy (1977) on economics of silk cocoon production under irrigated mulberry in Devanahalli taluk, Bangalore district have reported similar results.

5.5.2 Marginal value productivity of various resources in mulberry cultivation

The production function analysis was used for the estimation of marginal value products of the resources. In fact, the Cobb-Douglas function estimate and geometric mean level of inputs and outputs were used to find out the marginal value product. The knowledge of the marginal returns of resources is useful because it indicates economic level of resources to be used. The producers by comparing marginal value product with the marginal factor cost can decide optimal use of resources. Maximum efficiency of resources occurs when the ratio of marginal value product to marginal factor cost is unity.

It was found that in case of Belgaum district, the positive marginal values product organic manure, fertilizers, irrigation and bullock labour indicated the possibility of further increase in the use of these inputs in the production of mulberry leaves. The MVPs of growth regulators and human labour were negative thereby indicated the over use of resources under production and hence advocated to reduce the use of these resources so that the marginal value productivity of these factors become positive.

Whereas, in Bagalkot district, the positive MVP to MFC ratios in respect of organic manure, fertilizers and irrigation indicated the possibility of further increase in the use of these inputs in the production of mulberry leaves. The MVP to MFC ratios for growth regulators, human labour and bullock labour were negative thereby, indicated over use. Therefore, use of these resources required to be reduced so that the marginal value productivities of these factors become positive.

Resource optimization for both districts together showed the positive MVP to MFC ratios for organic manure, fertilizers and bullock labour indicated the possibility of further increasing use of these inputs in the production of mulberry leaves. The MVP to MFC ratios in respect of growth regulators, irrigation and human labour were negative thereby indicating the possibilities of reducing the use of these resources so that the marginal values product of these factors become positive. The similar results reported by Murthy (1977), in his study on economics of silk cocoon production with irrigated mulberry in Devanahalli taluk, Bangalore district

5.5.3 Production function analysis in cocoon production

In case Belgaum district the regression coefficients of mulberry leaves and human labour were positive and also turned out to be statistically significant at five per cent level of probobility while, dfls was positive and also turned out to be statistically significant at one per cent probability level. In Bagalkot district, the regression coefficients of dfls and human labour were positive and also turned out to be statistically significant at five per cent probability level while, for mulberry leaves it was positive and also turned out to be statistically significant at one per cent level of significance. Overall, the regression coefficient of dfls and human labour was positive and also turned out to be statistically significant at five per cent level of significance. The negative and non-significant coefficients showed that the respective factors were used in excess of requirements.

High R^2 value observed was due to the fact that the cocoon production to a great extent was dependent upon these inputs included in the function. The coefficient of multiple determinations (R^2) was also quite high (0.94) as was observed across the districts indicated that the five variables included in the function together explained 94 per cent of the variation in the yield of cocoon. The studies by Chandrashekhar Reddy (1985) on income and employment generation in sericulture vis-à-vis alternative crops in Hosur taluk of Dharampuri district have reported similar results.

5.5.4 Marginal value productivity of various resources in cocoon production

In case of Belgaum district, the positive marginal value product of mulberry leaves, dfls and human labour indicated the possibilities of further increasing the use of these inputs in the production of cocoons.

The MVP of disinfectants were negative thereby, indicated the over use and then the possibility of reducing their use so that the marginal value product of these factors become positive.

In Bagalkot district, the positive marginal value product of mulberry leaves, dfls disinfectants and human labour indicated the possibilities of further increase in the use of these inputs in the production of cocoons.

For both districts together the positive marginal value product of mulberry leaves, dfls, human labour indicated the possibilities of further increase in the use of these inputs in the production cocoons. The MVP of disinfectants was negative thereby, indicated the over use and thus there is a need for the reducing the use of this resource so that the marginal value product of this factor become positive.

5.5.5 Annual household farm income from silk cocoon production

On an average, the farmer of Belgaum realized relatively more cocoon yield as main product per rearing when compared to farmers in Bagalkot with an overall average of 969.90 kg per acre for 1500 dfls for both districts together.

Which appeared significantly high on per hectare basis (2424.75 kg/ha) when compared with the results of Kerutagi (1991) estimated that the average yield of cocoons obtained from a hectare of mulberry crop in Bijapur district was 1,001.40 kg. Chandrappa *et al.* (2001) conducted cost-returns analysis for shoot feeding method of mulberry cocoon production in Shidlaghatta and Chintamani taluks of Kolar district in Karnataka and found that the average cocoon yields was 52.10 kg for 100 Dfls (781.5 kg/acre/yr).

However, the gross returns realized by farmers on both main and byproducts *i.e.*, from the sale of cocoon and byproducts on five rearing seasons remained the same in both the districts and valued at Rs. 194655.45 per acre in case of Belgaum and Rs. 192201.60 per acre in case of Bagalkot.

In case of Belgaum district the farmers realized an income of Rs. 11337.50 per acre from sale of manure/litter and Rs. 8562.50 per acre from crop waste which is used as fodder for animals. The corresponding returns on byproducts returns obtained by farmers in Bagalkot district were Rs. 10927.50 and Rs. 7821.50 per acre, respectively.

The net return obtained by farmers in Belgaum was substantially more at Rs. 32164.80 per acre per annum over the net returns of Rs. 19504.15 per acre per annum by Bagalkot farmers. This could be due to increased cost on human labour and mulberry leaves besides due to lower cocoon yield /rearing in Bagalkot district. However the net return obtained by the farmers in across the districts was Rs. 24330.60 per acre, which was significantly less, when compared with the results of Purushothaum *et al.* (2009) reported in his study that the net returns from one acre of mulberry was Rs. 52,206 per year.

5.6 Marketing of silk cocoons

5.6.1 Marketing functions

From the study, it was observed that the whole process of marketing of silk cocoons in the study area involved packing, transportation and selling functions. Packing and loading was done by usually man labour. About 40 to 50 kgs and 80 to 100 kgs cocoons were packed in gunny bags. Gunny cloth and jute thread were commonly used as packing materials. The cocoons were transported by buses generally.

The government cocoon market arranged for the sale of produce and charged a market fee of one per cent of the sale value. Open auction system was the common method of sale practiced in all government cocoon markets.

5.6.2 Marketing channel

The most common and only marketing channel found in the study area was:

Channel: Producers- Government cocoon market

For the farmers of Belgaum district, Athani constituted a most important market where 60 per cent of the farmers disposed–off as high as 66.23 per cent of cocoon produced in this market. This was followed by Mudhol market located at an average distance of 77 kms where, 16.67 per cent farmers sold 13.24 per cent of the total produce.

Whereas, for the farmers of Bagalkot district, Mudhol constituted a most important market where 68.33 per cent of the farmers disposed off as high as 63.15 per cent of cocoon produced in this market. This was followed by Athani market located at an average distance of 56 kms where, 18.33 per cent farmers sold 25.20 per cent of the total produce. On the other hand any of the Bagalkot farmers were not sold their produce at Gokak market even though it is located nearer to the Bagalkot district. When market price of cocoon prevailing in each market was analyzed and it was observed that the price prevailing for the farmers of Belgaum in the local markets was Rs. 152.94, Rs. 155.00 and Rs. 170.16 in case of Athani, Mudhol and Gokak markets, respectively.

On the other hand, for the Bagalkot farmers, the price prevailed in local markets like Athani was Rs. 161.90 and Rs. 153.60 in Mudhol market. Whereas, it was marginally more in case of Bangalore and Ramanagar markets. The price prevailed in Bangalore and Ramanagar markets for the farmers of both the district was in the range between Rs. 180.00 to Rs. 186.00. Hence, large proportion of farmers marketed their small quantity of produce at local markets.

5.6.3 Cost of marketing of silk cocoons

The total marketing cost (Table 4.22) incurred per 100 kgs of cocoons by farmers of Belgaum (Rs. 1164.20) was comparatively less than the farmers of Bagalkot (Rs. 1239.35). The significant item of marketing cost across the districts was transport charges for output and accounted about 25.00 per cent of the total marketing cost. The next important item was the cost of packing material (around 18.00%) followed by marketing fee (14.00%) loading and unloading cost including hamali charges shared (around 10.00%), grading and packing charges (around 5.00%) across the districts. Commission charges paid by the farmers accounted to around 2.50 per cent of the total marketing cost in both the districts. While the personal expenditure accounted a major proportion of the total marketing cost at 24.50 per cent across the districts due to locational disadvantages of cocoon markets in the study districts. Hence, the hypothesis was proved with respect to marketing cost varies across districts.

5.7 Constraints associated with sericulturists

5.7.1 Problems of farmers in mulberry cultivation

The farmers in Belgaum and Bagalkot expressed scarcity of irrigation water during summer season (over all Garrett score 74.62) and were most important major constraint in mulberry cultivation which inturn reduced mulberry yield with a corresponding reduction in number of dfls reared. The mulberry crop for better yield should be regularly irrigated. Besides is very much necessary to regulate the water supply to the crop carefully when the leaves are harvested during silkworm rearing. The reduced growths of leaves during rearing period affect the profitability from the cocoon production. Open wells and bore wells were the only sources of irrigation water for mulberry cultivation in the study area. Wells possessed limited supplies of water which almost dry-up during summer. Rainfall is scanty and whatever is received is unevenly distributed. Hence, the regular irrigation is most critical for efficient production. Although the soils and climatic conditions of the area are ideally suited for extensive cultivation of mulberry, the availability of irrigation water largely influenced and limited the area under mulberry in the study area.

Farmers also expressed that the shortage of skilled labour (over all Garrett score 55.80) was another major problem. Skilled labour is required to planting of mulberry cuttings and other operations in mulberry cultivation.

The respondents also reported that the high incidence of pest in mulberry such as leaf eating caterpillar, thrips and mealy bugs and disease like powdery mildew infestation as prominent problem in the study area. However, other problems like non-availability of good quality mulberry cuttings followed by un-favourable climate and costly inputs and non suitability of soil type.

5.7.2 Problems of farmers in cocoon production

The majority (over all Garrett score 77.20) of respondents felt that high temperature during summer was the major constraint (Table 4.24) in case of cocoon production constraints. It affected the normal activity of silkworms thereby the yield of cocoons got affected to a greater extent during summer. Respondents also reported that the yield of cocoons was higher during winter season. The farmers also felt that due to the shortage of labourers and high wage rates (over all Garrett score 62.30) it was difficult to carry out the sericultural operations as silkworm rearing is a labour intensive enterprise. They also felt that non-availability of disease free laying (over all Garrett score 57.60) which is the basic material for rearing. The respondents also opined that problem of pest and diseases were more (over all Garrett score 56.10). It could be seen that almost all respondents expressed the attack of uzifly. Though the uzifly net was used by majority respondents, the yield of cocoons was affected by the incidence of uzifly. Infection of flacherie, grassarie and muscardine were also found in the study area (Dodamani *et al.,* 1997). The non -availability of good quality of leaf (over all Garrett score 52.10), difficulty in procuring stands, trays followed by high cost of silkworm rearing equipments as problems in cocoon production. The respondents also felt that they never received any extension advice regarding better rearing practices and maintenance of hygienic conditions (over all Garrett score 35.00). Next major problem faced by farmers was lack of guidelines on the use of disinfects and the method and time of its application for control of infection in rearing house. The respondents in the study area were boiling the disinfectants in the rearing room by closing the rearing house airtight. A large number of houses had poor ventilation, flooring and poor insulation against external temperature extremes. These problems were found in the study area and were in line with the problems reported by Khan (1985) and Anil Kumar Yadav (2008).

5.7.3 Problems of farmers in marketing of cocoons

All the respondents reported (Table 4.25) the high price fluctuation in the market prices as major problem(over all Garrett score 78.00), in the marketing of cocoons. In 2011-12 budget proposal, the import duty on imported raw silk was slashed from China from 30 per cent to 5 per cent. As a result, the prices of silk cocoons witnessed a drastic fall of around 57 per cent to Rs. 150 per kg from Rs. 350 per kg last year (2010-11). The weavers had found it cheaper to import silk than buying it from reeler. This move from union government leads to a very miserable condition of discouraging Indian silk growing farmers from the production as there was an abrupt fall in the price of silk cocoon in the market.

Lack of local market facility was also reported by (over all Garrett score 66.00) respondents as a problem, in respect of marketing of cocoons. In respect of market facilities to the farmers it could be ascertained that facilities in the market were very poor in the local markets that existed for cocoon produce. Hence, as a result of this the farmers often were forced to take small quantity of their production to distant markets and their by indecently faced more marketing cost per unit of the produce marketed and overhead personal expenditure. The respondents (over all Garrett score 54.00) opined the marketing credit was not advanced against the security of the cocoon produce brought to the market and there was the lack of storage or warehousing facility. Most of the respondents in the study area expressed (over all Garrett score 46.00) that the prices offered in the nearest markets like, Athani, Mudhol and Gokak, were non-remunerative. This was mainly because of the understanding among the existing few reelers in these markets on the price and competition was also less among them. In addition the above problems, the farmers also expressed delay in the receipt of payments (over all Garrett score 39.00) towards the sale of produce in addition to deduction of unauthorized charges by reelers from the sale proceeds. Hence, the hypothesis was proved with respect to constraints in mulberry cultivation, cocoon production and marketing of cocoons.

6. SUMMARY AND POLICY IMPLICATIONS

6.1 Introduction

Sericulture is one of the important sectors of economy in India and plays an important role in poverty alleviation. Compared to agricultural crops, sericulture provides more employment round the year and fetches higher income to the rural farm families. Sericulture has been an important income generating cottage based industry in the country. This industry has been providing sustainable income for different strata of people in the rural society including the landless.

Sericulture is a cottage industry and one of the most labour intensive sectors in Indian economy. Sericulture is practiced in over 60,000 villages in India. In Karnataka it is practiced in 19,868 villages and sericulture industry provides direct employment and livelihood to more than 11 lakh persons engaged in different sericultural activities like mulberry cultivation, silkworm rearing, silk reeling, tisting, dyeing, weaving *etc.*

Sericulture industry concerned with the production of silk and is divided into seven phases, *viz.*, cultivation of mulberry, silk worm seed production, rearing of silk worm, reeling of raw silk, twisting, dyeing and weaving of silk. Cultivation of mulberry and rearing of silk worms are the farm based activities managed by the silk cocoon producers. Mulberry leaf is the host plant for silk worm. It is possible to harvest four to seven crops per year in the tropical areas. Although, sericulture has been practiced on small or medium sized holdings in our country, the remunerative return from sericulture has enabled a few large scale ventures also.

Mulberry silk is produced from silk worm (*Bombyx mori* L.) which feeds on mulberry leaves. Mulberry leaves form a major share of the cost of cocoon production. . Production of the silk depends upon the quality and quantity of the silk cocoon produced and which in turn depends on mulberry leaves produced. The area under mulberry and silk cocoons in Karnataka during 2010-11 was 62, 697 hectares and 52,708 tonnes, respectively.

The budget for 2011-12 is considered as agriculture budget and several beneficiary oriented schemes for farmers were announced. However, sericulture sector is denied of the benefit by announcement of reduction in customs duty in the union budget. Once the prices of cocoons and raw silk reduced, there was a large-scale uprooting of mulberry in the sericulture belts of Karnataka which resulted in drastic decline in raw silk production in turn will increase the demand and supply gap .

The overall objective of the study was to analyse the cultivation of mulberry, production and marketing of silk cocoons in Northern Karnataka. In this regard the following specific objectives were formulated:

6.2 Specific objectives

1. To analyze trends in mulberry area and cocoon production in Karnataka.
2. To workout cost and returns in mulberry cultivation and cocoon production.
3. To study the cost incurred by the farmers in marketing of cocoons.
4. To document constraints in the cultivation of mulberry, production and marketing of cocoons.

6.3 Methodology

6.3.1 Sampling procedure

The study has been conducted under the jurisdiction of University of Agricultural Sciences Dharwad. Belgaum and Bagalakot districts accounted for the first and second largest area under mulberry, respectively under both rainfed and irrigation conditions. Hence, these two districts were selected for the study. Further, a multistage random sampling procedure was adopted to select the taluks, villages and farmers. In the first stage, Belgaum and Bagalakot districts were selected as these two districts were the major mulberry silk producing districts under the University jurisdiction.

In the second stage, Athani and Chikkodi taluks in Belgaum district and Mudhol and Jamkhandi taluks in Bagalakot district were selected, as the area under mulberry was highest in these taluks. In the next stage, five villages each from the four selected taluks were selected. Six farmers were selected from each village thus, the total sample size constituted 120 sericulturists, from whom the data were elicited.

6.3.2 Source of data

These sericulturists were interviewed personally by using a pre-tested questionnaire prepared for the purpose. Primary data pertaining to sericulturist's socio-economic characteristics, land holdings, cropping pattern, asset position, cost and returns, marketing of cocoons and constraints involved in production of mulberry and silk cocoon were collected. The secondary data relating to area under mulberry and production of silk cocoon were collected from department of sericulture, Government of Karnataka and various other published sources.

6.3.3 Analytical tools and techniques

The computed growth rates for mulberry area and total cocoon production were estimated using an exponential growth function. The primary data collected from 120 respondent farmers was subjected to simple tabular analysis and budgeting technique was employed to compute the costs and returns in mulberry cultivation and silkworm rearing. Cobb-Douglas production function was employed for evaluating the resource productivities and allocative efficiency of important resources used in mulberry cultivation and cocoon production by farmers. And Garrett's ranking technique was used to identify the constraints in mulberry cultivation, cocoon production and marketing of cocoons in the study area.

6.4 Major findings of study

1. The annual growth rates for mulberry area showed negative trends for the state, traditional and non-traditional districts. The area under mulberry in the state has declined at the rate of 3.38 per cent every year. Out of six traditional districts five districts showed decline in mulberry area. Thus, the overall growth rate of traditional districts in terms of mulberry area was negative (-4.09%). In non-traditional districts, there was also a decline in the area under mulberry in the last ten years period and the decline was observed to be at the rate of 3.70 per cent per annum.
2. The total cocoon production in state also has declined annually at the rate of 1.17 per cent. . Almost fifteen districts showed negative growth rate in respect of cocoon production during the study period. A marginal annual increase or growth (0.027%) in total cocoons production in the traditional districts was observed. However, the overall growth rate for production in non-traditional districts was found to be decreased by 5.70 per cent annually.
3. The per hectare cocoon productivity registered a significant increase in the state and has grown at the rate of 1.73 per cent annually. The traditional sericulture districts together showed overall positive growth rate in respect of per hectare cocoon productivity (1.01%). The overall cocoon productivity in the non-traditional districts showed a declining trend (0.41%) during the ten year period.
4. About 72.49 per cent of the respondents were in the age group of 31-50 years and 80.83 per cent of the respondents were illiterate. The percentage of illiteracy (87.00%) was more in the Belgaum district.
5. The average size and family composition of mulberry farmers depicted almost a similar status between male (50 to 53%), female (33 to 34%) and children (14 to 16%) members in case of Belgaum and Bagalkot districts.
6. The average land holding under mulberry crop was 1.30 acre which accounted about 14 per cent of farm size among the sample farmers. The average operational land holding size of the sample respondents across districts together was 9.02 acres.
7. Cereals and pulses occupied a major cropped area in both the districts at about 60.00 per cent of the gross cropped area. The cropping intensity of almost 200 per cent was observed in both the study districts.

8. A large proportion of farmers (86.18%) were found to have allocated area under mulberry in the range between 0.50 to 2.00 acres across districts.
9. Total cost of establishment of mulberry garden in Belgaum district by farmers was worked out to be Rs. 30344.34 per acre, whereas, in Bagalkot district it was Rs. 28687.68 per acre. On the whole major item of cost in the establishment of mulberry garden was on human labour (about 23%).
10. On an average in Belgaum district, the total human labour required per acre for the cultivation of mulberry garden was 29.33 man days and that of bullock labour was 2.88 pair days, whereas, in Bagalkot it was 27.38 man days and that of bullock labour was 2.62 pair days.
11. Overall operation wise and input wise break up of cost of mulberry cultivation indicated that the total cost incurred in the mulberry cultivation was worked out to be Rs. 12699.82 per acre.
12. The gross returns from mulberry cultivation were Rs. 9742.2 and Rs. 9475.15 per acre in Belgaum and Bagalkot districts, respectively. Across districts, it was Rs. 9472.91 per acre.
13. The total cost of rearing for 300 dfls (per acre) in Belgaum district was Rs. 32,498.13 in which variable cost itself was Rs. 29,440.02 accounting as high as 90.58 per cent to the total. Total fixed cost was Rs. 3058.11 (9.41%). The major costs were labour cost (Rs. 14, 245.11) and cost of mulberry leaf (Rs. 8505.00) during each rearing in Belgaum district.
14. The total cost of rearing for 300 dfls (per acre) in Bagalkot district was Rs. 34,539.49 in which variable cost was as high as Rs. 31,570.79 accounting 91.40 per cent to the total. Total fixed cost was Rs. 2968.77 (8.59%). The major costs were labour cost (Rs. 15, 840.39) and cost of mulberry leaf (Rs. 9117.90) during each rearing in Bagalkot district. The silkworm rearing cost was relatively more in Bagalkot when compared to the farmers of Belgaum.
15. In Belgaum district, from 300 dfls (per acre), farmers produced 200.70 kg of cocoons and 3.69 tonn of litter. Whereas, in Bagalkot district, from 300 dfls (per acre) farmers produced 187.29 kg of cocoons and 3.00 tonnes of litter. Per acre productivity of cocoons in Belgaum district was about seven per cent more than realized in Bagalkot district.
16. The gross returns obtained for 300 dfls (per acre) in Belgaum district was Rs. 38, 931.09. Net returns were Rs. 6432.96 and the B:C ratio was 1.19. Whereas, in Bagalkot district, the gross returns obtained was Rs. 38, 440.32 per 300 dfls. The net returns were Rs. 3900.83 and the B: C ratio was 1.11.
17. The cost per kilogram of cocoons in Belgaum district was Rs. 161.92 whereas, in case of Bagalkot district it was Rs. 184.41. The gross returns obtained per kilogram of cocoons in Belgaum district was Rs. 193.57. Net returns per kg of cocoons were Rs. 32.05. Whereas, in Bagalkot district, the gross returns obtained per kilogram of cocoons was Rs. 204.78. Net returns per kilogram of cocoons was Rs. 20.82.
18. In Belgaum district, the regression coefficient of organic manure was positive and also turned out to be statistically significant at five per cent probability level while, bullock labour was positive and also turned out to be statistically significant at one per cent probability level.
19. In case of Bagalkot district, the regression coefficients of organic manure, fertilizers and irrigation were positive and also turned out to be statistically significant at five per cent probability level.
20. Overall returns to scale, being less than unity reflected the operation of decreasing returns to scale in the production of mulberry leaves.
21. Resource optimization for both districts together showed the positive MVP to MFC ratios for organic manure, fertilizers and bullock labour indicated the possibilities of further increasing the use of these inputs in the production of mulberry leaves.

22. In Belgaum district, the regression coefficients of mulberry leaves and human labour was positive and also turned out to be statistically significant at five per cent levels while, dfls and Paraffin paper and news paper were positive and also turned out to be statistically significant at one per cent probability level.
23. In Bagalkot district, the regression coefficients of dfls and human labour was positive and also turned out to be statistically significant at five per cent level while, mulberry leaves was positive and also turned out to be statistically significant at one per cent level.
24. The returns to scale being more than unity reflected the operation of increasing returns to scale in the production of silk cocoons.
25. For both districts together, the positive marginal values productivities of mulberry leaves, dfls, human labour and paraffin papers and news paper indicated the possibility of further increase in the use of these inputs in the production cocoons.
26. The annual household income from sericulture obtained by farmers in Belgaum was significantly more at Rs. 32164.80 per acre per annum over by Bagalkot farmers of Rs. 19504.15 per acre per annum.
27. A large proportion of the produce by farmers in the study area was marketed at Athani, Mudhol and Bangalore, while, a very small proportion was marketed in Ramanagar and in the nearby Gokak market.
28. The total marketing cost per 100 kilogram of cocoons by farmers of Belgaum (Rs. 1164.20) was comparatively less than the farmers of Bagalkot (Rs. 1239.35). The significant item of marketing cost across the districts was transport charges for output which accounted for 25.00 per cent of the total marketing cost.
29. The main problem encountered by mulberry cultivators in the production of mulberry leaf were the irrigation problem during summer and shortage of skilled labour. Respondents also reported that the incidence of pest in mulberry such as leaf eating caterpillar, thrips and mealy bugs and disease like powdery mildew infestation also found prominent in the study area.
30. The foremost problem faced by the silk cocoon producers in the study area was high temperature during summer. The respondents also felt that due to shortage of labourers and high wage rates it was difficult to carry out sericultural operations. They also opined that problems of pests and diseases were more. It could be seen that almost all respondents expressed the attack of uzifly to silkworms. Though the uzifly net was used by majority respondents, the yield of cocoons was affected by the incidence of uzifly. Infection of flacherie, grassarie and muscardine was also found in the study area.
31. Main problem in the marketing of cocoon was the high price fluctuation in the market prices. Lack of local market facility was also reported by respondents, in respect of marketing of cocoons. Most of the respondents in the study area expressed that the prices offered in the nearest markets like, Athani, Mudhol and Gokak were non-remunerative.

6.5 Policy implications

1. The growth rate analysis has clearly indicated that the area under mulberry in traditional districts (4.09%), non-traditional districts (3.70%) and in Karnataka (3.38%) was declining, which inturn affected the production of silk cocoons. Since the annual net profit earned in silkworm rearing was highly encouraging (Rs. 24330.60/acre/year) and offers large scope to increase the area under mulberry both in traditional and non-traditional districts. This requires intesfied extension activities such as trainings, demonstrations among farmers by State Department of Sericulture.
2. The major problem faced by the sericulturists in mulberry cultivation was shortage of irrigation water during summer (GS=74.62). This problem could be reduced by effective use of water by adopting drip or sprinkler irrigation systems. Thus, government is required to continue the subsidy support to the farmers for promoting drip or sprinkler irrigation in mulberry producing areas.

3. High pest and disease attack both during mulberry crop cultivation (GS=46.40) and silk worm rearing (GS=56.10) were considered as constraints which drastically reduced the leaf yield of mulberry and of silk cocoon. Hence, there is a need to organize various extension activities through trainings, demonstrations *etc.* to educate the sericulturists from time to time for effective control of pest and diseases and diffusion of cost effective technologies to enhance production of quality cocoons.
4. Majority of the sericulturists in the study area marketed their silk cocoons in the nearby local markets where they lacked basic infrastructural facilities as compared to the traditional or specialised silk cocoon markets. The government should arrange for development of required infrastructural facilities in these local markets. So that the sericulturists will get competitive price for their produce.
5. In the marketing of cocoons, the main problem reported by farmers high price fluctuation in the market for cocoons (GS=78.00). Besides this, a cut in import duty by Government in 2011-12 budget from existing 30 to 5 per cent lead to import become cheaper and consequently reduced the domestic price of silk cocoon from Rs. 350 per kg to Rs. 150 per kg, thereby discouraging its production .Therefore, there is a need for a long-tern policy on sericulture in order to encourage mulberry production and stabilize domestic market prices. This could be in the form of implementation of minimum support price for silk cocoons coverage of silkworm rearing under crop insurance programme.
6. The highest possible returns in >2 acres size of holding group per acre was accrued at Rs. 43567.80 and Rs. 29213.70 by Belgaum and Bagalkot farmers, respectively.
7. The highest possible returns by four cocoon crops per acre was at Rs. 6191.72 and Rs. 3754.54 gross returns per crop by Belgaum and Bagalkot farmers.
8. The size of holding of >2 acres and four crops per year paying highest possible returns are recommended to be included in the package of practices.

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AN ECONOMIC ANALYSIS OF MULBERRY CULTIVATION, PRODUCTION AND MARKETING OF SILK COCOONS IN NORTHERN KARNATAKA

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ABSTRACT

Sericulture is one of the important sub-sectors of India agriculture and plays an important role in the farm economy. The present study was attempted to analyse trends in mulberry area, cocoon production, and its productivity in the traditional and non-traditional districts and for the state as well for the period from 2001-02 to 2010-11. Costs and return structures, marketing of cocoon, constraints in sericulture were analyzed using primary data collected from a sample of 120 farmers of Belgaum and Bagalkot districts in north Karnataka. The Cobb-Douglas Production function, tabular approach and budgeting technique and Garrett's ranking technique were employed to analyze the data. Annual growth rates estimated using exponential growth function w.r.t. mulberry area showed a decline both in traditional (4.09%) and non-traditional (3.70%) districts. The annual decline in area was significant at 3.38% for the state as a whole. There was also a decline in cocoon production (1.17%/annum) in the state during the period. While, there was a significant increase in per hectare productivity of cocoons for the state. The cost of cultivation of mulberry garden was worked out to be Rs. 12699.82/acre/rearing. Cost of silkworm rearing per acre per rearing for 300 dfls was relatively more in Bagalkot (Rs. 34,539.49) over Belgaum (Rs. 32,498.13). Net returns realized per acre per rearing and B:C ratio were more in case of Belgaum (Rs. 6432.96 and 1.19) when compared Bagalkot (Rs. 3900.83 and 1.11). Transportation cost was a major cost in cocoon marketing in both districts accounted for 24.85% of the total marketing cost of Rs. 1200.50/qunintal. The main constraints encountered by farmers revealed through Garrett's score in mulberry cultivation were shortage of irrigation water and persistence of high temperatures that affected silk worm rearing during summer and high market price fluctuations was another major constraint in the cocoon marketing. Farmers with more than 2.00 acres farm size under mulberry having four crops per annum realized maximum profits.