In accordance with the objectives of the study, to acquire knowledge, the relevant studies carried out in the recent past were referred. This chapter offers a brief review on the impact of technology adoption on knowledge and adoption level, socio economic status of sericulturists, income and employment generation. The review of literature is presented under the following sub heads.

I. Knowledge and adoption of improved sericultural technologies by farmers.

II. Association between the socio economic characters of the farmers and technology adoption.

III. Economic impact of adoption

IV. Constraints in adoption

V. Economics of mulberry and cocoon production

VI. Employment generation in sericulture

VII. Participation of women in sericulture.

I. Knowledge and adoption of improved sericultural technologies by farmers

Adoption is a decision to make full use of a new idea, practice or technology as the best course of action (Rogers,1962). Wilkening (1963) described the adoption of an innovation as a process composed of learning, deciding, and acting over a period of time. When an individual accepts a new technology or package and practices it, the phenomenon is known as adoption.

Many improved technologies were developed in sericulture at a fast pace in the last three decades. Proper adoption of these technologies by the farmers is vital for obtaining higher yield and thereby reducing the yield gap in cocoon production. The success of any technology largely depends on its
effective adoption and utilization in the field. The studies carried out on adoption of improved technologies are reviewed below:

Prakash Kumar (1986) reported that there was no significant difference in the overall adoption of recommended practices of mulberry cultivation and silkworm rearing by big, small and tenant farmers of Ramanagara taluk, Bangalore district. Nearly two-thirds of small and tenant farmers had applied only partial dose of fertilizers and had not followed any plant protection measures while about half of the big farmers had used full dose of fertilizers and plant protection measures.

Shivaraja (1988) observed that majority of big farmers had high adoption and high net income levels, while it was quite the reverse in case of small and marginal farmers. The adoption behaviour of big, small and marginal farmers with respect to recommended practices of bivoltine silkworm rearing was found to have positive and significant relationship with their knowledge level.

Ashwath Narayana (1989) reported that nearly two third of the farmers belong to medium and high adoption categories with respect to adoption of silkworm races, bed cleaning and leaf quality.

According to Sreenivasa (1989) cent percent of the sampled farmers had correct knowledge about mulberry variety, system of planting and irrigation, location of rearing house, recommended race of silkworm and number of feedings per day. Likewise cent percent of them had adopted the practices like mulberry variety, system of planting and weeding, recommended race of silkworm, number of feedings per day and grading of cocoons before marketing.

Satheesh (1990) conducted a study in Kanakapura taluk of Bangalore rural district and reported that majority of the beneficiaries had adopted practices like selection of races (98%), disinfection (96%), bed cleaning (95%), source of dfts (93%) and very few beneficiaries followed black boxing of eggs. Further he had concluded that, the knowledge and adoption of chawki rearing practices by beneficiaries of chawki rearing centres were significantly higher than non beneficiaries.
Based on a study in Thailand, Viratpong (1990) opined that because of the high income potential, diffusion of sericulture is rapidly increasing both in number of adopters and in expansion of mulberry area.

Gopala (1991) studied the adoption of recommended practices in developed and less developed areas of Kolar district, Karnataka and concluded that there was significant difference in the overall adoption among the two categories.

According to Srinivasalu (1991) big farmers were high adopters of new sericulture technologies in Karnataka.

Raghu Prasad (1992) conducted a study in Chitradurga district and found that most of the farmers had adopted the recommended races (94%), chemicals used for disinfection and black boxing (92%) and time of plucking leaves (84%). Low adoption was reported with respect to disinfection of rearing house, moulting care and bed cleaning using nets.

Shivamurthy et al. (1992) carried out a study in Dharwad district of Karnataka and noticed that majority of the farmers had more knowledge with respect to the type of leaf to be fed to chawki worms, number of feeds per day and disinfection procedures. Besides, majority had adopted plant spacing, length and thickness of plantation material and depth of planting.

Gowda et al. (1992) reported that, imparting sericulture knowledge to farmers is the pre-requisite for changing their attitudes, skills and adoption level, which are essential components of rural development.

Most of the farmers in Mysore district had adopted simple practices like variety, plant spacing, frequency of feeding and bed cleaning whereas application of FYM, fertilizer, disinfection and RKO were adopted partially. No farmer had adopted plant protection measures, incubation care and bed spacing (Dolli et al., 1993).

Anjaneya Gowda (1993) reported that marginal farmers showed better adoption as they had less land area that made them to concentrate and involve deeply in the activities.
Siddaramaiah and Prakash Kumar (1994) studied the adoption of improved sericultural practices by big and small farmers in Ramanagaram taluk of Bangalore district, and observed that 60% of the respondents applied the recommended quantity of FYM, 25% applied the recommended dose of fertilizers and 43.75% adopted the recommended plant protection measures. They also indicated that many of the sericulturists adopted improved rearing practices like getting worms from CRC (90%), bed spacing (80%), maintenance of temperature and humidity (80%), adoption of disease and pest control measures (87.5%), optimum density of mounting (80%) and harvesting of cocoons at right time (80%).

The results of a study conducted by Singhvi et al. (1994) showed that all / majority of respondents were aware and adopted most of the mulberry cultivation and silkworm rearing practices except some of the crucial practices like fertilizer application, plant protection measures, bed cleaning by net and pebrine disease control measures where knowledge level and adoption were abysmally low. Only 1.7% of the respondents were having separate rearing house.

Adoption of improved practices was more among non traditional farmers, because they were new to sericulture and started with new technologies whereas traditional farmers were not willing to change their nature of rearing. The tendency for acceptance of new technologies was high in big farmers (Zeaul Ahsan, 1994).

The level of adoption was higher for practices like FYM application, spacing in late age silkworm rearing and disinfection, whereas the adoption was low/poor for practices like application of fertilizers, spacing in chawki rearing and incubation care. The adoption level among different categories of farmers was in the order of big farmers, small farmers and marginal farmers (Chikkanna et al., 1995).

Govindaiah et al. (1996) opined that, adoption regarding plant protection measures was high in big farmers and literates.
There was non significant difference between small and big farmers of Tumkur district in overall knowledge and adoption of improved practices of sericulture (Shreedhara, 1997).

Manju (1997) reported that only 27.5% farmers had reared bivoltine breeds in Belgaum district of Karnataka and the rest were rearing cross breeds.

According to Lakshmanan et al. (1998a) most of the sample respondents in Salem and Dharmapuri districts of Tamil Nadu neither applied inputs like FYM, fertilizers etc., nor adopted any disease control measures during silkworm rearing as per the recommendation.

Srinivasa et al. (1998a) in their study on adoption of sericulture technologies in the non-traditional sericulture belt of Karnataka, reported that small farmers had high adoption index followed by medium and big farmers. The simple technologies were adopted by majority of the farmers.

Krishnamurthy et al. (1999) observed that 70 per cent of the sericulturists had medium to high level of knowledge on recommended sericulture technologies in the traditional area of Gowribiddanur and Sidalaghatta taluks of Kolar districts in Karnataka.

The level of knowledge among different categories of farmers in K.R Nagar taluk of Mysore district with regard to disinfection, egg transportation, black boxing, bed cleaning and maintenance of humidity was same. But, the extent of adoption varied among the different categories with 70% full adoption in small scale and above 80% full adoption in medium and large scale farmers (Jagadisha, 1999).

Ganapathy et al. (1999) revealed that a large number of sericulturists in Mysore taluk (37.5 percent) were low adopters of recommended practices.

Adoption of recommended sericulture technologies was 36, 49 and 15 percent under high, medium and low categories respectively in Kolar district. Disease management in sericulture was practiced fully by 54%, partially by 38% and 8 percent were non-adopters (Raghu et al., 1999).
Narayana Swamy et al. (2000) studied the adoption of improved sericulture practices by different categories of farmers in Hoskote taluk, Bangalore district. Practices like maintenance of temperature and humidity, mulberry leaf storage methods, use of round bamboo trays for silkworm rearing and use of chemicals for control of diseases were practiced by most of the farmers as per the recommendation. Only 19.71% of the farmers followed black boxing of eggs irrespective of their land size.

Kavitha (2001) stated that, farmers with high farming experience, farm size, cropping intensity, social participation, mass media exposure, economic motivation are better adopters than others.

The scale of farming and technology adoption in sericulture go hand in hand. Raveendra Mattigatti et al. (2002) by employing Cobb-Douglas production function analysis and the technological decomposition model found that the technological gap between different scales of farming was significant. The shift from small scale to large scale had proved efficiency to the extent of 137.93%.

According to Thiagarajan (2002) majority of the farmers in rain fed areas had poor knowledge about recommended mulberry variety/ silkworm breed, application of FYM, fertilizers and bio-fertilizers, rearing space, disinfection, hygiene and bed disinfectant. Adequate knowledge was observed only for plant spacing. Most of the farmers had partial knowledge on method of leaf harvest, IPM against uzifly, silkworm mounting and cocoon harvesting. The same trend was observed in adoption of technologies.

Qadri et al. (2002) studied the adoption of CSR races and found that most of the sericulturists had adopted shoot feeding method for rearing CSR hybrids owing to its advantages over the traditional method of leaf rearing.

The knowledge level and adoption rate of bivoltine sericulture technologies were quite high with the farmers rearing CSR hybrids under PPPBST project. However, the adoption rate was found less in application of fertilizers, training of mulberry plants, sorting of cocoons and there was symbolic adoption in case of chemical fertilizers, disinfection of rearing house, maintenance of hygiene and application of vijetha. (Kumaresan et al., 2002).
Adoption of moriculture and sericulture technologies as a package had enhanced the overall cocoon productivity level per unit area by 64.5% in the semi arid Rayalaseema region in Andhra Pradesh. It was also observed that impact of individual technologies was very less effective as compared to the package of technologies in influencing the productivity levels (Prasad et al., 2002).

Mohamed and Baldeosingh (2003) pointed out that large majority of the respondents had fully adopted the recommended high yielding bivoltine races (90%), time of rearing (85%), time of harvesting of cocoons (75%) and time of disinfection (72%).

Rajeev (2004) conducted a study on adoption and perception of CSR hybrids in Kolar district, Karnataka and reported that 44.17% of the sericulturists had high, 31.66% had medium and 24.17% had low level of perception about the performance of CSR hybrids. But 41.67% farmers showed medium level of adoption.

Dandin et al. (2004) found that the adoption rate of technologies increased from 47.22 per cent to 83.02 per cent after implementation of IVLP programme by CSR&TI, Mysore.

A study was carried out to assess the knowledge and adoption of sericulture technologies by farmers in Mandya and Tumkur districts of Karnataka. The findings revealed that JICA farmers had sufficient knowledge on mulberry cultivation and silkworm rearing technologies, but the full adoption level varies from 35% (paired row system) to 100% (pruning method) for mulberry cultivation technologies and 35% (rotary mountages) to 100% (shoot rearing and separate rearing house) for silkworm rearing technologies (Sariful Islam, 2004).

Philip and Qadri (2004) assessed that the silkworm rearing technologies showed higher adoption levels compared to mulberry cultivation practices at Ernakulam and Trichur districts of Kerala.

A study on adoption of sericultural technologies by farmers of Uttar Pradesh showed 100% non adoption for mulberry variety and 100% adoption for separate rearing house, use of formalin, bleaching powder and
RKO bed disinfectant, maintenance of temperature and humidity and bed cleaning (Jaiswal and Kumar, 2005).

Majority of big farmers have knowledge on identification and control of diseases and they were fully adopting the control measures. The reasons for this are better economic conditions and more exposure towards new technologies (Sujatha and Sujathamma, 2005).

Sreenivas et al. (2005) reported that FYM was adopted by maximum number of sericulturists (82.9%) followed by disinfection & hygiene (46.5%), separate rearing house (38.7%) and mounting care (34.7%) in non traditional areas of central Karnataka.

The seed rearers of Madakasira exhibited 87% of total knowledge, 11% of partial knowledge and 2% of no knowledge of recommended sericulture practices. Similarly the total, partial and non adoption accounted for 73%, 14% and 13% respectively (Ramanjaneyulu et al., 2005).

Gope (2006) noticed that all selected farmers had high knowledge of mulberry variety, plant spacing, quality of leaf, size of the leaf and bed cleaning. Most of the sericulturists in non-traditional area had better knowledge about new technologies than those in traditional area. But, the knowledge regarding soil type and manure was more in traditional area compared to non-traditional area.

A study conducted in Chamarajanagara district by Mallikarjuna et al. (2006) indicated that the knowledge level of sericulturists on mulberry cultivation technologies varied from 7% (vipul application) to 82% (application of FYM) and the full adoption level varied from 1% (vipul application, use of bio fertilizer, application of chemical fertiliser) to 60% (garden spacing). Further, the knowledge level of silkworm rearing technologies ranged from 2% (use of bed cleaning net and egg transportation bags) to 32% (separate rearing house).

All sampled farmers of Sathyamangalam taluk, Erode district had 100% knowledge about the recommended mulberry variety and plantation spacing with 100% and 94% adoption respectively. 68% had full knowledge about FYM and fertilizer doses, but 52 and 58% of the farmers had adopted these
practices fully. Partial knowledge was noticed for bio-fertilizers (52%), seriboost (44%) drip irrigation (58%) and control of tukra (68%). Non-adopters were high for these four technologies (82%, 64%, 90% and 84% respectively (Meenal and Rajan, 2006).

With respect to silkworm rearing technologies, it was observed that all farmers had full knowledge about mounting method and 82% had full knowledge on the type of rearing house, silkworm breeds and shoot rearing. Partial knowledge was noticed for technologies such as incubation of eggs (60%), black boxing (62%), bed cleaning (64%) and IPM of uzi fly (78%). Adoption indices showed that technologies such as mounting method (100%), shoot rearing (82%) and type of rearing house (80%) were highly adopted by the farmers followed by disinfection (68%), bed spacing (66%) and new mountages (66%).

Results of an interview of 150 sericulturists in Anantapur district, Andhra Pradesh revealed high adoption for plantation spacing, application of FYM, disinfection, bed spacing, temperature and humidity maintenance during rearing. Adoption was low/nil for practices like bio – fertilizers, vermiculture and mulching. The adoption level among different categories of farmers was in the order of big farmers> small farmers> marginal farmers (Sujatha et al., 2006a).

Madhu Prasad (2006) applied paired comparison technique for selected silkworm rearing technologies and ascertained the extent of adoption by farmers of Kolar district. Results revealed that preference for shoot feeding technology, package of practice for chawki mulberry garden and application of vijetha powder scored high values.

A study on adoption level of new sericultural technologies conducted in Erode district of Tamil Nadu revealed that except three mulberry cultivation technologies viz., glycel application, VAM inoculation and vermicomposting all the other technologies were adopted either fully or partially. Most of the silkworm rearing technologies were adopted fully (Mani et al., 2006).

A study undertaken in 13 villages of Maharashtra state by Sunil Dutt and Chole (2002) showed that 46.42% respondents’ adoption level was high
whereas that of 37.50% and 16.25% respondents' was medium and low respectively.

Sujatha et al. (2006b) interviewed 150 sericulturists in Chittoor district, Andhra Pradesh and concluded that adoption level of recommended mulberry cultivation practices was high in 68%, medium in 18% and low in 14% of the respondents.

Venkatesh Kumar and Ismath Afshan (2006) stated that the most effective source of knowledge and skill was training followed by farm visits, exhibition, field tours and demonstration.

Adoption of CSR hybrids by farmers of Kolar district in Karnataka was studied by Rajeev et al. (2007). Results revealed that 44.17% of sericulturists had high level of perception regarding the performance of CSR hybrids whereas 31.66% had medium level and remaining 24.17% had low level. The reasons stated were that most of the farmers were convinced of the yield, silk quality, productivity and returns from CSR hybrid rearing.

The knowledge and adoption level of farmers in Malavalli and Srirangapatana taluks of Mandya district, Karnataka was high regarding high yielding mulberry varieties, shoot harvesting method and separate rearing house. This is because majority of the farmers were selected under JICA and had the opportunity to gain knowledge about the improved technologies (Lakshmanan and Geetha Devi, 2007c).

Deepa and Sujathamma (2007) studied the technology adoption in semi arid conditions of Chittoor district in Andhra Pradesh. Soil testing and application of bio fertilizer was not adopted by 86.11% and 70% farmers respectively. But 70% of the farmers had planted the recommended mulberry variety. Most of the silkworm rearing technologies were fully adopted viz., disinfection (82.22%), recommended brushing (87.22%), new silkworm races (80.00%) and mounting care (76.66%).

According to a study by Srinivasa et al. (2007) the knowledge and adoption levels of farmers had increased by 42.64% and 90.69% respectively after training. The improvement in the knowledge level of the extension staff ranged between 8.04% and 93.33% after training.
II. Association between the socio economic characters of the farmers and technology adoption

Research efforts during the recent past led to evolving of many high yielding mulberry varieties, silkworm breeds, and their production technologies. However, the actual productivity depends on the acceptance and also the extent to which farmers adopt these technologies. The adoption of new technology is not a simple and one time process but a number of social, economical, institutional, psychological, physical and biological factors influence the process to a considerable extent (Singh and Yadav, 1989). Improved technologies even when sound by scientific standards, are of limited value if they are not adopted due to their inappropriateness to suit the agro-climatic and socio-economic milieu in which the farmers operate (Raman and Balaguru, 1992). Some of the literatures associating the socio economic characters of the sericulturists with their knowledge and adoption level are briefed below:

Chandrasekar (1985) found that the cost of production in sericulture decreased significantly with the increase in farm size in Dharmapuri district of Tamil Nadu.

The total cost of production of mulberry leaves and cocoon in one hectare of land decreases with the increase in size of the farm. Similarly, the gross and net income was inversely related to the size of the farm (Neelakanta Sastry et al., 1987).

The production function analysis in mulberry cultivation revealed that only coefficients of land were significant indicating great scope for increasing area under mulberry cultivation. An additional one hectare of mulberry land increased the net return by Rs. 3278 in marginal farms, Rs.3042 in small farms and Rs.2335 in large farms (Mari honnaiah, 1987).

Age and level of aspiration did not reveal any significant relationship with adoption of sericultural practices (Prakash Kumar, 1986).

Knowledge, extension guidance and irrigation potential contributed significantly for the variation in the adoption behaviour, irrigation contributed significantly for the variation in the net-income level, while knowledge and
market orientation were found to be significant in explaining the variation in the employment potential of big farmers. Market orientation and knowledge contributed significantly for variation in the adoption behaviour, irrigation and market orientation for the change in the net-income, while risk preference and market orientation for the variability in the employment potential of small farmers. Knowledge contributed significantly for the variation in adoption behaviour of marginal farmers (Shivaraja, 1988).

Nagaraja (1989) studied the relation between the management efficiency and economic performance of sericulturists in Karnataka. He concluded that sericulturists management was positively and significantly related to their economic performance. The management efficiency of large sericulturists was significantly higher than that of small sericulturists.

Education, social participation, cosmopolitanness, mass media participation, extension participation, extension contact, economic motivation were found to have a significant relationship with the knowledge level of respondents (Sreenivasa, 1989).

Age, education and farm size did not have any relation with the adoption behaviour of sericulturists, but family size, mass media participation, social participation, extension contact and economic motivation had significant relation with adoption (Sreenivasa, 1989).

Variables like education, total land holding, area under mulberry, mass media participation, extension participation and contact with personal source of information had positive and significant relationship with the knowledge and adoption of chawki rearing practices (Satheesh, 1990).

Education, social/ mass media/ extension participation, extension contact, cosmo politeness and economic motivation of farmers were significantly related to adoption (Srinivasalu, 1991).

The extent of adoption of sericultural practices by farmers of developed area was significantly associated with their education, total land holding, area under mulberry, mass media participation, extension contact and cosmopolitanesss. But in less developed areas adoption was significantly associated only with the area under mulberry (Gopala, 1991).
Prabhakar *et al.* (1992) reported that hardly 10-14% of the sericulturists in Chickmagalur district, participated in different social organizations reflecting low education level. The association of age and education with knowledge level was significant.

Geetha (1993), while studying the impact of socio-economic factors on adoption of improved sericulture technologies in Hassan district, reported that age, education, caste, occupation and experience in the field of sericulture influenced the adoption of sericulture technologies significantly.

Prabhakar *et al.* (1994) indicated that the socio-economic characteristics of the farmers in Kolar district played an important role in technology adoption and the experience in sericulture was a crucial factor compared to education for technology adoption and continuation.

The extent of adoption of recommended dosage of fertilizer by farmers of Ramanagaram taluk, Bangalore district was significantly associated with education, land holding, extension participation and economic motivation (Siddaramaiah and Prakash Kumar, 1994).

Significant association was found between adoption index and land under mulberry, income from sericulture. But education and extension participation were found non significant (Zeaul Ahsan, 1994).

The rate of adoption was significantly associated with sericulturists' education, land holding, mass media participation, extension contact and cosmopolitaness (Singhvi *et al.*, 1994).

Naresh (1996) analysed the knowledge and adoption of improved sericulture practices among trained women in Bangalore rural district and found significant difference in overall adoption between trained and untrained farm women. Knowledge and adoption level of the trained farm women was found to be associated with mass media use and decision making ability of their husbands.

Srinivasa *et al.* (1996a) in their attempt of relating socio-economic factors with knowledge and adoption in traditional and non-traditional areas of Karnataka reported that age, caste, education, radio listening, extension
contact, land holding and asset position were the important factors responsible for knowledge and adoption of improved sericulture technologies.

Variables such as education, mass media participation, material possession and risk preference among big farmers and education, mass media participation and extension participation among small farmers were significantly related to their knowledge level. With respect to adoption level, education, mass media participation, social participation, material possession and risk preference, credit facilities and employment potential among big farmers and education, mass media participation, extension participation and net income among small farmers were significantly related (Shreedhara, 1997).

Majority of the farm women belonged to the age group of 31-45 years (54%) and the rest were in the age group of 46 years and above. Further, 62% of the farm women were illiterate and their main occupation was agriculture. Around 76% of the farm women live in nuclear family and most of them had a farm of more than 5 acres (44%). Eighty percent of the respondents had a farming experience of more than 10 years. The social participation, extension participation and mass media participation of farm women was found to be far from satisfactory (Lakshmi Raju et al., 1997).

A study was conducted in Dharwad district of Karnataka on the adoption behaviour of sericulturists by Srinivasa et al. (1998b). The results revealed that adoption was significantly influenced by education and mass media participation as indicated by their elasticity coefficients. The probability levels of those who adopted the techniques, ranged from 0.43 to 0.61.

Total land area, cosmopoliteness and extension participation showed highly significant relation with the knowledge of small scale farmers. But none of the socio economic characters of the medium scale farmers showed significant relation with their knowledge level. Among large scale farmers, education and mass media participation were significantly related to their knowledge level (Jagadisha, 1999).

Shankar et al. (2000) analysed the factors discriminating technology use among sericulturists and found that factors such as aspiration level of the
farmers, trialability of technologies, scientific orientation of farmers, knowledge level of farmers about technological practices, farmers’ innovative proneness, felt need, achievement motivation and risk orientation were the strong determinants.

Correlation studies revealed that cocoon yield per unit area was related to the acreage under sericulture whereas the other practices like chemicals used, total spray solution and rearing space did not influence the cocoon yield (Narayana Swamy et al., 2000).

Data collected from farmers of non traditional area of Karnataka revealed that, socio economic factors such as family form and size, occupational status, experience, yield/100 dfls, income and extension support had a positive and significant correlation with the level of adoption. But education was not significant (Geetha et al., 2001).

As per the observations made by Thiagarajan (2002) in rainfed areas, age, education, family size, land holding, extension participation, extension contact and mass media participation did not exhibit any correlation with the adoption level of the farmers. But cocoon yield and social participation exhibited a positive and significant correlation with the adoption level.

Education, farm size, area under mulberry, exposure to mass media, type of rearing house, rearing equipments owned, economic motivation, cosmopoliteness, credit orientation, extension orientation and achievement motivation exhibited positive and significant relationship with innovativeness while age, silkworm rearing intensity, experience in sericulture, risk orientation and scientific orientation were not related to innovativeness (Madhu Prasad, 2002).

Major determinants of productivity were the allocation of land for sericulture, scale of brushing, inputs for mulberry and silkworm rearing, labour management and proper know- how of technologies (Rama Mohana Rao et al., 2002).

Lakshmanan and Geetha Devi (2002) employed Cobb-Douglas production function analysis to find out the factors influencing mulberry leaf
yield in Salem and North Arcot districts of Tamil Nadu. They reported that fertilizer and irrigation played major role in increasing mulberry output.

Munikrishnappa et al. (2002) by an analysis in Mysore district observed that the total land holding and extension participation had a significant association with the knowledge level of small scale sericulturists, but cosmopolitaness was negatively significant. Similarly age and area under mulberry significantly influenced the adoption level, but cosmopolitaness and extension participation were hampering the adoption of improved practices among small scale farmers. In case of medium farmers, cosmopolitaness and extension participation had a high and positive association with the knowledge level, whereas area under mulberry and cosmopolitaness were having a negative and significant association with adoption level. Extension participation depicted a strong and significant association with knowledge level of big farmers but it was not influencing the adoption level.

Geetha et al. (2003) concluded in a study in Mandya district, that more than technical factor, socio-economic factors play an important role in making bivoltine rearing successful.

Srinivasa et al. (2003) reported that the variables such as age, land holding, area under mulberry, cosmopolitaness and mass media participation in small farmers, area under mulberry and cosmopolitaness in medium farmers and cosmopolitaness in large farmers were found to have a significant association with technology adoption.

Mahesh Hunsikatti (2003) opined that the age of the farmer influenced the risk taking capacity and type of farming system. Old age farmers did not accept innovations and they were risk averters. It was found that both the small and large farmers belonged to young and middle age group.

The total as well as mulberry land holding was found more in CSR hybrid rearers compared to cross breed rearers. 85.19% of CSR hybrid rearers possessed the high yielding mulberry variety V1 whereas it was only 32% in cross breed rearers (Behera, 2004).

Independent variables like mass media participation and cosmopolitaness exhibited a positive and significant relation with the
perception of CSR hybrids in Kolar district. While variables like education, family type, social participation, innovation proneness and risk orientation had significant effect on the adoption level (Rajeev, 2004).

Through a study carried out in irrigated areas of Mandya district, Srinivasa et al. (2004) indicated that variables like female family members and mulberry area were found to have a positive and significant association with the cocoon yield whereas age, family size and male family labour depicted a negative association with cocoon yield. With respect to income, size of land holding, extension contact and extension participation of the farmers were found to have a positive and significant association.

Regression analysis revealed that the relationship between cocoon yield and socio economic characters of the sericulturists was non significant, but variables like age and area under mulberry showed a significant relationship with income (Srinivasa et al., 2004).

Chandrashekhar et al. (2005) conducted a study in Belgaum district of Karnataka and revealed that the knowledge level of sericulturists for recommended sericulture practices was found positive and non significant with education, land holding, experience in sericulture and mass media participation and negative and non significant with extension contact and participation. However, the ‘r’ value exhibited a positive and significant relation between annual income and the knowledge level of sericulturists.

A positive significant correlation of variables such as, mulberry acreage, number of dfls brushed per annum, cost of disinfection, FYM application and chawki transportation charges with the income realized was noticed in commercial chawki rearing centres in Karnataka (Vijaya Kumari and Rajan, 2005).

Qadri et al. (2005a) investigated the socio economic profile of sericulturists in Erode, Coimbatore and Dharmapuri districts of Tamil nadu and noticed that higher literacy rate (71.4%) found in Erode district had enhanced the adoption of improved sericulture technologies. Consequently the income/ unit area was found high in Erode and Coimbatore districts.
The major reasons cited for the success of PEBS and IVLP were cluster approach, knowledge empowerment of DOS staff and farmers through regular training, demonstrations of technologies as a package, strengthening of TSCs and RECs, preparation of crop schedule and batch brushing, distribution of chawki worms, compulsory disinfection followed by regular crop inspection and creating awareness about quality (Dandin et al., 2005a).

Factors such as education, experience in sericulture and mass media participation had a positive and significant association with the adoption level of sericulturists in Anantapur district (Sujatha et al., 2006a).

Vijaya Kumari and Rajan (2006) reported that experienced and literate people were actively involved in commercial chawki rearing. Area under mulberry, family size and experience of CRC owners in sericulture had significant correlation with adoption of chawki rearing technologies. Age and occupation were found to be non significant.

Independent variables such as education, experience in sericulture, social participation, mass media participation, extension participation, extension contact, material possession, net income and credit facilities were found to have positive and significant correlation with adoption. Age had a negative correlation with adoption (Sujatha et al., 2006b).

The impact of sericulture on the socio-economic status of the farmers was surveyed in Kolar district, Karnataka which showed that 69.16% of the respondents earned Rs.10,000 to 20,000 per annum and 24.30% earned between Rs. 20,000 to 30,000 and only 3.27% earned above Rs. 30,000/- per annum (Chowdappa et al., 2006).

The status of sericulture in farmer’s economy and its impact on the socioeconomic status of farmers like asset creation, savings and education was analyzed by Rajesh and Afshan (2006). They reported that under irrigated condition, sericulturists showed better socio-economic conditions compared to agriculturists. Sericulturists created more assets (39 percent) to agriculturist’s assets (24 percent), savings (25 percent) and education (65 percent). Thus, higher the dependency on sericulture vis-a-vis other
agricultural crops better is the socio-economic status of the farmers irrespective of the geo-climatic condition.

An analysis of data collected from 90 selected seed farmers revealed that extension participation and contact were significantly correlated to the adoption level of sericultural practices. Productivity parameters like cocoon yield/100 dfls, cocoon yield/acre, dfls brushed/acre indicated significant correlation with adoption level (Bhargava et al., 2006).

Factors such as education, income, social participation, mass media use, extension contact, cosmopolitaness and risk orientation were found to have positive relationship with adoption of sericultural practices in 13 villages in Maharashtra state, while age showed a negative relationship (Sunil Dutt and Chole, 2002).

Multivariate logit model was employed by Lakshmanan and Geetha Devi (2006) to find out the probability of adoption of V1 mulberry variety and CSR hybrids at farmers' households in Mandya district, Karnataka. Of the six variables considered, cocoon price was the major determinant of adoption and rest of them were observed to be positive.

There was a significant relationship between knowledge level and education, total land holding, extension contact, social participation and cocoon yield. However, age and experience of respondents had shown negative relationship with the knowledge level (Lakshmanan and Geetha Devi, 2007c).

Likewise, the variables such as education, extension contact and cocoon yield had shown significant correlation with adoption level. Area under mulberry and experiences of farmers had no relationship with the level of adoption. Regression analysis showed that education, cocoon price, availability of credit and extension contact had helped the farmers to adopt bivoltine cocoon production (Lakshmanan and Geetha Devi, 2007c).

Data collected from 100 farmers of Sathyamangalam and Gobichettipalayam taluks of Erode district in Tamil Nadu revealed that both knowledge and adoption was significantly influenced by most of the socio economic characters except age, education and family size. Linear regression
analysis showed that the socio economic variables contributed to 50.4 to 62.7% variation in cocoon yield. Training undergone by the sericulturists had a positive significant influence on cocoon production (Meenal and Rajan, 2007).

**III. Economic impact of adoption**

Most of the people living in rural areas are confronted with technological backwardness and to improve their living conditions, introduction of the appropriate technological inputs and effective percolation of the technology to the grass root level is the only option (Bisaria and Fotadar, 2000). The key factor responsible for sustenance of any technology is its economic viability. The impact of any technology is well appreciated based on its economic gain, easy adaptability and application simplicity (Dandin, 1997). Systematic adoption of recommended technologies leads to improvement in mulberry leaf yield and cocoon yield and thereby increases the income from sericulture.

The literatures highlighting the impact of technology adoption on the economic upliftment of sericulturists are presented below:

Bhat (1989) studied the bivoltine seed cocoon production in Attibele seed area and observed doubling of income of seed cocoon growers after adoption of recommended technologies.

Bhat *et al.* (1992) found that, adoption of new package of practices in Bikkanahally village had improved the yield and monetary returns.

Shivamurthy *et al.* (1992) stated that, augmentation of cocoon production is achieved through adoption of improved technologies at Dharwad district.

Majority of the trained farm women who got acquaintance with improved technologies obtained higher cocoon yields as compared to that of untrained farm women in Bangalore rural district (Naresh, 1996).

An incremental yield of 24.34 Kgs/ 100 dfls over traditional practices was reported in Chamarajanagar area after adoption of package of improved rearing technologies (Dayananda *et al.*, 2000).
Kawakami (2002) attributed improvement in knowledge of farmers and extension staff as the major cause for technology adoption under PPPBST project in Southern states that has led to economic viability.

Thiagarajan (2002) studied the economics of sericulture in relation to other crops under drought prone areas and reported that small farmers with one acre of rain fed mulberry garden derived some benefit in terms of income and employment.

It was found that the small, medium and large farmers realized 0.97, 0.15 and 2.74 percent higher returns by adopting bivoltine rearing over cross breed rearing (Keshava Reddy et al., 2002)

A comparative economic study of the old and improved rearing packages showed a net gain of Rs.1233.45 and Rs.649.75 for 40,000 larvae of CSR2 x CSR5 and BL24 x NB4D2 respectively (Meena et al., 2002).

An analysis of the rearing performance prior and after adoption of bivoltine technologies indicated that 57% of the farmers harvested less than 40 kg and no farmer harvested above 70 kg/100 dfls before adoption. Whereas after adoption no farmer had harvested less than 40 kg and 74% farmers had harvested above 70 kg/100 dfls (Rajan, 2002).

After adoption of technologies, an average increment of 4.21 MT/ha/yr was recorded in mulberry leaf yield whereas 66.42% rise was recorded in cocoon production (Damodara Naidu et al., 2002).

A study in Telangana region of Andhra Pradesh revealed that with the adoption of integrated technology package, the leaf yield had improved to 31,526 kg/ha/yr as against the bench mark yield of 20,772.80 kg/ha/yr. Similarly the cocoon yield increased to 51.74 kg/100 dfls after adoption from 27.17 kg (Venkataramana et al., 2002).

A study conducted by Bhargava et al. (2003) on economics of bivoltine and multivoltine seed cocoon production in Karnataka revealed that bivoltine seed rearers realized a net profit of Rs.60,276/acre/annum with a CB ratio of 1:1.96. Whereas the multivoltine seed rearers obtained Rs. 21,580/ as net profit with a CB ratio of 1:1.39.
Rajaram and Jaiswal (2004) reported that, increase in raw silk production and decrease in renditta was due to the adoption of new silkworm breeds that helped the farmers to increase their income at all levels.

There was a significant yield improvement in mulberry as well as cocoon production and reduction in crop losses due to the demonstrations conducted under IVLP programme (Dandin et al., 2004).

Comparative economics of reeling showed 1.58 times more profit for CSR2 x CSR4 hybrid and 2.23 times more profit for bivoltine double hybrids as compared to that of multivoltine x bivoltine cocoons (Sangappa et al., 2005).

Cluster approach studies conducted in three villages of Andhra Pradesh revealed vertical improvement in cocoon productivity per acre by 87.5% to 130.76% with increased net income ranging from 84.36% to 196.25% (Ramalakshmi, 2005).

Selected bivoltine sericulture technologies as a package were demonstrated to selected farmers in Karnataka to study the impact on productivity. It was observed that the average cocoon yield/100 dfls was improved by 38.25% over the bench mark yield (Hiriyanna et al., 2005).

Deepa et al. (2005) conducted a survey on leaf and cocoon yield before and after demonstration of new technologies in Mulakalacheruvu mandal of Chittoor district. It was reported that, technology adoption had increased the cocoon yield by 6.65 kg per 100 dfls.

Adoption of improved technologies revealed vertical improvement in per acre productivity by 50% and 61.3% with corresponding cost reduction by 8.3% and 24% in leaf and cocoon production respectively. Simultaneously, the cocoon yield/100 dfls also improved by 25.45% in adopted farmers when compared to non adopted farmers (Sakthivel et al., 2005).

The cocoon yield per acre was increased from 390 kg to 501 kg per year among JICA farmers. Income generated from one acre of mulberry garden had increased from 0.45 to 1.03 lakhs and from 0.34 to 0.80 lakhs in JICA and non JICA farmers respectively (Rahmathullah et al., 2005).
An attempt was made by Qadri et al. (2005b) to find out the impact of adoption of new bivoltine technologies through cluster approach in three clusters of Tamil Nadu proved that cocoon yield/100 dfls was improved by 20 kgs after adoption.

The effect of demonstration of technology package on mulberry leaf yield and cocoon yield in Ernakulam and Trichur districts of Kerala was studied by Philip et al. (2005). They noticed an improvement in mulberry leaf yield by 1370 kg/ac/yr and cocoon yield by 14.76 kg/100 dfls over bench mark as a result of adoption of technologies.

Adoption of sericulture technologies resulted in an improvement of 300-700 kg of mulberry leaf yield/acre/year and cocoon yield of 10-30 kg/100 dfls in rainfed areas. As a result the income/100 dfls was also increased by Rs.800-2000 (Gunashekar et al., 2005).

Geetha Devi et al. (2006a), observed that number of dfls brushed per acre/ year had increased from 748 to 965 due to significant improvement in mulberry leaf production by advocating new technologies. As a result, a quantum leap in cocoon production from 364 kg/acre/year to 632 kg was also noticed.

The studies carried out on impact analysis of technologies on cocoon productivity in Jammu and Kashmir state revealed that non adoption of improved technology by the farmers is responsible for low cocoon productivity (Qadri et al., 2006).

Ten to twelve percent increase in mulberry leaf yield and 29-30% increase in cocoon yield was noticed by adopting new sericulture technologies among farmers of Parigi and Pydeti villages of Anantapur district. Thirty two percent net profits over bench mark was also recorded (Kasi Reddy et al., 2006a).

Need based technologies were advocated among high, medium and low performing farmers of Kolar district and impact survey was carried out at the end of I and II year. Results revealed an increase in cocoon yield by 8 kg, 6 kg and 7 kg respectively in high, medium and low performing farmers (Shobha Rani et al., 2006).
Kasi Reddy et al. (2006b) reported that adoption of INM-IPM module by farmers in Anantapur district of Andhra had increased the leaf yield from 40 MT to 45 MT/ha/year and the cocoon yield from 52 kg to 61 kg/100 dfls. The cost benefit ratio was also increased from 1:1.7 to 1:2.80.

Introduction of IVLP programme in Kodagapura village, Chamarajanagar district had increased their cocoon productivity from 34.39 to 56.48 kg/100 dfls and an additional income of Rs. 1800-2500 for 100 dfls was generated in comparison to the farmers with traditional practice (Gururaj et al., 2006).

The impact of demonstration of technologies as a package on the cocoon productivity was studied in Mysore and Mandya districts by Hiriyanna et al. (2006). Results revealed an improvement in cocoon yield by 15 kgs and net income by Rs. 1911.07 per 100 dfls.

Cocoon yield/100 dfls increased from 52 to 65 kg recording an improvement of 25% over benchmark as a result of adoption of improved technologies through IVLP programme in Salem cluster (Krishnamoorthy and Qadri, 2006).

According to Qadri and Dandin (2006) as a result of demonstrations and trainings organized to create awareness about the new bivoltine rearing technologies under cluster approach programme, the cocoon yield levels were remarkably increased to 71.3 kg, 64.8 kg and 55.8 kg/100 dfls in on farm (RSRS), off farm (TOT farmers) and non adopted farmers respectively. The share of bivoltine cocoon production out of the total cocoon production in Tamil Nadu was mere 0.09% during 1999-2000. This has increased to 26.3% in 2007-08 which is the highest share of bivoltine production achieved in the country. The factors responsible for this success were effective extension campaign, creation of awareness and adoption of new technologies.

IV. Constraints in adoption

Constraints in adoption of improved technologies result in variability in production and affect the diffusion of technologies. Some of the constraints opined by the farmers are indicated below.
The constraints as perceived by the sericulturists for non adoption and partial adoption of recommended sericultural practices were lack of knowledge, lack of finance, scarcity of irrigation water and lack of labour (Shivamurthy, 1988).

According to Dayananda Patel (1988) lack of technical know how of technologies was an important reason for the low productivity coupled with low quality.

The constraints as reported by the sampled farmers in mulberry cultivation were lack of water, non availability of labour and high yielding varieties, harvesting and transportation of leaves during rainy season. Untimely supply of layings, high cost of dfls, uzi menace, lack of separate rearing house, lack of disease control measures, lack of finance and fluctuations in cocoon price were the constraints observed in silkworm rearing (Sreenivasa, 1989).

Lack of knowledge on disinfection and disease control measures, lack of capital for construction of rearing house, non availability of M5 variety, labour and chawki worms in time were the major reasons identified for non adoption of recommended sericultural practices in Kolar district (Gopala, 1991).

Srinivasalu (1991) quoted lack of knowledge about temperature maintenance, disinfection and disease control measures as the barriers for adoption of technologies.

Trag et al. (1991) identified low yielding silkworm breeds and crude traditional rearing techniques as the main reasons for decline in raw silk production in Jammu and Kashmir state.

Aswathnarayana and Afshan (1992) reported that, inadequate resources and limited extension network were the reasons for non adoption in both traditional and non traditional belts of Karnataka.

Gopala and Krishna (1993) reported that major constraints faced by farmers were lack of knowledge about disinfectants and disease control, lack of separate rearing house and non availability of dfls in time.
Lack of knowledge about disease control, lack of capital, high cost of fertilizers, shortage of trays and non-availability of quality chemicals were the main reasons identified for non-adoption (Singhvi et al., 1994).

The main constraints reported for non / partial adoption of improved technologies by sericulturists in Malda district of West Bengal were lack of knowledge and awareness, lack of finance, lack of separate rearing house, non availability of inputs, non remunerative price for cocoons and sudden fluctuation in cocoon prices (Zeaul Ahsan, 1994).

Nikhade et al. (1995) indicated that lack of knowledge about fertilizer doses, silkworm disease and pest control measures, low cocoon prices, delay in payment were the major constraints for non adoption of technologies by farmers in Maharashtra.

The reasons cited for non adoption of sericulture by farmers in Coimbatore district, Tamil Nadu were inadequate marketing facilities, lack of control measures for silkworm diseases, non availability of labour and lack of credit facilities (Jagannathan, 1995).

Lack of separate rearing house, non-availability of quality layings, non-remunerative price for cocoons, non-availability of finance and unawareness of technology were the main reasons identified for non-adoption (Chikkanna et al., 1995).

Doddamani (1996) listed out the constraints faced by sericulturists in Gulbarga district, which included non availability of dfls, pest and disease control measures that led to low production.

Geetha et al. (1996) while studying the knowledge and adoption of the sericulture technologies by the farmers in South India reported that lack of scientific information, poor extension and organizational contacts, lack of sufficient credit facilities and training programmes were the major constraints.

Doddagadad (1996) indicated that insufficient transport facilities, contact with the scientists, lack of career growth, inadequate salary, lack of training, lack of participation of extension personnel at planning stage, lack of furniture and residential facility at the working place were the major constraints of extension personnel. He further mentioned that non-availability
of cocoon market, lack of sufficient credit facilities, lack of separate rearing house and non-availability of improved mountages were the major constraints faced by the farmers for effective adoption of improved sericulture technologies.

Lack of knowledge about diseases, fear of toxicity to silkworms, lack of inputs and poor extension are the constraints for non adoption of plant protection measures (Govindaiah et al., 1996).

Important reasons cited by farmers of Tumkur district for partial and non adoption of improved practices were lack of knowledge, lack of finance, lack of water, non availability of cuttings, FYM and fertilizers in time (Shreedhara, 1997).

The reasons for non adoption of technology as opined by the farmers of Dharwad district were lack of knowledge as the main constraint (81.30%) followed by low prices for cocoons (70.50%) and high costs (63.60%) (Srinivasa et al., 1998b)

The major constraints for non adoption of sericulture innovations in Tamil Nadu were lack of awareness and adoption of traditional practices (Lakshmanan et al., 1998a)

Raghu et al. (1999) in a study conducted in Kolar district found that non availability of quality dfls was the major constraint followed by silkworm diseases and lack of proper guidance.

Lack of finance, lack of knowledge, non availability of inputs in time and fluctuations in cocoon rate were the major constraints observed for non adoption among different categories of farmers of K.R. Nagar taluk of Mysore district (Jagadisha, 1999).

Venkatesh Kumar et al. (1999) inferred that the reasons for non adoption of improved sericultural practices among multivoltine seed cocoon producers in Magadi taluk of Bangalore rural district were lack of economic resources, indifference on the part of the rearers, lack of co-ordination between farmers and extension workers and lack of effective extension activities.
Shivalingaiah et al. (1999) in their study observed that lack of knowledge about application of NPK fertilizers, pest and disease control (87.57 per cent), non-availability of labour (62.13 per cent) and marketing problems (50.30 per cent) were the constraints expressed by the farmers.

Mohandas et al. (1999) concluded that though there was considerable improvement in technology adoption, the impact was not fully reflected on cocoon production due to low awareness of new technologies.

The major reasons affecting the adoption of recommended sericulture practices were lack of knowledge about fertilizer dose and disease control measures, lack of capital, and high cost of fertilizers. No good price, exploitation by middlemen and distant market place were the major constraints faced by sericulturists in marketing of cocoons (Ganapathy et al., 1999).

Saratchandra (2000) pointed out lack of knowledge as the major reason for low/ non adoption. He further stated that resource constraints, imbalance between the farm holding and the available man power, multiple crop pattern also affected the technology adoption.

Non availability of credit to the sericulture enterprise in Mysore district is the major constraint for non adoption of technologies in full scale (Mallikarjuna, et al., 2001).

Kanimozhi (2001) found that lack of awareness, lack of interest, high labour cost, high input cost, non availability of credit facilities, lack of technical guidance, monsoon failure, lack of irrigation facilities and poor marketing facilities were the major constraints faced by farmers in adopting IVLP technologies.

The major problems in adoption of bivoltine sericulture technologies were timely supply of quality silkworm eggs in required quantity, organizing large number of chawki rearing centres, providing hygienic condition and supply of required equipments (Rajan, 2002).

Thiagarajan (2002) reported that practices that are easy and do not involve cash inputs were readily adopted by farmers in drought prone areas.
Non availability of dfls in time, high incidence of disease and pests and poor quality of leaf were the constraints experienced by farmers.

Munikrishnappa et al. (2002) observed that lack of finance, lack of knowledge, lack of separate rearing house, non availability of inputs in time and fluctuation in cocoon price were the major constraints among different categories of farmers in Mysore district in adopting improved sericultural practices.

Difficulty in picking of ripened worms, spinning of worms in the bed, lack of uniformity in ripening and non availability of bed refuse were the constraints experienced by most of the farmers in Kolar district in adoption of shoot feeding method (Madhu Prasad, 2002).

Lack of finance, non-availability of separate rearing house, inadequate rearing materials, non availability and high cost of inputs and unstable cocoon price were the major constraints for non/partial adoption (Hiriyanna et al., 2002a).

Mallikarjuna et al. (2003) studied the constraints in adoption of new technologies in mulberry production and silkworm rearing under irrigated conditions of Karnataka. They observed lack of awareness, preference of traditional practices, high cost, high investment and lack of facilities were the major constraints for technology adoption in sericulture.

Lack of awareness and non-availability of technological inputs are the major constraints for technology adoption in seed areas of Southern states (Srinivasa et al., 2003).

In Kolar district 91.67% of the respondents expressed that lack of capital for construction of separate mounting sheds was the major constraint for non adoption of CSR hybrids (Rajeev, 2004).

Dandin et al. (2004) found that recommendations with regard to application of fertilizers, disinfectants and pest control measures were not adopted either partially or completely due to high cost. The limited use or non-use of FYM was mainly due to its non-availability. Further, lack of awareness about different technologies like new mountages, density in mounting, correct
time of harvesting, new system of pruning and thinning hindered the improvement in productivity.

Expensive and cumbersome technologies, lack of awareness, and poor accessibility of technology were attributed as the major reasons for non adoption/partial adoption (Philip and Qadri, 2004).

The main reasons observed for partial and non adoption of recommended sericulture technologies by farmers of Mulakalacheruvu mandal of Chittoor district were lack of knowledge, strong belief to own ideas, reluctance on advanced practices, lack of extension participation and contact and financial constraints (Deepa et al., 2005).

The main problems encountered by sericulturists of Kolar district were shortage of water in summer, pest and disease incidence, high temperature in summer, non availability of dfIs and chemicals (Lakshmi Prasad, 2005).

Non availability (100%) and complicated application procedure (77.08%) were the major constraints in adoption of bio fertilizer among the farmers of Kolar district (Madhu Prasad et al., 2005).

The reasons attributed for 100% non adoption of recommended mulberry variety by farmers of Uttar Pradesh were lack of knowledge and adoption of traditional customs (Jaiswal and Kumar, 2005).

It was observed that technologies which involve high cost were either partially adopted or not adopted and technology inputs which were supplied by DOS were fully adopted (Sreenivas et al., 2005).

The reasons for partial adoption by small and marginal farmers were poor financial conditions, negligence and lack of proper guidance (Sujatha and Sujathamma, 2005).

Non availability of cutting edge and cost effective technologies to the primary stake holders has been one of the major bottlenecks affecting the production and productivity. Though large number of technologies were developed by research institutes, the field acceptance/ awareness of these technologies is rather poor resulting in wide gap in yield realization. The reasons for poor adoption of new technologies were attributed to poor
performance of the technology at field, lack of adequate information, defective approaches and one sided traffic of technology transfer (Dandin et al., 2005a).

The major constraints observed in Chamarajanagara district in technology adoption were belief in traditional practices, lack of awareness of new technologies, high cost and investment (Mallikarjuna et al., 2006).

The major constraints for low or non-adoption of the improved technologies by the farmers of Sathyamangalam taluk, Erode district were non-availability of inputs (34%), lack of awareness (26%), lack of proper technical guidance (18%) and the high cost of inputs (22%) and preference to traditional practices (38%) according to a study by Meenal and Rajan (2006).

Major constraints faced in adoption of silkworm rearing technologies were difficulty in picking of worms, requirement of more inputs for chawki garden, tukra infestation, high cost and pungent smell of Vijetha, availability of duplicate disinfectants in the market with synonymous names (Madhu Prasad, 2006).

Lack of knowledge, lack of technical guidance, lack of finance, traditional practice, strong belief on own ideas, over confidence, non availability of cuttings in time and high cost of fertilizers were the main reasons identified for non adoption of technologies by farmers of Anantapur district (Sujatha et al., 2006a).

The reasons for non/partial adoption of new technologies were attributed mainly to poor performance of technologies at the field level, lack of adequate information about the new technologies and defective approach for transfer of technology (Geetha Devi et al., 2006a).

Low or no cost technologies were adopted fully by farmers of Bangalore rural district. Lack of awareness and non availability of technological inputs were listed as the major constraints for technology adoption (Anandakumar et al., 2006).

The main constraints faced by sericulturists of Chittoor district, Andhra Pradesh were lack of knowledge, lack of finance, scarcity of water, lack of technical guidance, traditional practice, lack of skilled labour, high cost of fertilizers and scarcity of electric power (Sujatha et al., 2006b).
The reasons noticed for non adoption of new sericultural technologies by farmers of Erode district, Tamil Nadu were associated with high cost, lack of awareness and non availability of inputs in time (Mani et al., 2006).

The reasons observed for the poor rate of adoption of bio fertilizer application by farmers of Chittoor district, Andhra Pradesh were lack of awareness and high cost of inputs (Dee and Sujatamme, 2007).

V. Economics of mulberry and cocoon production

Sericulture is a remunerative crop for all categories of farmers with short gestation periods and quick returns. The economics of sericulture is dependant on how various resources and inputs are managed. Sericulture uplifts and ameliorates the economic conditions of farmers by way of diversifying the farming system, high income generation at frequent intervals and providing off farm employment opportunities (Bajpai et al., 2003). Though vast literature on the cost and return structure of mulberry and cocoon production is available, the recent ones are briefed here below:

Chandrasekar (1985) reported that the cost of establishment of one acre mulberry garden under irrigated conditions of Dharmapuri district of Tamil Nadu was Rs.8860.72 and that of cocoon production was Rs. 11,972.00. The gross return from cocoon production was Rs. 19,997/acre/year and net returns realized was Rs.8025.00 which was 2.6 times higher than that of other competitive crops.

An empirical analysis of the costs and returns from mulberry sericulture in Karnataka by Nagaraj et al. (1986a) revealed that the net return per acre of irrigated mulberry garden was around Rs.11,000/- from four crops.

A study on the economic benefits of sericulturists belonging to six different mulberry holdings and regions indicated that the economic gains obtained are both land specific and region specific (Hanumappa, 1987). Because, the returns accrued was comparatively lower in sericulturists having land area of 0.5 -1 acre in the rain fed region than other classes. But in irrigated region, the sericulturists having land area of 1.00 to 2.00 acres and above 2.00 acres were able to derive much higher returns.
Murtuza Khan (1987) reported that production of bivoltine seed cocoons was more profitable than that of multivoltine in Anekal taluk of Bangalore district. The total cost per acre of bivoltine seed cocoon production was Rs. 14,245.16 with a gross return of Rs. 18,987.75 as compared to Rs. 12,827.22 and Rs. 15,895.02 respectively in multivoltine seed cocoon production.

The total cost of production and net returns in sericulture had a direct relationship with the size of the farm. Returns per rupee of investment were higher from sericulture than any other crop in Chittoor district, Andhra Pradesh (Chandra Reddy, 1987).

Kerutagi (1991) reported that the cost of maintenance of one hectare mulberry garden under irrigated conditions in Bijapur district, Karnataka was Rs.18,043.99. The gross and net return from silk cocoon production was Rs.88961.96 and Rs.52,680.16 per hectare per annum respectively.

Ragavendra et al. (1992) estimated that the cost of cultivation per acre per year for producing cross breed cocoons under irrigated conditions accounted for Rs. 4,312.05 in less than 0.5 acre, Rs. 3,037.39 in 0.5-1.0 acre and Rs. 2,514.27 in more than 1.0 acre farms. The labour cost per acre per year for these farm categories was Rs. 18,986.27, Rs.13,175.07 and Rs.11,056.45 respectively.

Doreen Rose (1992) reported that farmers spent an amount of Rs. 2,251.99 for establishment of one acre mulberry garden under rainfed conditions. The maintenance cost was Rs. 596.77, the cost of production of one kilogram of mulberry leaf was Rs.0.85 and the net income earned was Rs.617.84.

Raveendaran et al. (1993) from the data collected from 50 mulberry farmers in Anna district of Tamil Nadu concluded that silkworm rearing was one of the most profitable enterprises compared to others even for small farmers with less mulberry area.

Dolli et al. (1993) observed that the average cocoon yield per acre of rain fed mulberry garden was 79 kg and the net income realized was Rs. 6,400 in Mysore and H. D. Kote taluks.
In a study on income and employment generation in dry land sericulture, Basavaraju (1993) observed that the average cost of establishing one acre of mulberry for large farmers was Rs.3,125.00.

Rajesh (1995) observed that farmers of Chamarajanagar invested Rs.64.34 for producing one kilogram of cocoons and the return was Rs.73.34. The cost benefit ratio worked out was 1:1.14.

The cost of cocoon production declined with the increase in farm size, because of the operation of economics of scale relatively in large farms. The net income of big farmers per acre was two times more than that of the marginal farmers (Jagannathan, 1995).

Lakshmanan (1995) found that the net return per acre/year from cocoon production was Rs.31289.19 in holding size I, Rs.29663.85 in holding size II and Rs.27710.23 in holding size III. He also observed that farmers with holding size I had accrued higher returns than holding size II and III and concluded that farmers having 0.5 or less acres of mulberry garden (mostly marginal farmers) could obtain more benefit from sericulture. The most probable reasons suggested were the more number of crops raised and high participation of family labour in holding size I as compared to other holding sizes.

Doddamani (1996) reported that the cost incurred for establishment of one hectare of mulberry garden was Rs.6534.37 and the expenses were concentrated in few items like leaf, labour and marketing cost.

It was estimated that the cost benefit ratio for one hectare of mulberry garden was high in Dharmapuri district (1:1.41) as compared to Salem district (1:1.30). (Lakshmanan et al., 1996)

Srinivasa et al. (1996b) reported that the investment on silkworm rearing is highly lucrative and economically viable in spite of the risk of fluctuations in labour wages, cocoon yield and price. They studied the economic viability of sericulture enterprise in Kolar district of Karnataka and indicated that the establishment cost of one hectare mulberry garden was Rs.6,480.00 and that of rearing assets was Rs.29,557.50. The net present value at the discount rate of 12.00 percent was found to be Rs. 70,940.08.
The internal rate of return was 35.02 percent and the benefit-cost ratio was worked out to be 2.82 at the discount rate of 12.00 percent.

It was reported by Kerutagi and Shankara Murthy (1996) that the gross returns from silk cocoon production was Rs.88,961.96 with a net return of Rs.52,680.16 per hectare of mulberry garden.

Shah (1996) studied the cost of cocoon production in progressive and non progressive farmers of Jammu & Kashmir and opined that progressive farmers invested more in fixed capital and hence, the cost of leaf production per acre was 1.68 times more in progressive farmers. However, due to effective management, the leaf produced was 1.76 times higher than non progressive farmers, thus reducing the cost of leaf/kg.

Cost of mulberry garden maintenance was more in irrigated areas compared to rain fed areas because of frequent inter cultural operations, more input usage and involvement of more labour (Suma, 1997).

Lakshmanan et al. (1997a) suggested that specific development schemes like implementation of minimum support price for cocoons, coverage of crop insurance for silkworm rearing and diffusion of cost effective new technologies would enhance the sericulture industry in Salem and Dharmapuri districts of Tamil Nadu.

Economics of sericulture widely differs across the states and regions due to the varying sericultural practices adopted according to the socio economic conditions of farmers. The cost benefit ratio is governed chiefly by the price of cocoons. In the absence of a price policy, the benefit fluctuates widely (Lakshmanan et al., 1997b).

Smaller holdings had spent higher amount and it decreased as the holding size increased. The higher cost incurred by marginal land holders was due to the excess use of both FYM and family labour. An interesting relation ship observed was that the cost of production and quantity of leaf decreased as land holding size increased. Similarly, remarkable difference was observed in the cost of production of one kg of cocoon among the different holding sizes. It decreased as the area of mulberry increased and this was due to the
higher production cost and realization of low cocoon yield in small holding sizes (Lakshmanan et al., 1997c).

Rajesh and Afshan (1998) analysed the cost structure of rainfed sericulture of Chamarajanagar area and compared it with that of ragi and jowar. They observed that though the net returns realized was more in ragi (Rs.786/ha/crop) compared to sericulture (Rs.690/ha/crop) the cost benefit ratio was more in sericulture i.e 1:1.16 as against 1:1.13 in ragi.

Chandrappa et al. (2000) reported that the initial cost of establishment of one acre irrigated mulberry garden was Rs.8,978 and the cost of garden maintenance was Rs. 15,902 with a labour employment of 256 man days. The total leaf produced per acre per annum was 12 tonnes with a production cost of Rs. 1.33 per kg of mulberry leaf.

A comparison of the economic benefit over investment in production of bivoltine and cross breed cocoons in K.R Nagar taluk of Mysore district had revealed that bivoltine earns higher net return than cross breeds owing to the climate, skilled man power and technical guidance received from developmental agencies (Lakshmanan et al., 2000).

A comparative study of cocoon production in coastal area with traditional area of Andhra Pradesh revealed that the cost benefit ratio was 1:1.70 and 1:1.19 respectively (Rao et al., 2000).

Roy and Sain (2000) conducted a cost-benefit analysis of silk cocoon production among different categories of farmers in Malda district, West Bengal. The estimated return-cost ratio was greater than unity and NPV was found positive in all cases. The observed value of IRR was more than 50 per cent for marginal farmers, while the pooled value of IRR was 44 per cent. The rate of return on investment was almost 50 percent, with an attractive short pay back period ranging from 2.37 years (marginal farmers) to 3.37 years (large farmers).

Landless farmers earned nearly 50% income from sericulture whereas marginal and small farmers earned 22.89% and 12.11% respectively from sericulture (Padma Tripathi, 2000).
Kumaresan and Vijaya Prakash (2001) studied the economics of sericulture vs competing crops such as sugar cane, paddy, turmeric etc., in Erode district of Tamil Nadu and concluded that the revenue obtained from sericulture was higher than that of all the other major crops cultivated in that area namely paddy, sugarcane, gingelly, groundnut and sorghum.

The linear analysis of the data collected from 120 farmers from Hassan and Mandya districts of Karnataka on the cropping patterns and income levels of cross breed and bivoltine rearers indicated that the area under mulberry should be increased to 30.75% during kharif and 33.61% during rabi season for CSR farmers for maximizing the returns (Srinivasa et al., 2001).

The average cost incurred for producing one kg of cocoon was higher in shelf rearing (Rs. 77.71) compared to shoot feeding (Rs.69.43) method. Similarly the net return per rupee investment was also high in shoot feeding (1:1.76) when compared to shelf rearing (1:1.58) (Chandrappa et al., 2001).

A comparative analysis of shoot feeding and shelf rearing methods indicated that irrespective of the methods, major part of the expenditure incurred was for mulberry leaf followed by labour component and chawki worms (Umesh et al., 2001). For every rupee invested in cocoon production a return of Rs. 1.82 and Rs. 1.63 were realized in shoot and shelf rearing methods.

Hiriyanna et al. (2002b) reported that the expenditure incurred for rearing CSR hybrids was higher than that of multi x bi hybrid rearing due to usage of more inputs. Similarly the benefit cost ratio was also higher in CSR hybrids (1:1.92) compared to multi x bi hybrids (1:1.35).

Kumaresan et al. (2002) studied the economics of CSR hybrid cocoon production under PPPBST project in Karnataka. The cost of cocoon production was worked out to Rs. 10485.11 for CSR hybrids and Rs. 6917.04 for cross breeds. The high production cost of CSR hybrids was due to usage of more inputs, particularly leaf, disinfectants and rotary mountages. The net revenue was estimated to Rs. 3545.66 for CSR hybrids and Rs.1099.27 for cross breed. The BC ratio was 1:1.34 and 1:1.16 respectively for CSR hybrids and cross breeds.
Dandin and Kumaresan (2003) empirically analysed the cost of cocoon production and reported that cost of production per 100 dfls was Rs.4901.12 with a B:C ratio of 1:1.54. The cost of production of one kg of cocoon was estimated at Rs. 81.68. Further they also informed that ten crops schedule was more efficient for 2-4 acres of mulberry garden with two plot system.

Viswanathan et al. (2003) reported that the maintenance cost of one acre of mulberry garden was worked out to Rs. 8030 and Rs. 7912 in Kolar and Tumkur districts respectively.

Behera (2004) studied the impact of technological change among CSR and cross breed rearers of Mandya district, Karnataka and reported that the cost of leaf production was Rs. 11,295.56 per acre per year for CSR hybrids while it was Rs. 9,879.87 in cross breeds. In both cases labour was the major item followed by FYM, fertilizers, bullock power and irrigation. Similarly the cost of cocoon production per acre per year was also high in CSR hybrids. The B:C ratio was worked out to 2.09 in CSR hybrids and 1.79 in cross breed for every one rupee invested. It clearly revealed that the returns from CSR hybrid was more than cross breed due to higher cocoon yield and more prices fetched for CSR cocoons.

An economic analysis of mulberry sericulture among the farmers of Mandya district, Karnataka revealed that the net profit earned from bivoltine cocoon production was much higher than cross breed rearing (Lakshmanan & Geetha Devi, 2005a). The net profit estimated was Rs. 40364.23 for bivoltine breeds and Rs. 25367.69 for cross breeds per acre per year. The cost of production of one kg of bivoltine cocoons was Rs. 80.35 and Rs. 74.64 for cross breed cocoons. The cost – benefit ratio was 1: 1.76 and 1:1.54 for bivoltine and cross breed cocoons respectively.

A study was conducted in rain-fed condition of Chamarajanagar district to work out the economics of sericulture at selected sample households. The study revealed that farmers incurred loss by taking up sericulture in the study region. However, there were no alternative economic opportunities other than sericulture in the study areas where the prevailing climate suits sericulture.
and offer regular own family employment round the year (Lakshmanan & Geetha Devi, 2005b).

A comparative economic analysis of cocoon production in Kolar district by Lakshmi Prasad (2005) estimated that the cost of establishment of one acre mulberry garden was Rs. 5492.12 and that of silk cocoon production was Rs. 6987.10 per 100 dfls. The gross and net returns were Rs.8251.96 and Rs. 1264.86 per 100 dfls respectively.

The revenue obtained from sericulture was comparatively higher than all other major crops cultivated in Erode district, except that of banana. The major reasons expressed by the farmers for practicing sericulture were higher profitability and continuous income throughout the year. Further in sericulture, apart from the advantages of higher returns and regular income for farmers, the crop losses are minimized and the yield levels are stabilized due to the popularization of standard scientific technologies (Dandin et al., 2005b).

Dandin and Basavaraja (2005) made a case study of large scale farming in Talawadi of Tamil Nadu and Anekal of Karnataka and found that the production cost of one kg of cocoons was Rs.70/- in both places.

Balasaraswathi et al. (2006) made a comparative analysis on the economics of mulberry and cocoon production in Dharmapuri and Erode districts of Tamil Nadu and concluded that the net returns/acre/year was higher in the former (Rs.25,629.03) than that of the latter (Rs. 17,834.33) The cost benefit ratio was 1:1.61 and 1:1.38 in Dharmapuri and Erode districts respectively.

The expenditure incurred for rearing of CSR hybrids were higher in non traditional area compared to traditional area. The Benefit cost ratio in traditional area was better (1:1.92) than that of non traditional area (1: 1.72). (Hiriyanna et al., 2006).

It was reported by Venkatesh et al. (2006) that a regular and substantial income of 80-90% out of the 14-40% land used for sericulture (25000-50000 rupees/acre/year) was generated in Kanakapura, Channapatna and Kunigal taluks of Bangalore rural district in Karnataka.
Although profitability in sericulture is positive, its stability depends on two major factors viz., cocoon price stability and cost of cocoon production. So, minimum support price for cocoons should be advocated to increase both productivity and profitability (Lakshmanan and Mallikarjuna, 2006).

A comparative economic analysis of CSR hybrid vis-à-vis cross breed cocoon production in Karnataka indicated that though the expenditure incurred for rearing CSR hybrids was higher than that of cross breed rearing due to usage of more inputs for the former, the benefit cost ratio of CSR hybrid (1:2.05) was better than cross breed (1:1.89) (Kumaresan et al., 2006).

Hiriyanna et al. (2007) compared the performance and economics of CSR hybrids with the popular cross breed, Kolar gold. The total cost of leaf and cocoon production per acre per year was Rs. 36,443.26 and Rs. 32,982.15 for CSR hybrids respectively. It was Rs. 35,027.57 and Rs. 27,284.10 for Kolar gold. The total income including the income from by products was higher in CSR hybrids (1,30,081.00) than Kolar gold (Rs. 1,07,624.00). The same trend was reflected in net income also i.e net returns from CSR hybrids was Rs. 60,655.59 as against Kolar gold (Rs. 45,312.33). The cost benefit ratio worked out was 1:1.87 for CSR hybrids and 1:1.72 for Kolar gold.

The contribution of sericulture enterprise in Vidarbha region of Maharashtra was found to be the highest at 52% (Rs.82,315/ha/yr) when compared to other competitive crops in that region (Hajare et al., 2008).

Large scale farmers, possessing more than 5 acres of mulberry incurred a total expenditure of Rs. 65,655.35 and Rs. 64,167.90/ acre/year respectively in Karnataka and Tamil Nadu towards cocoon production. In case of small/ medium scale farmers, the total cost of production was Rs. 72,677.93 and Rs. 64,537.58/ acre/year in Karnataka and Tamil Nadu respectively. The Tamil Nadu farmers incurred more expenditure on transportation of cocoons as they generally market their cocoons in Karnataka due to lack of competitive cocoon market in Tamil Nadu. The per kg cost of cocoon production was worked out to Rs. 88.00 for both large and small scale farmers in Karnataka, whereas in Tamil Nadu, the large scale farmers spent
more amount (Rs.100.28) compared to small scale rearers (Rs. 93.48). This was due to hired labour and marketing problem faced in Tamil Nadu (Dandin et al., 2008).

VI. Employment generation in sericulture

Sericulture is an important tool for employment generation and it provides regular short term income mainly to small and marginal peasants of rural India. Out of the 5.76 villages in India, sericulture is practiced in about 50,000 villages, providing employment to more than 60 lakh people in rural and semi urban areas (Mathew Thomas, 1989). The following are the literature supporting the employment generation through sericulture.

Aiyaswamy (1980) observed that 607 man days of male and 827 man days of female labour were involved in sericulture per hectare per year in Coimbatore district.

Hanumappa and Erappa (1985) reported that the employment potential for mulberry cultivation was higher for hired labour and the family labour compound was more pronounced in silkworm rearing.

Chandrasekar (1985) found that sericulture provides two times more employment i.e 538 man days /ac/yr than other alternate crops in Dharmapuri district of Tamil Nadu.

Hanumappa (1986) found that cultivation of one hectare mulberry required 371 man days per year.

It was also estimated that the employment generation was about 400 man days per annum per acre (Nagaraj et al., 1986b).

According to Prakash Kumar (1986), the total labour required for maintaining one acre of established mulberry crop/cutting was 37.7 man days, while that of rearing 100 dfls was 42.5 man days. More than half of the labour used both in mulberry cultivation and silkworm rearing in respect of big farmers came from hired labour group, while small and tenant farmers met more than half of the labour requirement through family labour.

One hectare of mulberry garden generated remunerative employment to 12 to 13 persons through out the year (Jolly, 1987).
In cocoon production, the cost of human labour constituted a major portion followed by mulberry leaves in all categories of farmers. The total cost of cocoon production was maximum in large scale farmers because of the higher amount of human labour utilized (Marihonnaiah, 1987).

One acre of mulberry generated employment for 430 man days under rainfed and 1,168 man days under irrigated conditions. The percentage of increase in labour input as a result of 1% increase in cocoon output was about 0.47 in rainfed and 0.58 in irrigated mulberry gardens (Benchamin and Jolly, 1987).

The human labour utilization decreased with the increase in the size of the farm. The high labour utilization in small farms was due to the ready availability of family labour (Neelakanta Sastry et al., 1987).

Small farmers employed less human labour in silk cocoon production than large farmers (Chandra Reddy, 1987).

According to Basavaraju (1993) out of the total cost of production, 70% was spent on human labour.

Yadaiah and Sarangapani (1994) studied the costs and employment generation in sericulture enterprises in Warangal district of Andhra Pradesh. The total employment generated was about 923.31 man days and the total cost incurred was Rs. 13902.57 per hectare.

Participation of family labour was 56% out of the total manpower involved in sericultural activities under rainfed conditions of Chamarajanagar (Rajesh, 1995).

Around 65% males per acre were employed in mulberry garden establishment and irrespective of farm sizes inter cultivation and harvesting of leaves created around 50% employment. As the leaf produced was more in big farms, naturally they reared more number of layings resulting in increased cost of production and employment (Jagannathan, 1995).

Human labour employment was analysed using data collected from 200 farmers in Anantapur and Chittoor districts of Andhra Pradesh. The results showed that employment generation was inversely proportional to
holding size. Higher employment in small farms was due to higher leaf yield and brushing capacity per unit area. A direct relationship was observed between hired labour use and holding size (Ganapathi Rao et al., 1995).

It was observed that sericulture generated 227 and 117 man days respectively in progressive and non progressive farmers and the reasons stated were adoption of recommended technologies by the former. But relatively higher share of family labour was engaged by non progressive farmers due to their inability to pay wages (Shah, 1996).

A survey on the cost and returns of cocoon production in Bijapur district revealed that 98% of the expenditure was operational cost, out of which 40% was for mulberry leaves, followed by human labour (20%). Among the human labour, family labour used was about 65% (Kerutagi and Shankara Murthy, 1996).

Aravind More (1996) made a comparative study on the economics of sericulture and sugarcane in Mandya district of Karnataka and reported that sericulture generated 777.4 man days/acre/year.

Irrespective of the farm sizes, 50% of the leaf production cost was incurred for human labour (Lakshmanan et al., 1997c).

It was found that a higher share of family labour was employed on smaller holdings (size I: <0.5 acre) compared to larger holdings (size IV: >1.5 acre). Further, a direct relationship between holding size and hired labour employment was also observed (Lakshmanan et al., 1997d).

The pattern of labour usage and productivity of labour in sericulture with respect to various activities in different categories of farmers were studied by Jayaram et al. (1998). The results showed that 357 man days were engaged per acre per year in irrigated sericulture as against 170 man days in rain fed sericulture. Under irrigated conditions 186 man days of hired labour and 171 man days of owned labour were used, a similar trend was reported in rainfed conditions also. The productivity of labour was high among large scale farms, revealing greater economics of scale.

Mulberry sericulture can solve problems like unemployment, rural migration and poverty to a considerable extent not only in the irrigated belts
but also in dry land areas. The use of family labour was found to be negatively related with the increase in holding size (Lakshmanan et al., 1998b).

Kumaresan et al. (1999) evaluated the comparative economics and labour use pattern in shoot and shelf rearing methods of silkworm rearing and stated that 5.72 man days of male labour and 11.23 man days of female labour could be saved for rearing of 100 dfls by practicing shoot rearing method with an increase in revenue.

Pushpa and Netaji (1999) conducted a study on income and employment pattern of farmers in various integrated farming systems in Rasipuram and Namakkal taluks of Salem district in Tamil Nadu and found that maximum additional employment generated (515 man days) was in sericulture compared to poultry (160 man days) and dairy (170 man days).

On studying the comparative economics of silk growers on the basis of land holding in Etawah district, Padma Tripathi (2000) opined that sericulture offers maximum support in earning and employment needs to landless farmers. The landless group utilized more family labour (37.08%) when compared to marginal (27.30%) and small (20.14%) groups.

Kumaresan and Vijaya Prakash (2001) reported that sericulture required more labour compared to other crops in Erode district, a high labour cost of Rs.20235.67/ac/yr was spent on labour.

The labour usage was more in mulberry cultivation for CSR hybrid rearing over cross breed rearing by 3.29%, but it was quite reverse in silkworm rearing as most of the sampled CSR hybrid rearers adopted labour saving shoot rearing technology instead of the conventional tray rearing methods adopted by most of the cross breed rearers (Behera, 2004).

Bisen et al. (2005) studied the economics of cocoon production in Balaghat district of Madhya Pradesh and concluded that approximately 51% of the cost was spent for human labour.

Of the total cost of one acre mulberry garden establishment the expenses for human labour accounted to 38.77% (Lakshmi Prasad, 2005).
An economic analysis of cocoon production in Erode and Dharmapuri districts of Tamil Nadu by Balasaraswathi et al. (2006) revealed that labour cost incurred in Erode district was high due to the higher wages and shortage of manpower.

Lakshmanan and Geetha Devi (2007a) reported that one acre of mulberry sericulture had generated 532 mandays in various activities in Gobichettipalayam and Udumalpet taluks of Tamil Nadu. Of this, 319.20 man days were from own family source and 212.80 man days were hired.

A study on employment generation in dry farming sericulture in Karnataka by Lakshmanan and Geetha Devi (2007b) showed that 112.65 man days were engaged in leaf production of which owned labour involvement was found to be more (66.50 man days) than hired labour (46.15 man days). Out of the various activities involved in mulberry leaf production, shoot harvesting utilized more man power (68.20%) and in case of silkworm rearing more labour was used during adult rearing (40.69 man days).

Though small, marginal and landless farmers had surplus labour stock, they were not able to increase the labour productivity, partly because of the unsuitable climatic conditions and partly due to lack of irrigation and non adoption of technologies (Lakshmanan and Geetha Devi, 2007b).

VII. Participation of women in sericulture

Women are closely associated with sericulture and they form the major work force in various activities of sericulture. Few studies that signify the involvement of women in sericulture are briefed below:

More than half of the labour force used in cultivation of mulberry and silkworm rearing was contributed by women labour (Prakash kumar, 1986).

Out of the 4005 man days of employment opportunity in sericulture activities, 2116 man days were of light nature fit for women folk (Jolly, 1987).

Dandin (1994) surveyed the involvement of women in various sericultural activities and revealed that involvement of women was 49.55% and 49.67% in mulberry production and silkworm rearing respectively. Women’s involvement was found to be less in seed production (20.46%).
Women's participation was high in rearing sector than mulberry cultivation. A great deal of variation exists in their participation across different sericultural regions and socio economic groups and also across their age, status in the household and educational levels (Gayathri Devi, 1994).

Analysis of the Udaipur sericulture project, established by the Government of Rajasthan proved that it had a large impact on the lives, status, time use and attitudes of the large number of women who have participated in the project (Creevey, 1996).

Women's participation in sericulture was studied in Sidlaghatta taluk of Kolar district by Lakshmi Raju et al. (1997). The results showed that involvement of women was less in operations like intercultivation, pruning, irrigation and pest & disease management. Majority of the farm women participated in activities like weeding (80%), leaf harvesting (76%) application of manures (74%), planting (72%) and fertilizer application (70%). With regard to silkworm rearing, most of the farm women were involved in chawki rearing (60%), feeding (80%), bed cleaning (74%), mounting (82%) and grading (80%). However, in the practices like disinfection, temperature and humidity maintenance, pest and disease management, involvement of women was considerably less. Only 10% of women participated in marketing of cocoons.

In the present system of male headed family, women serve mostly as a voiceless worker. Silk industry generates employment potentials for rural women (Gupta & Gupta, 1997).

A study conducted in Salem and Dharmapuri districts of Tamil Nadu showed that the composition of female labour was high in all farm size groups. The reasons attributed for this were most of the activities like weeding, leaf harvesting, feeding worms, bed cleaning and cocoon harvesting are unskilled in nature and labour wages were low for female labour (Lakshmanan et al., 1998b).

According to Naresh and Narayana Gowda (2000) the sericulture industry was fairly managed because the participation of women was 61% in total work force in various operations of mulberry cultivation and silkworm rearing.
The relationship between the participation of women in sericulture was correlated with income, total/mulberry land holdings and it was found significant. Participation of women was highest in indoor activities i.e. silkworm rearing (94.67%) followed by nursery raising (90.95%) and leaf plucking (87.47%). No participation was recorded in irrigation. Participation of women was very low in packing and marketing of cocoons, procurement of dfls and incubation (Saraswathi and Sumangala, 2001).

Savithri and Sujathamma (2003) by conducting a survey in Vedarakuppam and Gangudupalli villages in Chittoor district of Andhra Pradesh concluded that work participation of men and women was not similar in various sericultural operations and their decision making was not commensurate with their involvement.

In sericulture, women were relegated to less skilled but laborious activities like weeding and disinfecting the equipments (Siddagangamma, 2006).

Training of large number of women sericulturists accelerated the promotion of bivoltine sericulture in Tamil Nadu, because women were involved in most of the sericulture activities (Qadri and Dandin, 2006).

The sex ratio in labour participation was the highest in sericulture (1:1.86) when compared to other competitive crops viz., paddy, sugarcane and turmeric (Lakshmanan and Geetha Devi, 2007a).

The data on female and male labour ratio showed that the ratio was 2.25 for leaf production and 1.90 for silkworm rearing (Lakshmanan and Geetha Devi, 2007b).