n accordance with the objectives of the study, the data collected were analysed and the results derived are discussed in this chapter under the following headings.

5.1. Socio-economic profile of the sample respondents

5.2. Knowledge and adoption of improved sericulture technologies

5.3. Reasons for non adoption of improved sericulture technologies

5.4. Association between socio economic characters and the adoption/knowledge level of farmers

5.5. Economic analysis of cost of mulberry leaf and cocoon production

5.6. Employment generation in various operations of sericulture

5.1 Socio-economic profile of the sample respondents

Age: Erode district is a traditional sericulture district in Tamil Nadu and sericulture is being practiced since so many decades. Hence, all the sample respondents belonged to middle age group. The average age of both adopters and non adopters was around 47 years. Meenal and Rajan (2007) had also reported that age did not reveal any significant relation with adoption.

Family size: No difference in family size was noticed among adopters and non adopters and the average family size in the study area was around 4.3 members (Table 4.1.1). Earlier studies by Srinivasa et al. (2004) and Meenal and Rajan (2007) also confirmed that family size did not influence the adoption level.

Total land area: Farmers of adopters category owned more agricultural land (4.40 ac) than non adopters (3.07 ac). The total land holding was linearly related to the holding size groups indicating that more large scale farmers are taking up sericulture because of its added advantages. Similar observations were made by Behera (2004) and Lakshmanan & Geetha Devi (2007c).
**Mulberry area:** Similar trend like total land area was noticed for mulberry acreage too. Adopters had more of mulberry area (2.20 ac) than non adopters (1.55 ac). Munikrishnappa *et al.* (2002) and Srinivasa *et al.* (2004) had also reported that mulberry area significantly influenced the adoption level.

**Education:** Education is one of the prime factors that influenced adoption. As seen in Table 4.1.2 adopters were more literate than non adopters indicating that education had helped them to acquire knowledge about the new technologies and consequently practice them in the field. Moreover, it was observed that farmers of holding size IV were more educated, this again confirms that more qualified people are venturing in to large scale sericulture because of the economic benefits realized as reported by Dandin and Basavaraja (2005) and Dandin *et al.* (2008). Qadri *et al.* (2005a) also stated that the higher literacy rate found in Erode district had enhanced the adoption of improved technologies.

**Mulberry variety:** Adoption of the improved mulberry variety V1 was found high in adopters compared to non adopters (Table 4.1.3). Lakshmanan and Geetha Devi (2007c) had also observed high adoption of recommended mulberry variety by farmers selected under JICA project. Awareness and exposure to the new technologies and better economic conditions were the reasons for the high adoption noticed in farmers of holding size IV. It was reported by Zeaul Ahsan (1994) and Sujatha *et al.* (2006a) that the tendency to accept any new technology was high in big farmers. Farmers with small land holdings were continuing with the traditional mulberry variety and were not willing to change owing to the financial constraints.

**Plant spacing:** V1 mulberry variety and paired row system of plantation goes hand in hand. Hence, the same trend as seen in adoption of mulberry variety was witnessed for plantation spacing also (Table 4.1.4). The scale of farming and technology adoption were directly related (Raveendr Mattigatti *et al.*, 2002) with majority of the farmers of holding size IV following the recommended paired row system of plantation.

**Rearing house:** Table 4.1.5 clearly shows that 94% of adopters possessed an independent rearing house to conduct silkworm rearing. This is in agreement
with the findings of Mani et al. (2006) and Meenal & Rajan (2006) who had also reported high adoption of separate rearing houses by farmers of Erode district, Tamil Nadu. The reason for all adopters of holding size III and IV to own an independent rearing house is the financial upliftment they achieved by adopting the improved practices. On the contrary most of the non adopters of holding size I were conducting rearing in dwelling cum rearing houses which is attributed to their lack of awareness about the importance of a separate rearing house and the financial constraints.

**Training:** It was clearly evident from the study that more number of adopters had exposure to various training programmes compared to their counterparts (Table 4.1.6) which had helped them in acquiring knowledge about the new technologies and led to adoption. A study by Qadri and Dandin (2006) revealed that training of sericulturists accelerated promotion of bivoltine sericulture in Tamil Nadu. Gregory et al. (1994), Venkatesh Kumar & Ismath Afshan (2006), Srinivasa et al. (2007) and Meenal & Rajan (2007) also found that training undergone by the sericulturists had a positive and significant influence on their knowledge and technology adoption.

**Participation in Extension programmes:** Various extension programmes like field days, group discussions, enlightenment programmes and exhibitions were organized by the sericulture departments to create awareness among the farmers. But the participation level was found high (80%) among adopters which is due to the higher education level and economic conditions of the adopters. Illiteracy and poor economic conditions restrain the non adopters from participating in extension programmes. The findings of Bhargava et al. (2006) also showed a positive relation between extension participation and adoption.

**Contact with extension officials:** Regular contact with the extension officials was found high in adopters indicating the interest they had in adopting the improved technologies. This is supported by Sunil Dutt and Chole (2006) who noticed a positive relationship of extension contact with adoption of sericultural practices in 13 villages of Maharashtra. Sixty one per cent of non
adopters contacted extension staff occasionally which had resulted in poor adoption of improved technologies.

*Participation in mass media programme:* People who are literate and had more exposure to mass media were able to imbibe and implement the latest technologies better than others who are illiterate or neo-literate (Suman Chandra, 1997). This is confirmed in the study, that 24% of the adopters exhibited more than 60% exposure to mass media, whereas it was only 15% in non adopters.

*Social participation:* All the sample farmers owned membership in any of the sericulture quality clubs, self help groups, agriculture co-operative society or local organization and hence less than 50% social participation was recorded. As sericulture is a laborious activity they don’t find time to get involved in many social organizations.

5.2. Knowledge and Adoption of improved sericulture technologies

The development of new technologies does not yield benefits by itself. Mere introduction of any new, viable and competitive technology without a strategy for its effective transfer and participation of primary stake holders coupled with strong motivation to accept the change often ends up in failures. The sustainability of any new technology can be ascertained in the long run only when the farmers adopt the technologies. In recent years efforts were made to popularize bivoltine cocoon production through Japan International Co-operative Agency (JICA) project and Institute Village Linkage Programme (IVLP). As a result many new improved technologies were introduced in the field and demonstrated to selected farmers in a fast pace. However, adoption of technologies occurred at desired pace only in case of some technologies and in some regions. Because adoption has a direct relation with the knowledge/ level of understanding of an individual and knowledge is the prime requisite for adoption process. In order to find out the scale of knowledge and adoption in the study area, the knowledge and adoption indices of improved sericulture technologies were worked out.
5.2.1. Knowledge and adoption indices

Knowledge and adoption indices were calculated separately for mulberry cultivation and silkworm rearing technologies and cumulatively for all improved sericulture technologies. The results are depicted in Fig. 1-6. It is clear from the results that both the knowledge and adoption indices of adopters were comparatively higher than that of non adopters. Adoption of any technology is dependent on the knowledge acquired and hence both are inter related and exhibit a positive relation, *i.e.* the adoption index increases corresponding to the knowledge index. This is supported by Gopala (1991) who reported significant difference in the overall knowledge and adoption between developed and less developed areas of Kolar district. The possible reason for the high knowledge and adoption in adopters may be due to the fact that they are more literate and regularly exposed to various extension programmes and trainings under JICA and IVLP projects.

Another interesting observation made was that the knowledge and adoption indices had a direct and positive relation with the mulberry holding sizes in both adopters and non adopters. The above findings are in conformity with the findings of Shivaraja (1987), Srinivasalu (1991), Chikkanna *et al.* (1995) and Sujatha *et al.* (2006a) who had reported that the adoption level among different categories of farmers was in the order of big farmers>small farmers>marginal farmers. This can be attributed to the better economic conditions and infra structure facilities available coupled with the higher knowledge that had encouraged the big farmers to adopt the new technologies effectively.

It was also observed that the knowledge and adoption indices of silkworm rearing technologies were higher than that of mulberry cultivation technologies in both categories of farmers.

5.2.2. Knowledge and adoption of mulberry cultivation technologies

*Mulberry variety:* The knowledge level of farmers on the recommended mulberry variety was very high in both adopters and non adopters (Fig.7) and only ignorable number of farmers of holding size I had partial knowledge
(Table 4.2.1 & 4.2.2). This was due to the intensive extension programmes conducted in the study area that had created profound awareness among the farmers. The results are in line with the findings of Sreenivasa (1989), Gope (2006) and Meenal & Rajan (2006).

Similarly cent percent adoption of the recommended mulberry variety was noticed in majority of the farmers (Table 4.2.3 & 4.2.4) as already reported by Meenal & Rajan (2006) and Lakshmanan & Geetha Devi (2007c). Partial adoption was observed only in 5% and 9% of the adopters and non adopters respectively. The reason for the partial adoption is the unwillingness of the farmers to remove the existing plantation as they had to wait for another six months to get the leaf yield. This is in conformity with the results of Gregory et al. (1994).

*Plant spacing*: The same trend as seen in mulberry variety was witnessed for plant spacing also. Similar results were reported by Meenal & Rajan (2006). Partial adoption was found high in non adopters because of lack of awareness about the importance of paired row system of plantation. Farmers of HS III and IV had adopted wider spacing for their new plantation but continued their existing mulberry garden with closer spacing and hence partial adoption was found high in these farm sizes.

*Application of Farm Yard Manure (FYM)*: Knowledge and adoption of FYM application was high in adopters compared to non adopters (Table 4.2.1 - 4.2.4). Partial adoption was found high in non adopters’ category and the level of knowledge and adoption was directly related to the farm size. The same kind of observations were made by Sreenivasa et al. (2005), Mani et al. (2006) and Mallikarjuna et al. (2006). Most of the adopters possessed cattle and were aware about the composting method using sericultural wastes which had led to high adoption. Lack of knowledge and possession of few cattle compelled the non adopters to purchase FYM from market. Since the cost of FYM is high, the poor economic status of the farmers made them adopt the technology partially. The findings are in agreement with that of Lakshmanan et al. (1998a).
Application of chemical fertilizer: Though 95% of the adopters had full knowledge about chemical fertilizers only 81% had adopted it fully. Similarly, 83% of non adopters had full knowledge but only 29% had applied the recommended dose of fertilizer fully. Most of the farmers had applied partial dose of NPK fertilizers. This indicates that though awareness was created through effective extension measures, the high cost and non availability of fertilizers in time had prevented the farmers from adopting the technology. Partial application of fertilizers were earlier reported by Dolli et al. (1993) and Singhvi et al. (1994) in Mysore, Venkatesh kumar et al. (1999) in Bangalore, Lakshmanan et al. (1998a) in Tamil Nadu. Kumaresan et al. (2002) had reported symbolic adoption of chemical fertilizers. Non availability of fertilizers in time was stated as the main cause by Shreedhara (1997), whereas Dandin et al. (2004) and Sujatha et al. (2006a) attributed the partial or no adoption of recommended dose of fertilizers to its high cost.

Application of bio fertilizer: Knowledge and adoption of bio fertilizer was found to be very poor in the study area (Fig. 7 & 8) and majority of the farmers had no knowledge. Mallikarjuna et al. (2006) had also reported no/ partial knowledge for application of bio fertilizers. The reason for this may be lack of proper guidance, cost, non availability and hesitation to adopt. This is in conformity with the results of Madhu Prasad et al. (2005) and Deepa & Sujathamma (2007). Alagesan (1999) reported that the knowledge on bio fertilizer depends on education, socio economic status, social participation and mass media exposure. The farmers opined that, the bio fertilizers azotobacter and seriphos which are recommended exclusively for mulberry garden are not easily available in Tamil Nadu and when they get it from Karnataka the cost is almost doubled.

Spraying of seriboost: Most of the non adopters were not aware about seriboost and hence the practice was not adopted. The adoption level of adopters was comparatively less than their knowledge level. Application of seriboost is recommended in case of micro nutrient deficiency and hence this technology is adopted as and when symptoms are noticed which had reduced the percentage of adoption. Further, non availability, high cost and complicated application procedure were cited as reasons for non adoption in
the study area. The results are in agreement with the results of Meenal and Rajan (2006).

*Drip irrigation*: This technology is either adopted fully or not at all adopted. Lack of awareness about the advantages of drip irrigation had resulted in 69% of non adopters with no knowledge. The total cost of installing drip irrigation for one acre of mulberry is worked out to Rs.20,000.00. DOS, Tamil Nadu provides 50% subsidy per acre of mulberry garden. Many of the non adopters owned less than an acre and were not eligible to obtain subsidy, which might be a reason for non adoption.

*IPM of Tukra*: Tukra is caused by mealy bugs and integrated pest management measures (IPM) comprising of mechanical, chemical and biological methods are recommended to control the disease. Knowledge about the bio control agent, *Cryptolaemus montrouzieri* or *Schymnus coccivora* to control mealy bug was very poor in both adopters and non adopters owing to lack of information and technical guidance. Majority of the non adopters were not practicing any plant protection measures and the possible reasons are lack of knowledge, high cost of pesticides and fear of toxicity to silkworms. This is in agreement with the studies of Singhvi *et al.* (1994), Nikhade *et al.* (1995), Lakshmanan *et al.* (1998a), Ganapathy *et al.* (1999), Shivalingaiah *et al.* (1999) and Dandin *et al.* (2004). The better economic conditions, literacy and more exposure had made the adopters in general and big farmers in particular to practice physical and chemical methods of pest control. But, non availability of the beetles locally was found to be the major cause for non adoption of biological control. This is supported by Govindaiah *et al.* (1996) and Sujatha & Sujathamma (2005).

*5.2.3. Knowledge and adoption of silkworm rearing technologies*

*Separate rearing house*: Knowledge and adoption level of adopters was very high due to the awareness created through JICA projects and the 50% CDP assistance provided by Central Silk Board and DOS, Tamil Nadu for construction of rearing houses. Similar results were earlier reported by Sariful Islam (2004), Jaiswal & Kumar (2005), Mani *et al.* (2006) and Lakshmanan & Geetha Devi (2007c). Financial and resource constraints faced by the non
adopters to construct separate rearing house and non availability of land in small farmers were cited as constraints. This is in line with the results of Hiriyanna et al. (2002a) and Munikrishnappa et al. (2002).

*Silkworm race:* Among the adopters 98% of full knowledge and 86% of full adoption was noticed (Fig. 9 & 10 and Tables 4.2.5 – 4.2.8). Because they were convinced by the high cocoon yield, silk quality, productivity and returns realized from rearing of bivoltine hybrids. This is in conformity with the findings of Kumaresan et al. (2002) in a feedback study of PPPBST project of JICA. Rajeev et al. (2007) also reported high level of perception regarding the performance of CSR hybrids by farmers of Kolar district, Karnataka. The partial adoption noticed in adopters may be due to the reason that few farmers were conducting cross breed rearing during summer, fearing disease incidence and crop loss in bivoltine hybrids when the temperature go high. Further, fluctuations in cocoon price also influenced bivoltine rearing.

Separate rearing house and more bed spacing is one of the important pre requisite for bivoltine hybrid rearing. The non adopters with less land holding and with out separate rearing space rear other breeds with the minimum facilities available with them. This is reflected as more of partial adoption in holding size I.

*Disinfection:* Both adopters and non adopters showed high perception about disinfection. This is due to the intensive demonstrations carried out under JICA and IVLP projects in the study area (Dandin et al., 2004). Sujatha et al. (2006a) and Deepa & Sujathamma (2007) also reported high adoption of disinfection measures in Andhra Pradesh. In the present study, full adoption of the technology was found comparatively high in adopters as they had understood the impact of disinfection on the success of the cocoon crop and on the economic returns. Since many of the non adopters of holding size I were doing rearing in dwelling houses, perfect disinfection was not possible which had resulted in partial adoption.

*Maintenance of hygiene:* Variation in the knowledge and adoption level of adopters and non adopters was noticed. The farmers who rear CSR hybrids had more knowledge about maintaining hygiene in and around the rearing
Possessing a separate rearing house also enabled them to follow hygienic measures strictly. Whereas, lack of knowledge and rearing in dwelling cum rearing houses made the non adopters to adopt the measures partially. The similar kind of observation was reported by Meenal and Rajan (2006).

**Incubation:** Interestingly the knowledge and adoption level of incubation vary among the adopters and non adopters. Though 91% and 74% of full knowledge about the technology was observed, full adoption was reported only in 23% and 1% of adopters and non adopters respectively. This is because majority of the farmers in the study area were buying chawki reared worms from the near by chawki rearing centres (CRC) and they had no opportunity to practice incubation. In Erode district alone, 14 CRCs are functioning and the farmers are convinced of the advantages of buying chawki worms. This is in agreement with the results of a study made by Meenal and Rajan (2006) in Sathyamangalam area of Erode district. Few large scale farmers who owned separate rearing room, equipments and man power to carry out chawki rearing were handling eggs directly and practiced recommended incubation methods.

**Black boxing:** Similar results as observed for incubation was reported for black boxing also. Since black boxing is practiced only when incubation is done, non adoption of this practice was reported high.

**Shoot rearing:** All adopters surveyed exhibited cent percent knowledge of the technology and adopted it fully. High adoption of shoot rearing technology was also reported by Mani *et al.* (2006) in Tamil Nadu and Madhu Prasad (2006) in Karnataka. Lakshmanan and Geetha Devi (2007c) linked the knowledge gained through JICA projects for high adoption of shoot rearing. Qadri *et al.* (2002) found that the sericulturists prefer shoot feeding method for rearing, owing to its advantages over the traditional method of leaf feeding. Partial knowledge and adoption was noticed in non adopters with less land holding (HS I). The reasons cited were lack of infra structure facilities and poor economic status.
**Bed spacing:** As discussed earlier, the adopters had acquired full knowledge about the requirements of bivoltine breeds like providing more food and bed area and as a result the technology was adopted fully by 94% of the farmers. This is in agreement with the findings of Sujatha *et al.* (2006a). Partial adoption observed in non adopters was due to lack of awareness.

**Bed cleaning:** Though all adopters had awareness about bed cleaning, 9% of them did not practice it as it is a laborious activity. Instead they extended the beds gradually and applied lime powder to hasten drying of unused leaves. Philip and Qadri (2004) stated that expensive and cumbersome technologies were not adopted by the sericulturists. Among the non adopters only 47% practiced bed cleaning and the rest showed partial or non adoption. Lack of knowledge, non availability of man power and negligence were quoted as reasons.

**Use of bed disinfectants:** Knowledge about dusting vijetha, ankush or related bed disinfectants was high in adopters compared to non adopters. This is supported by Narayana Swamy *et al.* (2000), Jaiswal & Kumar (2005) and Madhu Prasad (2006). With respect to adoption of the technology 25% of the adopters practiced it partially as against 55% in non adopters indicating that vijetha was dusted only when disease symptoms were noticed. This kind of symbolic adoption of bed disinfectants was reported by Kumaresan *et al.* (2002). Fifty percent subsidy in the cost of disinfectants provided by DOS, Tamil Nadu, had encouraged the adopters to follow the practice. Sreenivas *et al.* (2005) 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. High costs, pungent smell of vijetha, availability of duplicate disinfectants in the market with synonymous names were observed as constraints in the study area.

**Mountages:** Rotary mountages were popularized through effective extension programmes under JICA and were supplied free of cost to selected farmers in the study area. Further, 50% subsidy was also provided under CDP for purchase of rotary mountages for bivoltine rearers, hence high adoption was reported. Sariful Islam (2004) found that JICA farmers had sufficient
knowledge on the new technologies. Partial knowledge noticed in holding size of non adopters might be due to less extension contact and less exposure to mass media and hence the technology was partially adopted. Non availability (Doddagadad, 1996), lack of awareness (Dandin et al., 2004), requirement of separate mounting hall (Rajeev, 2004), high cost (Mani et al., 2006) and strong belief to the traditional practice of using bamboo chandrike (Mallikarjuna et al., 2006) were cited as constraints in adoption of new mountages.

Mounting method: All 200 farmers surveyed displayed cent percent knowledge and adoption about the method of mounting. This was due to the effective dissemination of the technology. All the farmers either picked up the matured worms or adopted self mounting method as they were aware that the cocoon price depends on its quality. Meenal & Rajan (2006) and Deepa & Sujathamma (2007) had also reported high adoption of mounting method by farmers of Tamil Nadu and Andhra Pradesh respectively.

IPM of Uzi fly: Uzi fly is a serious pest of silkworm and the integrated control measures include mechanical (use of nylon net), chemical (use of uzi trap tablets) and biological (use of a bio control agent) is recommended to control its menace. Of all the 13 silkworm rearing technologies studied, interestingly no knowledge was reported only for this technology. Awareness about the use of bio control agent, Nesolynx thymus was very poor in both adopters and non adopters. Invariably all farmers were using nylon net enclosures to prevent the entry of uzi fly. Regarding the use of uzi trap tablets, farmers were not sure about the concentration of the solution and the placement of the trap. On the whole, majority of the farmers were adopting any one of the control measures but the integrated package was not adopted. Similar observations were made by Mani et al. (2006) and Meenal & Rajan (2006). The possible reasons attributed were lack of awareness and non availability of the bio control agent. This is in conformity with the findings of Singhvi et al. (1994) and Mohandas et al. (1999).
5.3. Reasons for non adoption of improved sericulture technologies

Table 4.3.1 highlights the reasons expressed by farmers of the study area for non adoption of improved mulberry cultivation practices. High cost of inputs like fertilizers, bio fertilizers, seric boom, pesticides and drip irrigation units were cited as the main reason for non adoption of recommended mulberry cultivation technologies by adopters. This is in agreement with the observations made by Singhvi et al. (1994), Dandin et al. (2004), Mani et al. (2006), Sujatha et al. (2006b) and Deepa & Sujathamma (2007). Non adopters perceived lack of awareness about the new technologies as the major constraint in adoption. The studies of Lakshmanan et al. (1998a), Saratchandra (2000), Kanmizho (2001), Jaiswal & Kumar (2005) and Anandakumar et al. (2006) supported the results of the present study. Non availability of inputs occupied the third place in both adopters and non adopters. Similar results were earlier reported by Govindaiah et al. (1996), Shreedhara (1997), Munikrishnappa et al. (2002), Srinivasa et al. (2003) and Madhu Prasad et al. (2005). Lack of proper technical guidance was cited as the fourth constraint which is in agreement with the studies of Kanmizho (2001), Sujatha et al. (2006a &b) and Meenal & Rajan (2006).

The constraints that come in the way of adopting improved silkworm rearing technologies are presented in Table 4.3.2. Though the priority of the constraints vary among the adopters and non adopters, the major reasons as perceived by the farmers are discussed. Lack of finance and credit facilities were reported as the major constraint by adopters. Though many studies support this fact, the recent ones that are in conformity with the findings are Mallikarjuna et al. (2001), Hiriyanha et al. (2002a), Rajeev, (2004) and Deepa et al. (2005). Fluctuations in cocoon price discourage farmers in practicing sericulture and they need a minimum support price, this is supported by Zeaul Ahsan (1994), Hiriyanha et al. (2002a) and Lakshmanan & Mallikarjuna (2006). The strong belief in traditional practices made the farmers unwilling to accept the change in technologies, specially with respect to improved hybrids and new mountages as observed by Lakshmanan et al. (1998a), Jaiswal & Kumar (2005) Mallikarjuna et al. (2006) and Meenal & Rajan (2006). As discussed earlier, lack of awareness, high cost and non availability of inputs
were observed as the other constraints. Lack of separate rearing house to carry out silkworm rearing was quoted as a constraint by few farmers of the study area. This is in agreement with the observations of Chikkanna et al. (1995), Doddagadad (1996) and Munikrishnappa et al. (2002).

5.4. Association between socio economic characters and the adoption/knowledge level of farmers

5.4.1. Correlation of socio economic characters of farmers with knowledge index of improved sericulture technologies

It is evident from Table 4.4.1 that the knowledge index of adopters had a positive significant correlation with their age, extension participation, extension contact and cocoon prices. This is in conformity with the findings of Sreenivasa (1989) and Munikrishnappa et al. (2002) who had reported a significant correlation between knowledge and extension participation/extension contact. Sericulture is practiced to get higher income, so naturally when the price fetched per kg of cocoons is more it acts as a driving force to learn more about the technologies. Lakshmanan and Geetha Devi (2006) had reported that cocoon price was the major determinant among farmers of Mandya district. Significant correlation noticed in holding size IV with many socio economic variables is due to the fact that large scale farmers have better resources, risk bearing capacity and desire for higher investments. This had forced them to acquire more knowledge about the recent technologies through extension programmes and contacts. Hence, none of the variables exhibited negative correlation in HS IV. Similar observation was also made by Jagadisha (1999).

Though formal education had no influence on the knowledge level of adopters, it was found to be positive, whereas it had a significant influence on the knowledge of non adopters. This indicated that higher literacy rate enabled the farmers to acquire more knowledge. This is supported by Qadri et al. (2005a) who stated that the higher literacy rate found in Erode district had enhanced the knowledge and adoption of improved technologies. Age exhibited a significant association with the knowledge of adopters, but in non adopters it was not significant and showed a negative correlation in holding
sizes II, III and IV. Sericulture is an inherited occupation among adopters and the long experience gained over decades might have helped them to acquire more knowledge when compared to their new counterparts. Similar observations were reported by Srinivasa et al. (1996a) and Lakshmanan & Geetha Devi (2007c).

Irrespective of the holding sizes, size of the family revealed a negative correlation in non adopters and positive but non significant correlation in adopters. This is because all the farmers surveyed had nuclear families and the average family size was around 4.3 members. Earlier studies by Srinivasa et al. (2004) and Meenal and Rajan (2007) also confirmed that family size did not influence the knowledge level. Except age and family size all the other variables studied were significantly related to the knowledge level of non adopters in general and farmers of holding size I in particular (Table 4.4.2). This indicates that more new farmers are taking up sericulture on an experimental basis with small area and they exhibit keen interest to collect information about the technologies. Knowledge gained leads to effective adoption and once they get good price for their cocoons they show more interest to brush more dfis and extend sericulture.

5.4.2. Correlation of socio economic characters of farmers with adoption index of improved sericulture technologies

The data can be referred from Table 4.4.3 & 4.4.4. A perusal of the data revealed that all the socio economic variables studied showed a positive correlation with the adoption index of adopters. However, total land holding and extension contact proved to be significant. This is in accordance with the studies of Geetha et al. (2001), Rajeev (2004) and Sujatha et al. (2006a&b) who had also concluded that most of the socio economic variables significantly influenced the technology adoption. Sericulturists with regular extension contact gather more information on new technologies and consequently adopt them practically. The similar kind of observations was made by Madhu Prasad (2002) and Bhargava et al. (2006). Many variables in holding size IV showed significant association with their adoption level confirming that the better resources, potentiality, desire and knowledge
possessed by large scale farmers made them to accept the new technologies readily. Chikkanna *et al.* (1995) also found a significant association with total land holding and adoption in big farmers of Kolar district whereas the relation was not significant in medium and small farmers. As stated by Lakshmanan and Geetha Devi (2006a), the higher price fetched for cocoons boosted the farmers to adopt the new technologies with more confidence.

Among the non adopters, except family size all the socio economic variables studied, exhibited a positive association with the adoption index of pooled farmers in general and farmers of HS I in particular. As discussed earlier, the interest showed by new farmers enabled them to acquire more knowledge and helped them to adopt the new technologies.

5.4.3. Correlation of socio economic characters of farmers with cocoon yield per acre per year

The ultimate goal of technology adoption is to maximize cocoon production. The cocoon yield realized per unit area is influenced by many factors. Table 4.4.5 reveals that the socio economic conditions of the farmers influence not only the knowledge and adoption level but also the cocoon productivity. Irrespective of the holding size a significant correlation between cocoon yield and variables like mulberry acreage, dfls brushed, price of cocoons and income realized per acre was observed in adopters. This is just because of the linear and positive link among them. The number of dfls brushed is decided based on the leaf yield available which in turn depends on the mulberry acreage and the adoption of improved technologies. Farmers adopting the recommended package of practices got more leaf yield and hence the brushing capacity was also high. The cocoon harvested was directly related to the number of dfls brushed and so the farmers brushing more dfls obtained more cocoon yield. The high productivity encouraged the farmers to invest more in sericulture leading to high adoption of technologies. These findings are in accordance with the findings of Zeaul Ahsan (1994), Narayanaswamy *et al.* (2000), Geetha *et al.* (2001) and Srinivasa *et al.* (2004) who also reported that the cocoon yield per unit area was related to the mulberry acreage. Geetha Devi *et al.* (2006a) and Lakshmanan & Geetha
Devi (2007 c) had found that implementation of IVLP and JICA projects had resulted in a quantum jump in adoption of new technologies and in turn increased the cocoon productivity.

It was observed in the present study that age was negatively related to cocoon yield in all holding sizes indicating that age alone can not influence productivity; it is the knowledge and adoption of new technologies which is important. Srinivasa et al. (2004) also found that age had a negative relation with cocoon yield in Mandya district.

Highly significant relation between dfls brushed, income realized per acre and cocoon yield in all holding sizes of non adopters was witnessed (Table 4.4.6). Mulberry area, extension and mass media participation also had a positive significant association in pooled farms. Brushing capacity, cocoon yield and income earned are interrelated, which was influenced by technology adoption. Adoption of technology needs basic knowledge which was acquired through participation in various extension programmes. Hence, extension and mass media participation revealed a positive significant association with the cocoon yield. Sreenivasa (1989) and Munikrishnappa et al. (2002) had also reported a significant correlation between knowledge and extension participation.

5.4.4. Correlation of socio economic characters of farmers with income per acre per year

Sericulture provides year round income and hence the association between the different socio economic variables with income was studied. Similar trend of correlation as seen in cocoon yield was noticed for income realized per acre per year also as the income depends directly on the cocoon yield. Income realized per annum from an acre of mulberry garden had a highly significant relation with mulberry acreage, social participation, dfls brushed per acre, cocoon price and yield realized per acre (Table 4.4.7). Based on a study in Thailand, Viratpong (1990) opined that because of the rapid diffusion of technologies, expansion of mulberry area and high income were achieved. According to Shreedhara (1997) and Geetha et al. (2001) mass media participation, social participation and net income were
significantly related. Srinivasa et al. (2004) stated that size of land holding and income were interdependent.

Among non adopters, all variables except education and family size were significantly associated with the net income, but age was negatively related (Table 4.4.8). In all holding sizes, positive and significant relationship was noticed for dfis brushed, yield obtained/acre/year and the price of cocoons. The inter dependency of these production variables were already discussed. The positive relation between cocoon price and income is in conformity with the findings of Lakshmanan and Geetha Devi (2006). The findings of Geetha et al. (2001) are in contrary where an inverse relation between income and rate of adoption was reported.

5.4.5. Regression analysis of factors influencing the knowledge index of farmers

The extent of adoption of new technologies was influenced by a number of factors among which, knowledge level was the foremost. The socio economic status of the sericulturists determined their knowledge level and hence a simple linear regression analysis of factors influencing knowledge was performed. As shown in Table 4.4.9, age, education and mass media participation had a highly significant influence on the knowledge level of adopters of holding size IV. This is supported by Srinivasa et al. (2004), Vijayakumari & Rajan (2006) and Meenal & Rajan (2007). In the study area, it was noticed that farmers of holding size IV were more educated and had exposure to print media more frequently. So they developed a favorable attitude towards change and gained knowledge on latest technologies. Suman Chandra (1997) also reported that as education level increased, the knowledge on pests and diseases also increased correspondingly.

Total land area, social participation, dfis brushed/acre and price of cocoons also significantly influenced the knowledge level of farmers belonging to holding size III. Education plays a key role in transforming the socio economic status of an individual. Educated farmers hold membership in social organizations which provided them opportunities to express and exchange their views and enrich their knowledge. As discussed earlier the price per kg
of cocoons is a sensitive variable and it determines the net profit a farmer could get by practicing sericulture. When the profit was more, it encouraged the sericulturist to continue sericulture and brush more number of dfls.

Knowledge level of non adopters (pooled farmers) was not significantly influenced by the variables studied (Table 4.4.10) but they expressed a positive coefficient except for age and family size. However, in holding size III extension contact had influenced the knowledge level of the farmers significantly. This indicated that though they were more illiterate compared to adopters, regular contact with extension officers and progressive farmers influenced their knowledge level.

5.4.6. Regression analysis of factors influencing the adoption index of farmers

The total land holding, extension, social participation, dfls brushed/acre and price of cocoons/kg had influenced the adoption of technologies significantly (Table 4.4.11). This is in line with the findings of Geetha et al. (2001), Rajeev (2004) and Sujatha et al. (2006a&b). Farmers with regular extension and social participation acquired more information on new technologies and adopted them sincerely. This is in accordance with the observations made by Madhu Prasad (2002) and Bhargava et al. (2006). The significant influence of adoption by total land holding and cocoon price is supported by Chikkanna et al. (1995) and Lakshmanan and Geetha Devi (2006) respectively. Farmers with more land holding cultivated mulberry in more area and reared more number of dfls. To obtain a successful cocoon crop they adopted the recommended technologies sincerely. Hence, it can be inferred that with the increase in the prices of cocoon, the interest of the farmers to adopt the new technologies also increased.

Dfls brushed per acre in case of non adopters of HS III influenced their adoption level negatively indicating that they were brushing excess number of dfls than their brushing capacity. Hence, it is necessary to educate them to estimate the brushing capacity based on the leaf yield to avoid crop failures.
5.5. Economic analysis of costs and returns from sericulture

In order to compare the relative profitability of sericulture in different holding sizes, comparison of costs and returns from sericulture was worked out and the results are discussed below.

5.5.1. Cost of establishment of mulberry garden per acre per year

An examination of Tables 4.5.1 and 4.5.2 clearly revealed that the cost of establishment of one acre of mulberry garden was high in adopters compared to non adopters indicating that the recommended technologies were adopted perfectly by the former. This is in accordance with the studies of Behera (2004), Lakshmanan & Geetha Devi (2005a), Kumaresan et al. (2006) and Hiriyanna et al. (2007) who reported that the cost of establishment was higher in CSR hybrid rearers than cross breed rearers. It was interesting to observe that the holding size and the establishment cost exhibited a direct relationship in non adopters and an inverse relationship in adopters. In adopters, the cost of establishment of mulberry garden was Rs. 16025.89 in HS I and it decreased to Rs. 14780.01 in HS IV. This is because of the operation of economics of scale in large farms. They used the inputs and labour rationally as most of the activities were carried out by hired labour. Small farmers used excess of inputs and labour as all the available family labour were engaged. Similar kind of observations were made by Marihonnaiah (1987), Neelakanta Sastry et al. (1987), Jagannathan (1995), Lakshmanan (1995), Lakshmanan et al. (1997a) and Dandin & Kumaresan (2003).

In non adopters, the cost of establishment was Rs. 12536.21 in HS I and it increased to Rs. 15219.85 in HS IV. This is because the farmers having less than an acre of garden were not aware of the improved technologies and the recommended dosage of inputs and cultural operations were not followed strictly. This in turn had reduced the input and labour cost drastically.

Among the different cost components, irrespective of the holding sizes, major cost was incurred on farm yard manure followed by human labour in both adopters and non adopters. This is supported by Lakshmanan et al.
(1997a) and Lakshmanan & Geetha Devi (2005a). The cost incurred on machine power increased with the farm size whereas the cost of bullock power decreased in adopters. The reason may be that the large scale farmers engaged tractors, tillers and rotovators for land preparation to save time. The marginal and small farmers mostly depend on bullock power as the hiring charge of tractors was high. No such specific relation was noticed in non adopters.

The annual share of establishment cost (fixed cost) was apportioned based on the economic life span of the garden. As this cost depends on the total establishment cost, the similar trend was noticed.

5.5.2. Cost of mulberry leaf production per acre per year

The operational cost and fixed cost incurred in mulberry leaf production are presented in Table 4.5.3 & 4.5.4. The cost of leaf production was high in adopters compared to non adopters as observed in establishment cost. The results of Shah (1996), Behera (2004), Lakshmanan & Geetha Devi (2005a), Kumaresan et al. (2006) and Hiriyanna et al. (2007) are in agreement with the present findings. Holding size wise analysis revealed the same trend as observed in establishment cost. In adopters, the cost of mulberry leaf production was in descending order with the holding size. This again is justified by the operation of economics of scale relatively in large farms as reported by Marihonnaiah (1987), Neelakanta Sastry et al. (1987), Jagannathan (1995), Lakshmanan (1995), Lakshmanan et al. (1997a) and Dandin & Kumaresan (2003). As the farm size increases, resource utilization and labour efficiency increases resulting in reduced cost of production. The relationship between the holding sizes and the cost of leaf production was in ascending order in non adopters. As discussed earlier, the possible reasons may be lack of awareness and non adoption of recommended technologies.

Labour is utilized in all activities viz., weeding, ridge making, FYM and fertilizer application, irrigation, shoot harvesting and pruning. Hence, a major share of leaf production cost was spent on labour wages in all farm sizes and in both categories of farmers. This is in conformity with the results of Lakshmanan et al. (1997a&c), Kumaresan & Vijaya Prakash (2001),
Lakshmanan & Geetha Devi (2005a) and Balasaraswathi et al. (2006). The labour cost was followed by the cost of fertilizer, farm yard manure, interest on working capital, irrigation, bullock power and land tax in order.

5.5.3. Cost of mulberry leaf per kilogram

The cost of one kg of mulberry leaf was determined by the total leaf yield and cost of leaf production per acre per year. The cost of leaf production was already discussed. Perusal of Tables 4.5.5 and 4.5.6 clearly showed that the cost of one kg of mulberry leaf was less in adopters (Rs.1.91) than non adopters (Rs.1.94). This was due to the quantum jump achieved in leaf yield due to the adoption of improved mulberry variety coupled with improved mulberry cultivation technologies by adopters. Shah (1996) conducted a study in Jammu & Kashmir and reported that due to effective management, the leaf produced was 1.76 times higher in progressive farmers than non progressive farmers, thus reducing the cost of leaf/kg. The leaf yield recorded in the current study was 18634.17 kg in adopters as against 16078.69 kg in non adopters. It was also observed that the leaf yield was directly related to the farm size in both categories of farmers. Because, the high knowledge and adoption of technologies found in big farmers had helped them to obtain more leaf yield. The cost per kg of mulberry leaf exhibited an inverse relation with the holding size as depicted in Fig.11&12 because it depends up on the productivity and production cost. The cost of leaf/kg was Rs. 2.08 in HS I and it decreased to Rs.1.75 in HS IV in adopters. Similarly in non adopters, the per kg leaf cost was Rs.1.98 in HS I and Rs.1.92 in HS IV. The reduction in leaf cost with the increasing farm size was earlier reported by Lakshmanan (1995) in Tamil Nadu.

A gradual increase in the leaf cost over the years was also observed. Similar studies conducted earlier revealed that the cost of leaf/kg was Rs. 0.33 (Chandra Reddy, 1987), Rs. 0.85 (Doreen Rose, 1992), Rs.1.33 (Chandrappa et al. (2000), Rs.1.38 (Dandin & Kumaresan, 2003) and Rs. 1.51 (Lakshmanan & Geetha Devi, 2005a). In the present study the cost of leaf per kg is Rs.1.91, this clearly shows the escalation in the prices of inputs and labour wages over the years.
5.5.4. Cost of cocoon production per acre per year

*Fixed cost:* Unlike mulberry leaf production, cocoon production requires many basic facilities like rearing house, rearing equipments, mountages *etc.*, and hence the depreciation cost of these form a major cost component. The study revealed that the depreciation value was high in adopters compared to non adopters (Tables 4.5.7 & 4.5.8). This is in accordance with the reports of Lakshmanan & Geetha Devi (2005a) and Kumaresan *et al.* (2006). Balasaraswathi *et al.* (2006) estimated the total non recurring cost in Erode district as Rs.7555.20/ac/yr. The high fixed cost is attributed to the more infra structure facilities like shoot rearing racks, mountages and sprayers *etc.*, owned by adopters. To perform complete disinfection as per the recommendation, closed type of rearing house with plastered walls and cemented flooring is essential and hence the adopters invested more on construction of rearing house. Further, DOS of Tamil Nadu and Central Silk Board provides 50% subsidy under CDP for construction of rearing house, purchase of shoot rack and mountages. Since owning one acre of mulberry garden is a basic criterion for CDP assistance, the non adopters having less than an acre faced financial constraints and continued with the available resources. Further, many non adopters were found to hire mountages and sprayer fearing the high cost of investment and maintenance.

A perusal of the depreciation cost of the different holding sizes revealed that the cost increased with the increase in farm size. As seen earlier, the leaf yield increases with the increase in holding size and as a result the brushing capacity increases. Naturally, this leads to more capital investment in the form of more spacious rearing house, more number of shoot racks and mountages. This kind of positive relation between the farm size and fixed cost was reported by Lakshmanan (1995) and Lakshmanan *et al.* (1997a).

A comparison of the cost of different items revealed that irrespective of the holding sizes, the cost incurred on rearing house was the major investment followed by the cost of mountages and shoot racks in both categories of farmers.
Variable cost: The variable/recurring cost of silkworm rearing is presented in Table 4.5.9 and 4.5.10. The results revealed that the expenditure incurred on recurring materials was higher in adopters (Rs.65033.44) compared to non adopters (Rs.56367.64) exhibiting a similar trend as seen with fixed cost. Lakshmanan and Geetha Devi (2005a) reported that the total variable cost was Rs.45606.87 in bivoltine as against Rs.40697.16 in cross breeds in Mandya district. The variation in the cost was due to the additional inputs like leaf, disinfectants and mountages required by the adopters. It was also noticed that in adopters, the cost of rearing decreased as the holding size increased. This is in conformity with the findings of Neelakanta Sastry et al. (1987), Jagannathan (1995), Lakshmanan et al. (1997a&c) and Dandin & Kumaresan (2003). According to economics of scale, the resource and labour are effectively utilized in large farms compared to small farms. This could be observed from the decreasing cost of leaf and labour in HS IV when compared to HS I. Farmers of HS IV depended on hired labour to handle the large scale rearing and effectively utilized the man power, whereas in HS I, inputs and man power were used in excess.

The magnitude of different cost components associated with cocoon production is shown in Table 4.5.11 and 4.5.12. Of all the costs incurred, cost of mulberry leaf ranked first, followed by human labour in all holding sizes. The number of dfls reared per acre increased corresponding to the increase in mulberry acreage. Since, most of the farmers in the study area purchased chawki worms from CRCs the cost of chawki rearing charges was added to the cost of dfls and the share of this occupied the third position. The amount spent on marketing of cocoons also exhibited a direct relationship with the holding size as the brushing capacity and the cocoon yield realized in large holdings were higher than small holdings.

Total cost (Fixed + Variable cost) of cocoon production: The total cost of cocoon production was also found to be high in adopters than non adopters as it is the summation of fixed and variable cost. The total cost was Rs. 73084.19 and Rs. 63773.69 in adopters and non adopters respectively, which is justified by the additional inputs used by adopters for following the improved bivoltine technologies. Further, it was also found that the adopters brushed
more number of dfls than non adopters and thereby increasing the cost incurred. The cost of cocoon production exhibited a positive and direct relationship with the holding size as shown in Fig.15. This is because of the increased brushing capacity in large farms which had invited more inputs and more labour.

5.5.5. Cost of cocoon production per kg

Table 4.5.13 and 4.5.14 revealed that the average cocoon yield/100 dfls, yield/acre and the price/kg of cocoons were high in adopters than non adopters. The adopters obtained an average yield of 64.99 kg/100 dfls and fetched an average price of Rs.144.50/kg of cocoons as against 61.51 kg/100 dfls and Rs.130.63/kg of cocoons in non adopters. The variation in the yield and cost was attributed to the adoption of improved sericulture technologies by the adopters which had not only improved the quantity but also the quality of the cocoons. This is supported by Hiriyanna et al. (2002a), Lakshmanan & Geetha Devi (2005a), Kumaresan et al. (2006) and Hiriyanna et al. (2007). Based on the production cost and yield realized, the cost of production of one kg of cocoon was worked out. Interestingly it was noticed that the cost of production of one kg of cocoon was high in non adopters (Rs.97.95) than adopters (Rs.87.63). This might be due to the low cocoon yield and price fetched per kg of cocoons in non adopters.

It could also be observed from Fig.13&14 that the cocoon yield increased and the cost of producing one kg of cocoons decreased as the holding size increased in both the categories of farmers. The results are in agreement with the results of Lakshmanan (1995) and Lakshmanan et al. (1997a). This might be due to the high cocoon yield realized and the higher rate obtained per kg of cocoons in holding size IV.

As seen in the cost of leaf/kg, a gradual increase in the cost of production of one kg of cocoons over the years was observed. The economic analyses conducted earlier revealed that the cost of production of one kg of cocoons was Rs. 64.34 (Rajesh, 1995), Rs. 75.23 (Lakshmanan, 1995), Rs.79.46 (Lakshmanan et al., 1997a), Rs.81.68 (Dandin & Kumaresan, 2003). In the present study the cost of cocoon production per kg of cocoons is
Rs.87.63, this clearly explains the escalation in the prices of inputs and labour wages over the years.

5.5.6. Returns from sericulture

From Table 4.5.11 and 4.5.12 it could be witnessed that the gross returns realized per acre per year from sericulture was Rs.124851.84 and Rs.94376.83 in adopters and non adopters respectively. Similarly, the net return realized was Rs.51767.65 in adopters and Rs.30603.14 in non adopters. In spite of the high cost of cocoon production, the adopters were able to realize more returns than non adopters. This is due to the better cocoon yield and better prices fetched by adopters by adopting the improved sericulture technologies. Lakshmanan et al. (2000) compared the cost economics of bivoltine and cross breeds in K.R Nagar taluk of Mysore district and reported that bivoltine farmers earned higher net returns than cross breed rearers owing to the skilled man power and technical guidance received from extension agencies. Lakshmanan and Geetha Devi (2005 a) estimated the net profit realized from bivoltine rearing as Rs.40364.23 as against Rs.25367.69 in cross breed rearing. According to Hiriyanna et al. (2007) the net returns received by CSR farmers (Rs.60655.59) was higher than that of farmers rearing Kolar gold (Rs.45312.33). The studies of Hiriyanna et al. (2002b), Behera (2004) and Kumaresan et al. (2006) are also in agreement with the present study.

Analysis of the returns among the different holding sizes revealed that, the net profit realized exhibited a direct relationship with the farm size in both categories of farmers (Fig.16). This is in line with the findings of Neelakanta Sastry et al. (1987), Lakshmanan et al. (1997a&c) who also reported the operation of scale economics in sericulture.

5.5.7. Cost Benefit ratio

The cost benefit ratio calculated was 1:1.71 in adopters and 1:1.48 in non adopters (Table.4.5.13 & 4.5.14). This again confirms the profit obtained by adopting the improved sericulture technologies. High cost benefit ratio in bivoltine rearers compared to cross breed rearers was earlier reported by
Hiriyanna et al. (2002b, 2007), Kumaresan et al. (2002, 2006), Behera (2004) and Lakshmanan & Geetha Devi (2005a). Lakshmanan et al. (1997a) reported that CB ratio is mainly governed by the price of cocoons and in the absence of a price policy, the benefits fluctuate widely. The cost benefit ratio also showed a direct relationship with the mulberry acreage and it increased with the increase in holding size in both adopters and non adopters.

5.6. Employment generation in sericulture

Sericulture is considered to be one among the agricultural activities that generate better employment opportunities in rural areas. The present study revealed that 542.80 and 483.37 man days were employed in sericulture in adopters and non adopters respectively. Table 4.6.1 and 4.6.2 clearly indicates that adoption of improved technologies had resulted in higher leaf yield and encouraged the farmers to brush more dfils and as a consequence labour involvement was found high in adopters. Prakash Kumar (1986), Shivaraja (1987) and Shah (1996) reported that adoption behaviour of sericulturists influences the employment potential and had a positive and significant relationship. Various research conducted on the employment generated through sericulture concluded with an employment potential of 227 man days (Shah, 1996), 440 man days (Jayaram et al., 1998), 506.20 man days (Lakshmanan et al., 1998b), 515 man days (Pushpa & Netaji, 1999) and 532 man days (Lakshmanan & Geetha Devi, 2007 a), thus indicating an increasing trend.

It was also observed that smaller holdings had generated more employment than large farms. In spite of the higher leaf yield and brushing capacity holding size IV had engaged less human labour in both the categories of farmers. This might be because of the higher productivity and operation of scale economics in large farms. Studies made by Neelakanta Sastry et al. (1987); Lakshmanan et al. (1997d, 1998b) and Jayaram et al. (1998) also indicated that human labour employment decreased with the increase in holding size because of effective utilization of labour in large scale rearing.
5.6.1. Mulberry garden establishment:

An average of 68.32 man days of labour were engaged in establishment of one acre of mulberry garden in adopters and it was 60.43 in non adopters (Table 4.6.3 & 4.6.4). The total labour engaged was high in the former because, they were adopting the recommended technologies strictly. This is in conformity with the findings of Shah (1996) who reported that due to adoption of technologies, the progressive farmers engaged more labour than non progressive farmers. It was also observed that holding size I had utilized more labour than other holding sizes in both adopters and non adopters. This reveals the ready availability of family labour in small holdings and the effective use of hired labour in large holdings. The comparison between size groups in both categories with respect to family labour employed revealed an inverse relationship \textit{i.e} higher magnitude of family labour was engaged in smaller holdings compared to large. In contradiction to this, the hired labour involvement increased directly with the increase in holding size. The results are in agreement with the results of Ganapathy Rao \textit{et al.} (1995); Lakshmanan \textit{et al.} (1997d); Jayaram \textit{et al.} (1998) and Lakshmanan \textit{et al.} (1998b). This is due to the easy availability of family labour in small farms and most of the operations were managed by family labour only.

The male and female labour participation ratio indicated that more female labour was employed compared to male (Fig. 23 & 24). This was due to the less labour wages for female than male. The involvement of male and female labour in any farm activity depends on the nature of the activity. It could be observed from Table 4.6.9 that weeding and fertilizer application was done exclusively by female labour whereas ridge making and irrigation were performed only by male labour. Among the various activities, weeding consumed more labour, followed by irrigation and plantation. Similar trend was noticed in non adopters also (Table 4.6.10).

5.6.2. Mulberry garden maintenance:

It was noticed that 264.58 man days and 228.48 man days of labour were utilized in mulberry cultivation in adopters and non adopters respectively (Table 4.6.5 & 4.6.6). The total labour engaged was high in the former than
that of the latter. Behera (2004) reported that the labour usage in mulberry cultivation was more in CSR hybrid rearers compared to cross breed rearers, owing to the additional inputs required for garden maintenance. Fig.19 clearly shows that more hired labour (65%) was utilized in adopters and more family labour was engaged in non adopters (39%). This is because of the high labour wages existing in the study area.

Another observation made from the current study was that the increase in land holding had an inverse relation with the labour utilization. Holding size I had generated more employment than other holding sizes. Prakash Kumar (1986) studied the labour utilization pattern in Ramanagaram taluk and stated that more than half of the labour used in mulberry cultivation came from hired source. Balasaraswathi et al. (2006) reported high labour wages and shortage of man power in Erode district. To cope up with the labour wages, the labour productivity was high in HS IV revealing greater economics of scale.

The share of family labour involvement was found high in HS I and it was the least in HS IV in both categories of farmers. Whereas the hired labour involvement increased proportionately with the holding size. This is in line with the findings of Prakash Kumar (1986), Ganapathy Rao et al. (1995), Lakshmanan et al. (1997d, 1998b) and Jayaram et al. (1998). Activity wise labour involvement in the pooled group indicated that shoot harvesting had consumed maximum labour followed by weeding in both categories.

An analysis of male and female labour employment showed that involvement of female labour was high in almost all activities except irrigation which was done only by male labour. This is in accordance to the studies of Lakshmi Raju et al. (1996); Saraswathi & Sumangala (2001) and Qadri & Dandin, (2006). Naresh and Narayana Gowda (2000) studied the behaviour of farm women and concluded that women contributed more than 61% of the total work force. Siddagangamma (2006) stated that in sericulture women were relegated to less skilled but laborious activities like weeding.
5.6.3. Cocoon production

Silkworm rearing is an off farm activity that requires 25 to 30 days to complete one rearing. Adopters employed 209.70 man days of labour/ac/yr in cocoon production as against 190.46 man days in non adopters (Table 4.6.7 and 4.6.8). Family labour utilization was comparatively high in non adopters (63%), whereas adopters were dependent on hired labour (52%) as depicted in Fig.21 & 22. This is justified by the additional food and space required while adopting the improved technologies by adopters that had called for additional work force which was met by the hired source. This is in conformity with the studies of Shah (1996) and Behera (2004).

Between holding size groups, smaller holdings had utilized maximum labour than other holding sizes. The higher employment generation in smaller holdings was mainly because of the disguised unemployment where the per capita land availability was very less and most of the small farmers’ main occupation was sericulture. Incase of big farmers the available family labour could not meet the high quantum of operations (both mulberry cultivation and silkworm rearing), they rely on hired labour and they use the work force economically and efficiently to achieve higher output. Analysis of family and hired labour employment revealed that the involvement of family labour decreased and hired labour increased with the increase in holding size. As discussed earlier, the reason for this is attributed to the surplus family labour available in HS I and HS II. This is in agreement with the findings of Prakash Kumar (1986); Ganapathy Rao et al. (1995); Lakshmanan et al. (1997d, 1998b) and Jayaram et al. (1998).

Operation wise analysis proved that maximum man days were used for rearing of silkworms which include feeding of worms, cleaning of beds and care during moulting followed by harvesting of cocoons and mounting of ripened worms (Table.4.6.9). This is supported by the studies of Lakshmanan et al. (1998b) and Lakshmanan & Geetha Devi (2007a). Gender wise comparison showed that the male: female ratio was 1:2.46 in adopters and 1:2.01 in non adopters (Fig.23 & 24). Lakshmanan and Geetha Devi (2007b) had estimated the male:female ratio as 1:1.90 in silkworm rearing.
Irrespective of the holding sizes, more female labour was engaged in almost all activities of silkworm rearing except disinfection and marketing. Disinfection was mainly performed by male and assisted by female labour. Cocoon marketing was totally a men’s domain and no female labour participation was noticed. This is confirmed by the reports of Prakash Kumar (1986), Lakshmi Raju et al. (1996) and Saraswathi & Sumangala (2001). According to Lakshmanan et al. (1998b) activities like feeding worms, bed cleaning, mounting and cocoon harvesting which are unskilled in nature are carried out by female labour. Another reason for the high female labour usage in more laborious activities like mounting and harvesting is the less labour wages for female labour. Lakshmanan and Geetha Devi (2007a) reported that 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 in Tamil Nadu.