CHAPTER 2

REVIEW OF LITERATURE

Review of literature is a document that provides background information on the subject area and details of previous research that is relevant. By undertaking a literature review one can able to summarise critically the current knowledge in the area under investigation, identify any strengths and weaknesses in previous work and thus can identify potential area of research with relevancy. Keeping in view the objective of the present study, attempt was made to review the literature, which had consequential relation to the present study. The review of relevant literature undertaken for the present study is presented under the following sub headings.

2.1 Socio-personal attributes of sericulturist and their relationships with knowledge and adoption of improved technologies

2.2 Knowledge and adoption of improved technologies by the sericulturist

2.3 Traditional knowledge and practices of muga culture

2.4 Impact on yield and economics under improved and traditional practices of sericulture

2.5 Constraints for non-adoption of improved technologies

2.1: Socio-personal attributes of sericulturist and their relationships with knowledge and adoption of improved technologies

Dayananda Patel (l985) indicated that age, education were non-significant relationship with knowledge level of farm men while in case of farm women there was a negative and significant relationship between age and knowledge level of recommended' practices in sericulture in Tumkur district.

Shivaraja (1985a) found that the net income of big farmers was seemed to be positively and significantly associated with knowledge on bivoltine seed cocoon production.

Prakash Kumar (1986a) found that, education, farm size and social participation of the sericulturists had positive and highly significant relationship with their level of adoption of sericulture practices. But, age of the respondents had a non significant relationship with level of adoption of sericulture practices.

According to Siddappaji *et al*. (1986), 59.0 percent of the respondents were literates in Mysore district. Out of these, 3.0, 17.0 and 24.0 percent were graduates, secondary and primary level respectively and the remaining 41.0 percent were illiterates.

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).

Aswathanarayana (1989a) found that there was significant association between age, education, social participation and extension participation of farmers and their knowledge on silkworm rearing practices. There was highly significant association between mass media participation and knowledge of sericultural practices. But, there was no significant association between the size of land holding and the knowledge of improved silkworm rearing practices.

The adoption of new technologies 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).

Sreenivasa (1989a) revealed that age, farm size and family size was found to have no relationship with the knowledge level of sericulturists with regard to silkworm rearing practices. Whereas, education, social participation, and extension participation, mass media participation were found to be having positive and highly significant relationship with the knowledge level of sericulturists about silkworm rearing practices.

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, 1990a).

Gopala (1991a) found that the education level, size of land holding and mass media participation had positive and significant relationship with the adoption of sericulture practices in developed area, while non significant in the less developed areas. While, the age and social participation had similar relationship with the adoption level of sericulture practices in both the developed and less developed area.

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

Prabhakar *et al.* (1992) reported that hardly 10-14% of the sericulturists in Chickballapur district, participated in different social organizations reflecting low education level. The association of age and education with knowledge level was significant.

Anjaneya Gowda (1993) reported that marginal farmers showed better adoption as they had less land area that made to concentrate and involve deeply in the activities.

Geetha (1993) studied the impact of socio-economic factor on adoption of improved sericultural technologies in Hassan district, revealed that age, education, caste, occupation and experience in the field of sericulture influenced the adoption of sericulture technologies significantly.

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

Singhvi *et al.* (1994a) reported that the rate of adoption was significantly associated with sericulturists' education, land holding, mass media participation, extension contact and cosmopoliteness.

Rathala *et al.* (1995) found that there was a direct relationship between the human labour input and size of land under mulberry. They have reported the opinion of the experienced sericulturists to engage the family labour for rearing of silkworms effectively and used the labour rationally. They also opined mulberry land holding size of 1.01 to 1.5 acres as optimum for mulberry sericulture and for silkworm rearing.

Naresh (1996a) analyzed 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 adoption.

Srinivasa *et al.* (1996) reported that caste, education level and size of land under mulberry had significant positive influence with the level of adoption of the improved sericulture practices in traditional sericulture area. On the other hand, the caste and size of land holding had non significant relation with the adoption of sericulture practices in new sericulture areas, while education level had significant and positive relationship.

Shreedhara (1997a) observed that 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 .

Majority of the farmwomen 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 farmwomen 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).

Study conducted in Dharwad district of Kamataka on adoption behavior of sericulturists 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 (Srinivasa *et al.*, 1998a).

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

Borkar *et al.,* (2000) reported that the highly significant association seen between education of the farmers with their knowledge level of biofertilizers. Age, land holding, annual income, socio-economic status, scientific orientation, risk preference, mass media 'exposure, extension contact and cosmopolitness characteristics of the farmers were found significantly associated with knowledge level of bio-fertilizers.

Mahanthesh (2000) reported that age had significant relationship with their knowledge on indigenous sericultural practices among sericulturists.

Data collected from farmers of nontraditional 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 of sericulture technology. But education was not significant (Geetha *et al.,* 2001).

Munikrishnappa *et al.* (2002a) observed that the total land holding and extension participation had a significant association with the knowledge level of small sericulturists but cosmopoliteness was negatively significant. Similarly, age and area under mulberry significantly influenced the adoption level, but cosmopolitans and extension participation was hampering the adoption of improved practices among small farmers. In case of medium farmers, cosmopolitans and extension participation had a high and positive association with the knowledge level, whereas area under mulberry and cosmopoliteness 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.

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

Barah *et al.* (2004a) documented that majority of muga farmers were in between the age group of 31-50 years, which was around 68.7 percent combining 31-40 and 41-50 age group together. He reported that almost 98.0 percent farmers were literate with primary and middle school standard education. He observed that muga culture has been existed in larger size family where members are more than four. It was revealed that only 15.0 percent farmers had more than one-acre muga food plantation. As regard to source of income primary source of income of 80.0 percent farmers were agriculture and sericulture. Experience of muga culture among the respondent's was high having 6-10 years experience among 24 percent farmers and more than 10 years experience among 61 percent farmers. Majority of the respondents had medium level of social participation (68.0%) and low extension contact (37.33%).

Mech *et al.* (2004a) reported that maximum of muga farmers (60.0%) were belonged to age group 30-50 years, while 40% farmers were belonged to below 50 years and nobody was found below 30 years of age. He recorded that 90.0% farmers had formal education of school and college level standard while remaining 10.0 percent were illiterate. Experience possessed 1-10 years by 36.7% farmers and more than 10 years by 63.3% farmers in the field of muga culture.

Independent variables like mass media participation and cosmopoliteness 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, 2004a).

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 while 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.

Chandrashekar *et al* (2005) conducted a study in Belgaum district of Kamataka 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 the sericulturists.

Qadri *et al.* (2005a) investigated the socio-economic profile of sericulturists in Erode, Coimbatore and Dharmapuri districts of Tamil Nadu. The results revealed 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 Coimbatote districts.

Sujatha *et al.* (2006a) reported that education, experience and mass media participation in sericulture had a positive and significant association with the adoption level of sericulturists in Ananthapur district.

Vijaya Kumari and Rajan (2006) revelaed 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 non-significant.

Lakshmanan and Geethadevi (2007a) observed that there was significant relationship between education, family size and total land holding with knowledge level of the farmers about bivoltine and cross breed sericultural technologies.

Data collected from the 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).

According to Srilatha *et al.* (2008) communication plays a vital role to bridge the gap between the technical advancement in the laboratory and the actual practice undertaken in the field of sericulture.

Jayaram and Indumati (2010) revealed the variables such as average of price per kg of cocoons attitude towards new technologies in sericulture, awareness about the technologies and experience in sericulture emerged as the strong determinants for classification between bivoltine silkworm reares and cross breed reares.

Goswami *et al.* (2015a) reported that among the muga farmers, almost 86.36% respondents belong to the male category while only 13.64% are female category. The majority of the rearers (62.73 %) are in the age group above 35 years followed by 25-35 years (34.55 %) and below 25 years (2.73 %). Among the respondent covered under the study, 42.73% of the respondents belong to ST, 22.73% SC and 34.55% belongs to general cast. Most of the respondents (60 %) are under 10th pass, 27.27 % are 10th pass, 7.27 % are illiterate and graduate level rearer are very few (5.45 %). Study also revealed that most of the respondents (70 %) are practicing muga culture as secondary source of income and only 30 % respondent rear muga as primary source of income. The study indicated that 58.18 % of the rearers have their own food plantation within 1- 3 acres area, 23.64 % of respondents have 3- 6 acres and only 7.27 % rearers having above 6 acres of food plantation area and remaining 10.91 % respondents are dependent on Village Grazing Reserves (VGRs) for rearing of silkworm

2.2: Knowledge and adoption of improved technologies by the sericulturist

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. When an individual accepts a new technology or package and practices it, the phenomenon is known as adoption. Although, the literatures on assessment of knowledge and adoption of improved technologies are scanty in muga culture, many workers reported about knowledge and adoption of improved technologies in mulberry sericulture. Some of the literatures available in muga and mulberry sericulture are stated below.

Rajashekaraiah (1979a) reported that 78 per cent of mulberry farmers had medium level knowledge on improved practices, while remaining 22 percent were equally belonged to high and low knowledge categories. He also depicted that size of land holding had significant influence on the overall knowledge of the farmers on sericulture practices.

Thangaraju and John Knight (1980) reported that there was better adoption of all the recommended practices by the trained sericulturists than that of the untrained. More than 90 per cent of the trained sericulturists followed correct spacing for mulberry and used the recommended space for silkworms and the practices like mulberry variety, fertilizer application, disease control measures and bush type pruning.

In Kolar district, 74 per cent respondents were literates, of which 2 per cent were graduates and 48 and 24 per cent had studied up to primary and secondary level only. They obtained cocoon yield of 28, 24 and 27 kg, respectively. Illiterates (26%) obtained an average yield of 27 kg cocoons in mulberry sericulture (Anonymous 1984).

Shivaraja (1985b) indicated that the levels of adoption of recommended practices of bivoltine silkworm rearing by big, small and marginal farmers were promising. All the three categories of farmers had followed the leaf preservation methods and temperature manipulating measures to an appreciable extent. The adoption behavior with reference to practices like spacing, type of leaves to be fed, bed cleanings, mounting density of worms in chandrike, number of feedings per day, time of feeding and the correct day of harvesting of cocoon from chandrike was high in case of big and small farmers when compared to marginal farmers.

Prakash Kumar (1986b) 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.

According to Shivamurthy (1988a), 70 percent of the farmers followed time of picking mulberry leaves, day of brushing, cleaning of the rearing seat, formalin preparation, control of uzi fly and grading of silk cocoons. He also reported that none of the respondents adopted the practices like egg disinfection, black boxing of eggs and proper method of bed cleaning by using cleaning nets.

Siddappaji and Vasundhara (1988) reported that most of the respondents in new sericulture area, grew the improved variety of mulberry *viz.* M_5 under irrigation and reared bivoltine breeds of silkworm *viz.* NB_{18}, NB_7 and NB_4D_2 except in a few pockets adjacent to traditional silk raising districts, where they raised local cultivar *viz.* Mysore local and crossbreeds (multi x bivoltine) of silkworns.

Shivaraja (1988) observed that majority of the 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 behavior 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.

Aswathanarayana (1989b) reported that about 35.83 per cent of farmers belonged to high knowledge category, 29.17 per cent to medium knowledge category and 35 per cent to low knowledge category. Thus, the results indicated that nearly 65 per cent of farmers had medium to high knowledge on silkworm rearing practices. Study revealed that nearly 75 per cent of the farmers in Kolar district belonged to medium and high adoption categories with respect to silkworm breeds, source of layings, chawki rearing practices, separate rearing houses and leaf quality, quantity and preventive measures adopted against pests and diseases, spacing of worms, bed cleaning, care at moulting, disease control, mounting and harvesting practices.

Sreenivasa (1989b) reported that, majority of respondents applied FYM, followed by bed cleaning, disinfection, adequate number of mountages required per 100 DFLs, worms space, control measures against Uzi fly. Only a few respondents adopted use of foam rubber pad, paraffin paper, and control measures against diseases.

Satheesh (1990b) 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 dfls (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.

Gowda *et al.* (1992) revealed that the transfer of improved sericulture technology to the Indian farming community is a basic requirement for rural development. It was found in general that recommended silkworm rearing practices were adopted more by large farmers than small and tenant farmers; that most farmers, irrespective of size, were not applying the recommended dosage of fertilizer to the mulberry crop; that there is a very low knowledge with respect to worm spacing, number of feeds, types of leaves to be fed, etc. This shows that there is a need for intensification of educational extension work.

Raghu Prasad (1992a) 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) revealed that majority of the sericulture farmers had more knowledge with respect to the type of leaf to be fed to chawki worms, number of feeds per day and disinfection procedure.

Dolli *et al.* (1993) reported that majority of the respondents adopted the sericulture practices fully like spacing and bed cleaning, while partially applied FYM and disinfection practices. The practices like chopping method, incubation care, application of fertilizer and mulberry variety were adopted.

Singhvi *et al.* (1994b) reported that 51.7 per cent of the respondents applied recommended dose of FYM and the remaining 48.3 per cent resorted to partial adoption. In the respect of fertilizer application, only 22.4 and 4.1 per cent of big and small farmers respectively resorted to full adoption. They also reported that 1.7 per cent of respondents were having separate rearing houses and followed recommended disinfection measures and the remaining 98.3 per cent reared silkworms in dwelling-cum-rearing houses following improper disinfection measures. The overall adoption of recommended measures of bed cleaning i.e., by using cleaning net was only at 16.7 per cent. They also reported that cent per cent of the respondents used nylon net for uzi fly control and none of them used both nylon net and uzicide against uzi fly.

Siddappaji and Prakash Kumar (1994) indicated that majority sericulturists adopted improved rearing practices like getting worms reared at CRC‘s (90%), giving recommended spacing for different instars (80%), maintaining optimum temperature and humidity measures (80%) followed by use of chemicals for disinfection (63%), adoption of disease and uzi fly control measures (87.50%), optimum density of mounting (80%) and harvesting of cocoons at appropriate time (80%).

Ganapathy Rao *et al.* (l995) found that there was a direct relationship between the labour input and the size of land under mulberry. They also reported the opinion of the experienced sericulturists to engage the family labour for rearing silkworms effectively and used the labour rationally. Land holding size of 1.01 to 1.50 acres was optimum for mulberry sericulture and for silkworm rearing.

Manju (1997) reported that Belgaum district majority of farmers adopted cross-breeds (72.5%), bivoltine (27.5%) followed by use of disease free laying, separate rearing house, disinfection, feeding of silkworms, leaf storage, feeding of chawki worms, shoot feeding method, bed cleaning and disease and pest management.

Srinivasa *et al.* (1998a) reported that small farmers had high adoption index followed by medium and big farmers in non traditional belt of Kamataka.

Krishnamurthy *et al.* (1999) observed that 70 per cent of the sericulturists had medium level of knowledge on recommended sericulture technologies in the traditional area of Gowribidanur and Sidlaghatta taluk of Kolar district in Karnataka.

Jagadisha (1999a) reported that knowledge level of different categories of farmers in K. R. Nagar, Mysore district with regard to disinfection, egg transformation, black boxing, bed cleaning and maintainance of humidity was same.

Krishnamurthy *et al.* (1999) observed that 70 percent 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.

According to Munikrishnappa *et al.* (1999) there is a wide gap in the knowledge and adoption of improved silkworm rearing practices. The small farmers were found to adopt the technologies better than the medium and large farmers in the study area. It was seen from the results that the farmers in general were found to have better knowledge and adopt the low cost technologies compared to high cost technologies. It could also observed that, small farmers were reluctant to adopt the technologies like bed disinfection and the large farmers were not adopting the technologies like, black boxing and bed disinfection. The major constraints in the study area were fluctuation in cocoon prices, lack of finance and poor knowledge level

The studies on adoption of improved sericulture practices by different categories of farmers in Hoskote taluk of Bangalore district found that most of the farmers preferred government grainages for procuring eggs and their own chawki. The other recommended practices *viz.* maintenance of temperature and humidity, mulberry leaf storage methods and use of round bamboo trays for silkworm rearing have been practiced by most of the farmers as per the recommended package. As regards to black boxing of eggs, hardly 15 to 25 per cent of the farmers follow it irrespective of their size. The new technology of platform rearing with whole shoots has not been followed by any farmers in the study area. Most of the farmers have used the recommended chemicals for control of diseases. The predominant silkworm diseases found were Muscardine (30%) and Sappe (30%). The average cocoon yield of 56 kg/100 DFLs was recorded, wherein large farmers have a slight edge (58 kg) compared to the marginal farmers (50 kg). Correlation studies revealed that the cocoon yield per unit area may be related to the acreage under sericulture whereas the other practices like chemicals used/litre of water, total spray solution and rearing space did not-influence much on the cocoon yield/100 DFLs (Narayana Swamy *et al.* 1999).

Raghu *et al.* (1999) revealed that the adoption level of recommended sericulture technologies was 36, 49 and l5 per cent under high, medium and low categories, respectively in Kolar district. In mulberry cultivation, planting of improved mulberry cultivars and application of FYM was 69, 65 per cent and 31, 35 per cent were full and partial adopters. Application of fertilizers was partial (60%), 36 per cent were full adopters, followed by 4 per cent non adoption. In silkworm rearing, cent per cent adoption was in rearing recommended breed and feeding the larvae lfour times a day. Highest per cent adoptions (82 %) were in the usage of number of circular bamboo trays in rearing and required mountages for the ripe worms. None of the respondents followed black boxing of eggs and not used leaf preservation chamber. Majority of the respondents (60%) harvested the cocoons on fifth day of spinning. Uzi fly management was adapted to the extent of 81 per cent, while the disease management was 54 per cent full, 38 per cent partial and 8 per cent were non adopters. Timely guidance and development activities are the hindrances in achieving proper adoption of improved sericulture technologies.

Venkatesh Kumar *et al.* (l999a) reported that, in a biological industry like sericulture, improved technology results in higher productivity and hence production; besides better quality of the end product is important although it may involve greater degree of risk and higher amount of cost. The need to adopt improved practices in relation to the research and development cannot be under estimated. The present study is an attempt to probe into the extent of adoption of improved practices on the part of the sericulturists of the state. Accordingly, in Bangalore rural district the Magadi taluk representing highest multivoltine seed cocoon producers of the state has been chosen for the study. It comprises of six technical service centres (TSC), further five villages were selected from each TSC. In this taluk the rainfed and irrigated farmers are of 1:2 ratios, so in each village 10 per cent of farmers in 1:2 proportion under rainfed and irrigated garden holding farmers were selected for the purpose. Hence, the total villages selected were 30 and the total numbers of respondents were 120, out of which 40 were rainfed and remaining 80 were irrigated farmers. The extent of adoption of improved sericultural practices by sericulturists is discussed.

Saxena and Singh (2000) reported that majority of the farmers (40.90%) belong to medium level of adoption category. They were following 5 to 7, out of l0 organic farming practices. Also, more than 33 per cent offarmers were following more than 7 numbers of organic farming practices. Where there were

25 per cent farmers who were following only 3 to 5 practices and are placed in low adoption category.

Sudhakara Rao and Choudhary (2001) reported that the 100 per cent respondents adopted recommended rearing technologies like separate rearing houses, using various disinfection measures like Vijetha, Suraksha, Sanjeevini and Wrap-up method of chawki rearing and also rotary mountages for rearing CSR hybrids.

Quadri *et al*. (2002) found that sericulturists adopted new recommended rearing methods for bivoltine rearing like shoot feeding, shoot harvest, use of plastic mountages and building pucca rearing houses.

According to Thiagarajan (2002) majority of the farmers in rain fed areas had poor knowledge about recommended mulberry variety/silkworm breed, application of FYM, fertilizer 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.

Venkataramana *et al*. (2002) reported that majority of the respondents adopted integrated technologies like shoot rearing method, sanitech disinfectant, wrap up method of chawki rearing and Raksha, Rekha disinfectant.

Mohammad and Baladev Singh (2003) indicated that majority of respondents (90%), had fully adopted high yielding seeds silkworms race followed by time rearing (85%), harvesting of cocoons (75%) time of disinfection of rearing house and equipments (72%).

Ramesha *et al*. (2003) reported that in two villages of Bidar district majority of respondents adopted recommended rearing technologies like separate rearing houses, using various disinfection measures like vijetha, suraksha, sanjeevini and wrap-up method of chawki rearing and also rotary mount ages for rearing CSR hybrids. Mohammed and Baladeo Singh (2003) indicated that majority of respondents (90%), had fully adopted high yielding seeds silkworms race followed by time rearing (85%), harvesting of cocoons (75%) time of disinfection of rearing house and equipments (72%).

Jayashankar and Dandin (2004) reported high adoption level (91.1%) in the practice of application of farm yard manure (8MT/acre/year) among sericulturists in Kolar district, whereas adoption level is low in recycling of farm and rearing residues for making compost or vermicompost.

Study conducted on awareness and adoption pattern of improved technologies of muga culture by Mech *et al.* (2004b) observed that 43.3% farmers fully aware and adopted systematic plantation as recommended. As regard to maintenance of plantation *viz,* input application, agronomical practices, etc only 13.3% farmers were fully aware and adopted the technologies. However, more than 90.0% farmers were not aware and adopted the grainage technologies, which included mother moth examination and egg surface disinfection. Negligible response was observed pertaining to awareness and adoption of box type mountage for spinning of muga cocoons.

A study conducted by Philip and Qadri (2004) revealed that, nursery preparation, spacing, plant training, plant protection measures, application of biofertilizer, triacontanol and vesicular arbuscular mycorrhizas (VAM), green manuring and vermicomposting were the technologies least adopted by the farmers in Emakulam. Similarly, in Trichur, application of biofertilizer, triacontanol and VAM, vermicomposting and green manuring were not well accepted, while mulberry cultivar, spacing and nursery preparation were fully adopted. Vital inputs such as organic manure and chemical fertilizers were not applied as per the recommended dose in both districts. Silkworm rearing practices such as separate rearing house, disinfection of rearing house and equipment, incubation, black boxing, wrap up, shoot feeding, use of vijetha, application of lime powder and bed spacing had higher level of adoption in Trichur.

Rajeev (2004b) 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.

According to Sariful Islam (2004), JICA farmers had sufficient knowledge on mulberry cultivation and silkworm rearing technologies, but the full adoption level varies from from 35 % (paired row system) to 100 % (pruning method) for mulberry cultivation technologies and 35 % (rotary mountage) to 100 % (shoot rearing and separate rearing house) for silkworm rearing technologies.

Geetha *et al.* (2005) reported that 100% farmers had knowledge on technologies like silkworm bed spacing and shoot rearing. It was reported that the adoption level of bed disinfection (vijetha) for CSR rearing was better (57%) compared to that of CB (34%).

Madhu Prasad *et al.* (2005) conducted a study in Kolar district reported that knowledge level of most of the sericulturists had full on animal excreta based manures However, 98 per cent of respondents had high knowledge in application of Neem cake followed by pongamia cake (9l.00%), groundnut cake (86.00%) and Hippe cake (52.00%). Only 49-52 per cent of respondents had knowledge on application of bio-fertilizers.

Narayanaswamy *et al.* (2005a) revealed that, majority of farmers have moderate knowledge about organic sericulture practices (54%) followed by low (30%) and high categories (16%), in Kolar District.

Vijaya Prakash and Dandin (2005a) reported that adoption of mulberry technologies by the farmers related to plant spacing and harvesting of mulberry leaves were highest (100%), followed by irrigation (95.08%), farmyard manure application (91.80%), dusting with vijetha (86.89%), disinfection (83.6l%), uzifly control (82.40%), shoot rearing (82.00%), use of improved mulberry variety (77.78%), use of separate rearing house (70.49%) and harvesting of cocoons (34.43%).

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. However, the knowledge regarding soil type and manure was more in traditional area than non-traditional area.

Mallikarjuna *et al.* (2006) indicated that the knowledge level of sericulturists on mulberry cultivation technologies in chamarajanagara district varied from 7% (vipul application) to 82 % (application of FYM) and the full adoption level varied from 1% (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).

Sujatha *et al.* (2006b) revealed high adoption for plantation spacing, application of FYM, disinfection, bed spacing, temperature and humidity maintainance during rearing. Adoption was nil/low for practices like biofertilizer, vermiculture and mulching. The adoption level among different catagories of farmers was on order of big farmers>small farmers>marginal farmers.

Deepa and Sujathamma (2007) studied the technology adoption in semi arid condtions of chittoor district in Andra Pardesh. Soil testing and application of biofertilizer was not adopted by 86.ll % and 70 % farmers respectively. However, 70 % of the farmers had planted the recommended mulberry variety. Most of the silkworm rearing technologies was fully adopted *viz.* disinfection (82.22%), recommended brushing (87.22 %), new silkworm races (80.00 %) and mounting care (76.66 %).

The knowledge and adoption level of farmers in Malavalli and Srirangapatna 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 Geethadevi, 2007a).

Lakshmanan and Geethadevi (2007b) found that 79 % farmers adopted shoot harvesting method followed by technologies such as separate rearing house (69%), high yielding mulberry varieties (62%), application of manure (36%), maintenance of temperature and humidity (35.50%), leaf harvesting method (33.75%) and cocoon harvesting (32%).

Dayananda and Kamble (2008a) reported that, knowledge level of 42.50% of respondents in Anekal taluk on integrated technology package (ITP) of mulberry cultivation was medium while 38.33 and 19.17% of the respondents had low and high knowledge levels, respectively. They also reported that the adoption level on integrated technology package (ITP) of mulberry cultivation was medium (42.50%) among the respondents, while 30.00 and 27.50 per cent of the respondents had low and high level of adoption, respectively.

Kasi Reddy *et al*. (2008) studied that, improvement of mulberry leaf and cocoon yield by adopting new technologies including V-1 mulberry variety in wider spacing (3' x 3) and drip irrigation, intercropping with green manures such as daincha (Sesbania aculeata), application of bio- fertilizers namely, Azotobacter and Azospirillum, application of neem cake and spraying of seriboost as a plant growth promoter. The sericultural technologies such as, separate chawki rearing and separate rearing house, disinfection with chlorine dioxide or bleaching powder, rearing of bivoltine dfls during favourable seasons, shoot rearing, use of bed disinfectants *viz.* Vijetha, use of plastic mountages etc., were also implemented in the study. Rearing of CSR2 x CSR4 hybrids during favourable season (August to February) and PM x CSR2 during the rest of the season (March to July) was taken up. The results revealed that an improvement of 16.9 - 19.00% in mulberry leaf yield, 29.00 - 38.11% (CSR2 x CSR4) and 17.56-31.23% (PM x CSR2) in cocoon yield. The cost and return of cocoons before and after adoption was calculated and a net profit of 48.28% was recorded over the benchmark.

Mallikarjuna *et al*. (2009a) revealed that, all the farmers having knowledge on advantage of separate rearing house / separate entrance to rearing house, disinfection of rearing house, new silkworm breeds, shoot rearing, bed spacing, bed disinfectant and rotary mountage. Similarly 97.5 %, 67.5 %, 72.5 % and 82.5 % of farmers possessed knowledge on time of harvest, deflossing, ‘sorting and transportation of cocoons respectively both in Mandya and Tumkur districts.

Mallikarjuna *et al.* (2009b) reveals that majority of the farmers have harvested the cocoons in right time (77.5%), 47.5% farmer have done deflossing, 62.5% of farmers have sorted the cocoons before marketing and 32.5 farmers have adopted proper method of transportation both in Mandya and Ttimkur districts.

Srinivasulu Reddy *et al.* (2010a) observed that 85-100% of the farmers had full knowledge in respect to improved mulberry varieties and partial knowledge of 34-42 % on Vipul and biofertilizer application.

Srinivasulu Reddy *et al*. (2010b) found that 64 % of farmers in Ananthapur, 73 % of farmers in Chittoor and 85 % of farmers in coastal area had fully adopted the separate rearing houses adopted with shoot rearing. The adoption level was greater in Anantapur and Chittor followed by Coastal areas.

Study conducted by Goswami *et al.* (2015b) revealed that box type bamboo mountages in place of traditional *Jali* is convenient and reusable but only 2.73 % respondents were found to use this mountage on trial basis, whereas 35.45 % respondents heard about the technique but not used and rest 61.82 % respondents were not aware about the use of this mountages. Study revealed that only 24.55 % of respondents used or are using rearing net and rest 75.45 % respondents do not use rearing net for silkworm rearing. Uzi fly is a serious silkworm pest causing a considerable damage to the cocoon crop during winter crops. To control uzi fly infestation 35.45 % respondents followed traditional methods, 58.18 % respondents do not take any control measures and 6.36 % respondents practiced biological control measures on trial basis.

2.3: Traditional knowledge and practices of muga culture

Various workers had described indigenous technical knowledge (ITK) and its importance in different fields. Adam (2009) reported that indigenous technical knowledge (ITK) is a body of knowledge built up through generations by a group of people living in close contact with nature. Buresh and Cooper (1999), have defined indigenous technical knowledge as consisting of facts, experiences, practices, resource management strategies and production systems developed through trial-and-error during several millennia in a given community, nation or region. Darr *et al*., (2009) define indigenous technical knowledge, as a key component of traditions and cultures of the people. Anyira (2010) opined that agriculture indigenous knowledge "AIK" offers great opportunities for improved agricultural production and sustainable food security. Many authors have recognized it as an important source of developmental information and have recommended its proper documentation and dissemination for sustainable agricultural development. Warren (1991) noted that AIK has made a tremendous contribution to crop production by poor farmers. Emery (1996) opined that indigenous knowledge is considered to be cultural knowledge in its broadest sense, including all of the social, political, economic and spiritual aspects of a local way of life. Atte (1989) enlightened that Indigenous Technical Knowledge (ITK) is the knowledge of a given population that reflects the experiences based on their tradition. Muga culture is an age old traditional practices sustaining amidst the rural folk since time immemorial in Assam and few states of North East India. It involves lot of traditional practices and beliefs over the time and many of time these traditional practices have proved to be successful and sustainable. The first official record of muga silkworm and muga silk related to 1662. A remark that, the silks are good, but the people produce little more than they require for use is attributed to the famous traveler Lean Joseph Javernier, who made special mention of a silkworm variety from Assam that remained on trees all the year round and the brilliant stuff made out of them (Thangavelu *et al.*1988a). Some of the reports about the traditional practices and beliefs associated in muga culture are cited below.

Thangavelu *et al*. (1988b) documented that prior to selection of seed, traditional rearers survey the rearing of different seed growers to ensure quality of seeds. They never select seed from disease-infected rearings and if the intensity of diseases is enormous, the rearers avoid such crops. For selection of healthy brood, rearers preferred dark green colour larvae, copper coloured head of larva, presence of two excreta in the posterior and abdominal segments of fifth instars larva and uniform growth with no symptoms of disease of larva. Pointed posterior end and light chocolate colour of pupae, high percentage of silk contents in the cocoon, uniform size of cocoons, sinking of pupae when put in to water and pink colour haemoceal of pupae are considered as best characters for selection of seeds in the pupal stage. Moths are allowed to couple overnight and next morning if the moths are not decoupled naturally, the rearers light a fire at some distance which helps to decouple of moths. The rearers use the eggs laid up to third day and prior to brushing they used to clean the trees and rearing site. Rearers do not use soap and oil during rearing.

Bhattacharya *et al.* (1992) reported that the farmers adopted certain practices for selection of healthy broods of muga. In order to select a healthy brood of muga silkworm, the traditional rearers strictly observed egg laying pattern of moth, colour of eggs, morphological character of moths, coupling behaviour, detached eggs from the *khorika*, hatching pattern, mobility of worms, feeding behaviour, cuticular pigmentation of worms, presence of excreta in larval rectum, larval growth, pupal character, silk contents, etc

Bhattacharya *et al.* (1993) reported that a muga farmer practiced lot of traditional practices like cleaning and burning of weeds in rearing field, incomplete weeding, direct mode of brushing, mixed plantation, day wise separate brushing, spreading banana leaves on the ground after brushing, restriction of women in to rearing field, screening of worms based on size, etc.

Borthakur (2003a) reported that the golden colour muga silk produced by *Antheraea assama* Westwood is confined to the Brahmaputra Valley of Assam only. Various traditional practices adopted by the muga farmers during silkworm seed production. The moths are provided with a room in a thatched hut, the walls of which are plastered with mud, for copulation and subsequent laying of eggs, the floor of the hut is sprinkled with wood-ash, which prevents the entry of other insects. Even in the room, nobody is allowed to enter to ensure the protection of eggs and the worms from other germs. The moths are allowed to copulate only for an overnight and then decoupled and male moths are driven away by lighting a fire at some distance in the next morning. Likewise, the female moths are allowed to lay eggs for a maximum of three days and they are removed from the sticks. For controlling the insects a few scaly fishes are tied at the base of trees, which keep the insects engaged at the base of the trees and they never climb above to reach the worms. The scaly fishes are used because the insects require a longer time to eat them.

Phukon *et al,* (2006) reported that rearers used to transport the seed cocoons generally in night from different seed zones of Assam and other North Eastern states. While collecting the seed cocoons, they observed the concentration of excreta present on the ground of rearing field, presence of least egg shell in the khorika used, presence of excreta in the rectum of larvae, copper colour of mouth part, peak harvested cocoons, etc. While preserving the seed cocoons, the rearers sprayed Tulsi (*Ocimum sanctum* Linn) and Neem *(Azadirachta indica)* mixed water on the floor to maintain temperature, humidity and make the room hygienic. After emergence of moths, the female is tied on *khorika* and male moths are allowed to couple naturally. Prior to brushing the newly hatch worms, the rearers used to tie dead scaly fish, frogs and keep molasses at the base of the host plants to attract ants and finally burn them. Generally, the rearers used slippery leaves or bark of banana plants, Tora (Zingiberaceae), buffalo dung, ash, etc to stop movement of worms in to ground. During the night, some rearers placed bamboo leaves on the top of the host plants to drive away the nocturnal birds, predators.

Dutta *et al.* (2009) reported that the farmers used to hang dead frogs, crabs, or rotten fish randomly in different places of rearing field to check bugs which is a sucking pest of early stage muga silkworm. To control the red ants, keep banana (*Musa domestica*) just beneath the soil surface of rearing field. He also reported various practices for control of pest of muga host plants. To prevent mortality of silkworms, the farmers use to pin some plants like (*Colocasia esculenta*) in the tree trunk during rearing.

Unni *et al*. (2009) reported that muga rearers of Assam have been practicing muga culture with traditional methods. Rearers collect eggs from other sources or prepare eggs from the moths emerging out from a selected portion of cocoons from the previous crop following some traditionally approved criteria for the cocoons. Rearers select seed cocoons with utmost care based on size of the cocoons, habit of the larvae, response to physical touch, eating behavior, etc. To protect host plants like Som, Soalu, etc. from grazing animals, muga rearers traditionally apply fresh cow dung on the base of the plants. Controlled burning of undergrowths in the host plantation prior to rearing is another practice followed by the farmers, which helps in removal of pest and predator infestations, disease causing micro flora, etc. Another cost effective disinfection practice being followed by the traditional rearers is to hang all the equipments used in rearing above their kitchen fire. This practice is effective as continuous exposure to high temperature helps in desiccating pebrine spores and other disease causing microbes from the equipments. During rearing, worms are brushed by using *Khorika* made of thatch grass to the base of plant.The rearers also do not move out of the field. Both these practices are found to be sanitary measures against secondary contamination of silkworm diseases.

Sarmah *et al.* (2010) reported that the leaf of som plants, which resembles with the leaf of Indian iron wood *Mesua ferrea* L. is mostly preferred for rearing by the farmers. The farmers also select the variety of som plants by chewing the leaves. The rearers usually select the seed cocoons by seeing the larval colour, movement of worms, number of ridges on the silkworm litters (preferred 6 ridges) and by touching the tubercles of the larvae. Feeding of leaves of the plants from top to bottom is considered as good sign of healthy larvae. The farmers make ‘khorika’ of thatch grass for facilitating the moths to lay eggs. Some farmers hang tulsi twigs in between khorikas and believe that this practice prevents the outbreak of pebrine disease of silkworm. Dry leaves of certain plants are used for spinning of cocoons, which produces shining and compact cocoons.

Cow dung is a great source of methane (CH_4). Microbes found in this cow dung are mostly anaerobic and release methane as a by-product of their oxidation activities. When this methane in the cow dung spread comes in contact with air and sun's heat, it is converted to Formaldehyde which have antimicrobial and germicidal properties. It even kills spores of bacteria. Thus, cow dung providing as a pretty good nature friendly disinfectant (Anonymous, 2014).

Chakravorty *et al.* (2015) reported that the traditional rearers strictly obeys the rules in protecting the farm from intruders by bamboo fencing, burn dry and damaged branches, unwanted trees, shrubs, weeds, grasses and herbs, which could harbour pests and spread disease causing microorganisms in the rearing field. To remove ants from the plant, rearers used a dead fish, frog or a lizard of the genus *Australolacerta*, locally known as *naipia*, near the base of the tree to first attract the ants in large number and then to burn them off. To drive the cattle away from grazing the host plants, clumps of cow dung are deposited around the base of the trees.

Goswami *et al.*, (2015c) reported that usually the rearers prefer to rear Chawki worms on Soalu plants and after completing 2^{nd} or 3^{rd} instars, worms are transferred to Som plants. In Lakhimpur, Dhemaji, and Sonitpur districts of Assam only Som plants are preferred due to its availability for silkworms rearing but in districts like Kamrup, Udalguri and Kokrajhar both Som and Soalu are used as primary food plants for silkworm rearing.

2.4: Impact on yield and economics under improved and traditional practices of sericulture

To adopt a new technology by a farmer, he needs to ascertain whether the new technological implementation is useful in terms of his farm productivity. The farmer need to know if the technology would provide some sort of competitive advantage in terms of costs, quantity or quality of production, marketing, etc. and would really give him a strategic advantage over the existing technology. The most important 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). Adoption of recommended technologies in sericulture leads to improvement cocoon yield and thereby increases the farm income from sericulture. The literatures highlighting the impact of technology adoption in sericulture are cited below.

Choudhury, S. N (1970) reported that muga silkworm produces the unique golden colour silk which is more durable and has high demand in the global market. This silkworm is polyphagous in nature and feeds on a wide range of host plants

An empirical analysis of the costs and returns from mulberry sericulture in Karnataka by Nagaraj *et al.* (1986) revealed that the net return per acre of irrigated mulberry garden was around Rs.11,000.00 from four crops.

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.

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

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.

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.

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

Data recorded from the farmers field during Bhadia (August-September) seed crops rearing revealed that mortality of worms was reduced by 27.66% with 33% gain in ERR and additional production of 26 cocoons under recommended technologies as compared to the conventional method. Similarly, mortality of worms was reduced by 16.34 % with 7.37% gain in ERR and additional production of 16 cocoons under recommended technologies as compared to the conventional method (Anonymous 1998-99).

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).

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

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.

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 CSR_2 x CSR_5 and BL_{24} x $NB4D_2$ respectively (Meenal *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 4% farmers had harvested above 70 kg/100 dfls (Rajan, 2002a).

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. 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 BCR was 1:1.34 and 1:1.16 respectively for CSR hybrids and cross breeds.

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 benchmark 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.* 2002b).

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 cost benefit ratio of 1:1.96. On the other hand, the multivoltine seed rearers obtained Rs.21,580/acre/annum as net profit with a cost benefit ratio of 1:1.39.

Barah *et al.* (2004b) reported that in muga culture, yield gap between demonstration centre and the farmers is 50% in seed and 30% in commercial crop.

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/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/year was also high in CSR hybrids. 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

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.* 2004a).

. Mech *et al.* (2004c) reported that the muga farmers who adopted technology in full they had harvested 50-60 cocoons per laying as against 30-40 cocoons per laying in partial adopters and below 20 cocoons per laying in non adopters

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.

Assessment of integrated technology package for sustainable development of muga culture under farmers' condition revealed that through technology intervention in integration, cocoon production at farmers' level could be increased by 66.7% in Chatua seed crop and by 79.3% in Bhadia seed crop over benchmark. The benefit cost ratio (BCR) after technology intervention calculated to be 2.06 against 1.37 of the traditional farmers. (Anonymous 2004-05)

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

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).

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 .

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.

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

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).

Study on integration of improved technology package of muga culture had shown the production of 52 cocoons against the production of 29 cocoons per dfl in traditional method. Cocoon production in integrated technology intervention is increased by 66.7% in Chatua seed crop (March-April) and 79.3% in Bhadia (August-September) seed crop over benchmark production (Barah *et al.* 2006).

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.

Introduction of IVLP programme in Kodagapura village of Chamarajanagar district had increased cocoon productivity from 34.39 to 56.48 kg/100 dfls and an additional income of Rs.1800-2500 per 100 dfls (Gururaj *et al.* 2006).

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

Kasi Reddy *et al.* (2006a) noticed that adoption of new sericulture technologies among farmers of Parigi and Pydeti villages of Anantapur district resulted 10-12 % increase in mulberry leaf yield and 29-30% increase in cocoon yield. They also recorded the increase of net profits by 32 % over benchmark.

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 1:2.8.

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.

Mech *et al.* (2008) documented that through technology intervention, average cocoon production in two commercial seasons of muga silkworm rearing was 63 cocoons per dfl against 39 cocoons per dfl in conventional method with an increased by 61.5 percent over conventional method. Moreover, through intervention of improved technologies in muga culture, net income was calculated to Rs.11, 400.00 with benefit cost ratio of 1.82 while net income in conventional method was Rs.3900.00 with benefit cost ratio of 1.33 per acre/year.

Study made by Phukan *et al*. (2008) on organic manure based farming system for sustainable muga crop production in N.E Region of India revealed that green manure with *Dhaincha* @ 50 kg seed per hectare together with 5t FYM and 1t vermicompost found to be sustainable alternatives of recommended practice of 10t FYM and 100:50:50 kg NPK per hectare for producing quality muga cocoon with 67.59 % ERR to that of 66.84% in recommended practice.

Kakati (2009) reported that in Lakhimupr district of Assam, about 68% muga growers' holds systematic plantation and 44% maintain them regularly on scientific line. About 48% muga growers adopt improved rearing technologies that increase dfl: cocoon ratio from 1: 55 to 1: 73.

Impact assessment on implementation of Cluster Development Programme showed a considerable increment of cocoon production after intervention of improved technologies through cluster approach. In the muga clusters, cocoon production has increased by 30.0 % in seed crop and 39.0% in commercial crop over benchmark in the initial year. In the subsequent year, cocoon production has increased by 65.0% in seed crop 43.0% in commercial crop over benchmark. Similarly, cocoon production has increased by 6.7% in the initial year and 10.8% in the subsequent year over benchmark in the eri cluster. In the same way, mulberry cocoon production has increased by 7.4% in the initial year and 19.1% in the subsequent year over benchmark. (Mech *et al*. 2011)

Barah and Mech (2011) reported that demonstration of integrated technology package at farmers, field in Jorhat, Golaghat, Lakhimpur and Dibrugarh district of Assam through participatory mode had shown a visible increase of muga cocoons production. In commercial crop, average cocoon production of three districts was calculated to be 69.8 cocoons per gram of eggs registering an increase of 51.0% production against pre-intervention benchmark production. Similarly, average cocoon production after technology intervention was calculated to be 50.1 cocoons per gram of eggs against benchmark production of 28.3 cocoons before technology intervention registering an increase of 77.0% in seed crop. Income generation in one acre of plantation through technology adoption has been calculated to be 55,840, where net income is Rs 31,300.00 with benefit cost ratio (BCR) of 2.27 in commercial crop, while income generation in traditional practice has been recorded Rs.37,040.00 with a net profit of Rs.19,420.00 and BCR of 2.10, Similarly, in seed crop, income generation in one acre of plantation through technology adoption has been recorded Rs. 44088.00, where net income is Rs 19548.00 with benefit cost ratio (BCR) of 1.80, whereas in traditional practice gross income has been recorded Rs. 24904.00 with a net profit of Rs.7,284.00 and BCR 1.41.

Rajan and Hazarika (2012) reported that following technologies developed at CMER&TI, Lahdoigarh for enhancing muga cocoon production as well as muga raw silk.

1. I**ntercropping**: For enhancing farm income, intercropping Ginger, Turmeric and Colocasia has been introduced in Som plantation. These intercrops grow well without effecting usual growth and leaf yield of Som which can generate an additional net income of Rs.6000- 10000 in one ha systematic plantation of Som.

2. **Chawki rearing (early stage rearing**): Improved Chawki rearing technology using nylon net on bush plantation has been developed for reducing early instars mortality. This involves maintenance of 15-20% plants per unit area at 6 feet height with NPK application @ 200:100:100 per hectare and remaining 80% plants with NPK application @100:50:50 per hectare as late stage rearing plot. Rearing of chawki worms is conducted on 90 days old foliage under nylon net and late stage worms are reared in remaining 80% plants. This results in gain of cocoon production per dfl during Chatua (40%) and Bhadia (70%) crops.

3. **Biological Control of Uzi fly:** Uzi fly is a major pest of muga silkworm causing extensive damage to the crop. The peak period of uzi fly infestation is December –February (80-90%). Biological control of uzi fly through release of local hyper parasitoids *viz. Nesolynx thymus* and *Exorista philippinensis* has been developed. The continuous release of biological agents can combat fly population and thereby can save muga silkworm crops to a considerable extent.

4. **Lahdoi :** An anti-fungal chemical formulation developed against muscardine disease of muga silkworm

5. **Bamboo mountage:** The bamboo mountage has developed for replacing the traditional Jali. It has been estimated that there is gain of 2 kg raw silk per 100000 cocoon mounted in the bamboo mountage as compared to the traditional jail. Moreover, use of bamboo mountage reduces space and labour requirement by 90% and 60% respectively.

'Lahdoi' a chemical formulation used for protection muga silkworm from fungal pathogens causes muscardine disease of muga silkworm generally prevalent during winter crops. Field trial of *'Lahdoi'* at farmers level in Upper Assam revealed that due to application of 'Lahdoi' cocoon production was recorded 70, 69 and 62 in Dibrugarh, Sivsagar & Jorhat and Golaghat respectively (Das & Das 2012).

Singh *et al.* (2014) reported that incidence of the viral and bacterial diseases *viz.* flacherie and grasserie caused large mortality to the muga silkworm, *Antheraea assamensis* Helfer thereby affected the cocoon silk production. The study deduced that the application of 0.01 % of Sodium hypochlorite during the rearing of muga silkworm (*Antheraea assamensis* Helfer) can effectively control the larval mortality due to bacterial and viral diseases thereby enhance the cocoon production.

Impact assessment of Front Line Demonstrations (FLD) of integrated technology package of muga culture recorded higher yield as well as higher economic return as compared to the farmers' traditional practices. The demonstration of technologies registered higher yield of 66.8 cocoons per dfl with 41.9 percent improvement as against 47.5 cocoons per dfl under traditional practices. Study also registered very narrow technology gap in the demonstration yield *i.e.*, 3.15 cocoons per dfl over the potential production. The improved technology packages also gave higher net return of Rs. 4855/-with higher benefit cost ratio 1.32 as compared to net return of Rs. 2045/- and benefit cost ratio 1.17 under traditional practice (Mech *et al.* 2015).

Goswami *et al.*, (2015) reported that during Jethua Crop (May-June), the cocoon yield of the farmers who adopted the technology ranged from 4552 to

6178 per 100 disease free laying (dfl) while in the traditional lot, it ranged from 4020 to 5490 per 100 dfl. It was observed that increase in cocoon yield in the technology adopted lots over that of control lot ranged from 8.07 % to 17.02 %. Similarly, during Kotia crop (October-November), the cocoon yield of the farmers who adopted the technology ranged from 4367 to 6215 per 100 disease free laying (dfl) while in the control lot, it ranged from 3970 to 5624 per 100 dfl. During this crop, increase in cocoon yield of the treated lot over that of control ranged from 6.70 % to 18.62 %. Significant improvement in cocoon production was observed due to the adoption of the chawki rearing technology in muga culture.

Choudhury, *et al.* (2016) reported that during last 10 years, muga raw silk production is swinging between 105-158 MT though the potential production is 200 MT.

2.5: Constraints for non adoption of improved technologies

Puttaswamy (1977) observed that lack of knowledge and resources as the primary reason for non-adoption of recommended practices by farmers. Other reasons he found were low prices for the produce and disease of the crop.

Rajashekaraiah (1979b) revealed that non-availability of credit, failure of crop, lack of trays and mountages, lack of knowledge about the control of disease were the most important disincentives for non-adoption of silkworm rearing technologies.

Chandrashekara (1985) reported that the major constraints expressed by 95 per cent farmers was the lack of advise relating to the information on ruling prices at various markets and low price. Lack of grading facilities and high fluctuation in prices of silk cocoons were also considered as constraints in obtaining good returns.

Khan (1985) reported that all the respondents producing multivoltine cocoons (100%) expressed the incidence of uzi fly as the major problem in getting good cocoon crop. On the other hand, 22 and 26 per cent of the farmers expressed the problem of shortage of irrigation water and human labour. Regarding marketing of cocoons 50 per cent of the respondents expressed the lack of transportation facilities and poor price for cocoon as the major problem.

Das *et al*. (1988) reported that the main constraints in confronting the expansion of Indian sericulture non availability of cheap agriculture labour, lack of sound technical man power, absence of local market, lack of improvement of marketing facilities, lack of production of god quality silkworm seeds.

Sarkar (1988) reported that the constraints contributing to get low yield of mulberry cocoons in West Bengal were lack of use of high yielding varities, lack of knowledge in adopting improved agronomical practices and lack of adequate training on the improved techniques of rearing.

The constraints as perceived by the sericulturists for non adoption and partial adoption of recommended sericulture technologies were lack of knowledge, lack of finance, scarcity of water and lack of labour (Shivamurthy, 1988b).

Sreenivasa (1989c) reported that, 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 seasons. Ultimately supply of layings, high cost of Dfl's, uzi menace, lack of separate rearing house, lack of disease control measures, lack of finance and fluctuation in the cocoon price were the constraints observed in silkworm rearing.

Satheesh (1990c) reported that reasons for not utilizing chawki rearing centres by the none-beneficaries was lack of adequate care and inadequate technical guidance at chawki rearing centres.

Gopala (1991b) indicated that lack of knowledge about disease control was the most important reason for non-adoption of recommended sericultural technologies by both developed and less developed areas. Lack of irrigation facilities got second rank in developed area while non-availability of M5 variety of mulberry got second rank in less developed area. Non-availability of labours in right time received fourth rank in developed areas as against lack of knowledge about disinfection measures which received fourth rank in less developed area.

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

Raghuprasad (1992b) reported that the major problems faced by sericulturists were distant cocoon markets, non-availability of labour input and dfls, non-availability of guidance about disease control, lack of financial assistance and irrigation potential, water as well as good prices for silk cocoons.

Gopala and Krishna (1993) reported that the major constrains faced by the sericulturists were lack of knowledge about control of silkworm diseases, lack of irrigation facilities, separate rearing houses, labour availability in time, lack of knowledge about disinfectant measures and non-availability of M-5 planting mulberry variety.

The study on the knowledge level of the sericulturists on the recommended sericultural practices and the characteristics associated with the adoption behavior (Singhvi *et al.* 1994), showed that majority of respondents were 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.

Chikkanna *et al.* (1995) found that the level of adoption of high in respect of FYM application, low or poor in respect of application of fertilizers, care at incubation and worms space. The adoption level among different categories of farmers was in the order of big farmers, followed by small and marginal farmers. Among the constraints lack of separate houses for rearing silkworms, non-availability of good disease free layings, non-remunerative prices for silk cocoons, non-availability of financial assistance as main reasons identified for non-adoption.

Jagannatha Rao (1995) identified constraints encountered by sericulture farmers in Coimbatore district of Tamil Nadu. Inadequate market facilities (80%), lack of control measures for silkworm diseases and pests (74%), non-availability of dfl‘s (52%)'and disinfection of chemicals in right time (48%) were considered as major problems.

Doddamani (1996) reported that the constraints of sericulturists in Gulbarga district of Karnataka were non-availability of dfls and lack of disease and pest controlling measures were the reasons for low production.

Datta and Dilip Kumarpradhan (1996) observed that major problems faced by sericulturists are, lack of knowledge about to maintain optimum temperature and humidity during silkworm rearing and lack of investment.

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

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 sericultural practices were lack of knowledge, lack of finance, lack of water, non availability of cuttings, FYM and fertilizers in time (Shreedhara, 1997b)

Raghu (1997) found that majority of respondents in Kolar district opined that non-abailability of quality dfls as major constraint followed by silkworm diseases and lack of proper guidance.

Further, Srinivasa *et al.* (l998c) reported that, lack of knowledge as the main constraints (8l.30%) followed by low prices for cocoon (70.50 %) and high costs (63.30 %) opined by farmers of Dharwad district.

Das and Saratchandra (1999) reported that the major problems faced by the sericulturists are lack of information, lack of technical guidance, distant markets that prevent from rearing these hybrids.

Ganapathy *et al.* (1999) reported that, the major reasons affecting the adoption of recommended sericultural practices were lack of knowledge about use of fertilizer dose, 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 the sericulturists in marketing cocoons

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 in K. R. Nagar taluk, Mysore district (Jagadisha, 1999b).

Shivalingaiah *et al.* (1999) observed that lack of knowledge about application of NPK fertilizers, pest and disease control, non availability of labours and marketing problems were constraints expressed by the farmers.

Venkatesh Kumar *et al*. (1999b) 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 rearers, lack of coordination between farmers and extension workers and lack of effective extension activities

Chandrappa *et al*. (2000) study revealed that a large number of sericulturists (37.5 percent) were low adopters of recommended practices. The major reasons affecting the adoption of recommended sericulture practices were lack of knowledge about ferilizer dosages and disease control measures, lack of capital, and high cost of fertilizers. Non existence of good price, exploitation by middlemen and distant market place were the major constraints faced by sericulturists in marketing of cocoons.

Nadadur (2000) observed that sericulturists perceived lack of separate rearing house, lack of adequate space and susceptibility of silkworm to various diseases and pests that lead low production.

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

Munikrishnappa *et al*. (2002b) indicated the constraints faced by the farmers in the adoption of improved sericultural practices. The major constraints for small farmers were lack of finance (42%), lack of knowledge (36.3%), lack of separate rearing house (31.5%) followed by non-availability of inputs in time (22%) and fluctuation in cocoon price (10%). Among the medium farmers, the major constraints were fluctuation in cocoon price (21%) followed by financial constraints, lack of proper knowledge, lack of separate rearing house (15.70 % each) and non-availability of inputs in time(10.5%). Among the large farmers, the major constraints were fluctuation in cocoon price (72%) followed by lack of proper knowledge (21 %), non-availability of inputs in time (17.8%), lack of separate rearing house (10.5%) and lack of finance (10.5%).

Rajan (2002b) reported that major problems remaining for the popularization of bivoltine technologies are timely supply of quality silkworm eggs in required quantity, organizing large number of chawki rearing centres, providing hygienic conditions and supply of all required equipments and disinfectants.

Barah *et al.* (2004c) inferred that inherent constraints in muga culture are manifolds, which in the order of priority are non-availability of quality seeds, high incidence of disease and pest, marketing, high cost of seeds, uncertainty of crops due to natural vagaries, absence of technical guidelines, etc. Of these, the high cost of technologies is the major impediment for adoption of improved practice at farmers' level followed by strong inclination towards the traditional practices.

Dandin *et al.* (2004b) found that recommendation with regard to application of fetrtilizers, disinfectants and pest control measures were not adopted either partially or completely due to high cost. The limited use/non use of FYM was 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

Mech *et.al* (2004d) documented that ignorance of technologies, high cost of technologies and strong inclination towards traditional practices were the first, second and third reasons for partial and non-adoption of technologies by the farmers.

Rajeev (2004c) reported that, 91.67 % of the respondents expressed lack of capital for construction of separate mounting sheds was the major constraints for non adoption of CSR hybrids.

Lakshmi Prasad, (2005) reported that the main problems encountered by sericulturists of kolar districts were shortage of water in summer seasons, pest and disease incidence, high temperature in summer, non availability of dfl's and chemicals in time.

Narayanaswamy *et al*. (2005b) reported that a foremost constraint faced by the sericulturist was non-availability of adequate quantity of organic manures ranked first. The second ranked constraint was high cost of manure, followed by low quality of manure and lack of knowledge about improved composting techniques in Kolar district.

Vijaya Prakash and Dandin (2005b) revealed that major constraints in the adoption of sericultural practices include the non-availability of input in time (72.22%), fluctuations in cocoon price (56.56%), requirements for a separate rearing house (33.32%) and high cost of inputs (l2.00%).

The main constraints faced by sericulturists of Chittor 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 fertilizer and scarcity of electric power (Sujatha *et al*. 2006c).

Geethadevi *et al.* (2006b) indicated that the development of new sericulture technologies does not yield benefits by itself. The new technologies are required to be transferred to the farmers' field. The reasons for non-availability/poor adoption of new technologies were attributed mainly to (a) poor performance of technologies at field level (b) poor knowledge of the farmers about new technologies and (c) defective approaches/one sided traffic of technology transfer/dissemination. Among these factors, the third aspect appears, to be a serious issue. The shifting emphasis of Indian sericulture towards diversification, commercialization, sustainability and efficiency necessitates for the state extension organizations to critically examine their extension approaches.

Mani *et al*. (2006) noticed reasons for non adoption of new sericultural technologies by farmers of erode district, Tamil Nadu were assessed with high cost, lack of awareness and non availability of inputs in time.

Mech *et al.* (2007) reported that in muga sector, marketing of end product is one of the major constraints since there is no organized market for muga cocoon or raw silk or fabric.

Dayananda and Kamble (2008b) revealed that, the main constraints faced by the sericulturists in Anekal taluk on mulberry cultivation were lack of knowledge about certain technologies (83.75%), non-availability of technical guidance (8l.25%), lack of easy finance (6l.25%) and uncertainty of irrigation and power'(30%).

Ram Mohan Rao and Kamble (2009) the main constraints with the farmers in adopting the new technologies were multiple cropping system and land allocation, non availability of irrigation and fertilizers, labour non availibity, assessment of mulberry leaf, quality of mulberry leaf and mulberry spacing.

Srinivasulu Reddy *et al.* (2010b) revealed that non availability of inputs in time, high cost of fertilizers, lack of finance, lack of proper knolwdge, scarcity of labour, lack of technical guidance, traditional practice etc were the main constraints for partial/non adoption at traditional districts like Anantapur and Chittor and non trational districts like coastal districts of Andhra Pradesh.

Ahmed, *et al.* (2012) reported that number of muga farmers in Assam converted themselves from muga culture to small tea growers due to continuous muga crop failure and environmental pollution. In Golaghat district 26.57% som plantation was reduced during period from 2009-2011 due to this practice.

Goswami *et al.,* (2015d) stated that 29.09 % of the respondents sale their cocoon to the linked farmer and remaining 70.91 % rearers sale their product through middle man. As per result most of the rearers (70.91%) used to sale cocoons through middle man due to non-availability of controlled cocoon market and sometime they deprived of getting actual price of their product.