CHAPTER 5

DISCUSSION

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

5.1 Socio-economic attributes of muga farmers in the study area

5.2 Knowledge level of the farmers on improved technologies of muga culture

5.3 Association between socio-economic characteristics of the muga farmers and their knowledge level of improved technologies

5.4 Adoption level of improved technologies of muga culture by the muga farmers

5.5 Association between socio-economic characteristics of muga farmers and their adoption level of improved technologies of muga culture

5.6 Traditional practices of muga culture

5.7 Cocoon yield under improved technologies and traditional practices

5.8 Economics of muga cocoon yield under traditional and improved practice

5.9 Constraints for non adoption of improved technologies by the muga farmers.

5.1: Socio-economic attributes of muga farmers in the study area

The socio-economic profiles of the respondents in the study area are given in Table 4.1.1 can be discussed as below.

Age: From the present investigation**,** it could be observed that, 58.0% farmers were belonged to middle age group (36 to 56 years). Generally, the people of middle age group are more enthusiastic and have high work efficiency. Usually they are more innovative and always ready to accept new things developed in and around to change themselves with the prevailing situation. The people of this age group are comparatively more laborious and have high sense of commitment and involvement. People of old age group might have got strong

mindset in various attribute based on their previous experiences. Relatively declining physical strength of many people of this age group is disabling to involve themselves in various works. On the other hand, young age people although have good work efficiency, they are not so much laborious. Many of time, they do not have strong mindset in various attributes. These may be the probable reasons for which majority of the respondents were in the middle age group followed by young age group (26.0%) and old age group (16.0%). Goswami *et al*.(2015a) also reported that most of the muga rearers are above 35 years and they have been practicing it for long time and the new generation (age group between 20-30 years) are seems not to be interested to involve themselves in this practice which might be due to present day work culture and patient they have. Findings of the study are also supported by the findings of Barah *et al.* (2004a) and Mech *et al.* (2004a). Similar finding was also reported in mulberry sericulture by Lakshmi Raju *et al*. (1997).

Sex: Almost 87.50% respondent belongs to the male category while only 12.5% are belongs to female category. Muga silkworm rearing is an outdoor activity and requires lot of skills and management efficiency for different activities both in day and night. Besides the day time activities, the rearers have to attend night time activities *viz*. protection of silkworms from nocturnal enemies, collection of ripen worms, mounting of collected ripen worms, etc. In such case, direct involvement in muga silkworm rearing is not comfortable for women although, they assist the male persons in different activities of silkworm rearing at day time. This may be the probable reason of less involvement of women in muga culture. Goswami *et al.* (2015a) also reported that among the muga farmers, 86.36% respondents belong to male category while 13.64% are in female category.

Caste: It was found that more than 41.0 per cent of the respondents belonged to Other Backwards Caste (OBC) and only 37.0 per cent of them belonged to Schedule Tribe (ST) followed by 10.0 per cent Schedule Caste (SC) farmers in the study area. While MOBC and general category farmers are only 8.5 and 3.5

percent respectively. It indicated that OBC, ST and SC communities of Assam are traditionally involved in muga culture and they are continuing it. Whereas the people of MOBC and general category are newly take up the muga culture with the assistance of various developmental schemes implemented by CSB and Department of Sericulture. A similar finding was reported by Goswami *et al.* (2015a).

Education: It is universal fact that education plays a key role in moulding and bringing desirable changes in human beings. In the present study, it was found that education of majority of the farmers was up to secondary level (47.0%) followed by primary level (42.0%). Poor economic condition of muga farmers and other social constraints made them to educate less and probably due to this reason 5.50% of the respondents are still found illiterate. The low education and illiterate could also be the result of a common social environment. However, due to changing trends in society, education level of some of the farmers is also gone up. This may be the probable reason for which education of 5.50% farmers was gone up to graduate level. In the present scenario, majority of the muga farmers found to be literate due to the awareness brought by the government on the importance of education and the efforts of the government and non-governmental agencies/institutions. The educated people can also help in disseminating the technology to other farmers and play a vital role in change the mindset of other farmers to adopt improved technology. The low level of education resulting non-understanding as well as not applying the scientific techniques of muga culture properly and they are always reluctant to adopt modern sericulture technologies. Mech *et al.* (2004a), Barah *et al.* (2004a) and Goswami *et al.* (2015a) also reported the same level of education among the muga farmers. However, finding of the present study is not analogous with the findings of the study conducted by Siddappaji *et al*. (1986) in mulberry sericulture where it was reported that 59.0 percent of the respondents were literates and the remaining 41.0 percent were illiterates in Mysore district

Family size: Families having with 4-5 members were more (86.0%) followed by 2-3 members (8.0%) and above six members (6.0%). The findings indicate that medium size families with 4-5 members can comfortably involve in muga culture as it is a labour intensive practice and required constant monitoring in day and night. As the muga culture requires constant man works, more number of persons in a family can easily be involved in different activities of muga silkworm rearing for its better results. The finding of the present study was in line with the findings of Barah *et al.* (2004a).

Primary occupation: Present study revealed that agriculture is the primary occupation of farmers (68%) while muga culture stood as secondary (26.5%). Most of the farmer's occupation were both agriculture and muga culture. As the muga crops are not assured due to various environmental factors like high temperature and humidity, heavy rainfall, storms, incidence of pest and diseases, etc, the farmers are compelled to choice other alternative for their livelihood. Most of the muga farmers conduct commercial crops during April-May and October-November depending on climatic condition suitable for muga silk worms. Some of the farmers conduct seed crop during February-March and August-September although it is risky and required extra care during rearing of silkworm. From the study, it could be established that muga culture is yet to be emerged as primary occupational venture as the success of the crops are depends on several abiotic factors *viz*. temperature, humidity, rainfall, etc. Majority of the farmers take muga culture as leaser time occupational venture. Goswami *et al*.(2015a) reported that most of the farmers (70.0 %) are practicing muga culture as secondary source of income and only 30.0 % respondent rear muga as primary source of income. Lakshmi Raju *et al.* (1997) also noticed that agriculture is the main occupation of majority of the farmwomen associated in sericulture.

Sericulture income: It was observed that annual income from muga culture of most of the farmers (90.0%) had low i.e. Rs. 30000.00 to 40000.00 only. Annual income of remaining 5.5% farmers had Rs. 40000.00 to 60000.00 and 4.5% farmers had above Rs. 60000.00. The income of the muga farmers is directly

related to land holding, carrying capacity and cocoon production. As it had mentioned that due various climatic condition and pest and disease incidence, many of the time farmers are failed to harvest good crops. In addition to that, non availability of organized muga cocoon market, the farmers often compelled to sale their cocoons in low price through middle men (Goswami *et al.* 2015d).

Land holding: It was observed that operational land holding of muga culture in the case of majority of the farmers (47.0%) had 1.0 acres followed by less than 1.0 acre (40.5% farmers) and above 1.0 acres (12.5% farmers). Present findings are also supported by the finding of the study made by Goswami *et al.* (2015a). The high land suitable for cultivation of muga host plants is also suitable for cultivation of tea plantation. Growing up of small scale tea garden by uprooting the muga host plants is a running trend observed specially in Upper Assam. As it was reported that number of muga farmers in Assam converted themselves from muga culturists to small tea growers due to continuous muga crop failure and environmental pollution (Ahmed *et al.* 2012), land holding of majority of the farmers under cultivation of muga host plants was found 1.0 acres. Present findings is almost closer to the findings of Goswami *et al.* (2015b) where it was reported that 58.18% muga farmers have their own food plantation within 1-3 acres area.

Experience in muga culture: From the Table 4.1.1, it could be seen that 30.5% farmers had 1-10 years, 52% farmers had 10-25 years and 17.5% farmers had more than 25 years of experience in muga culture. Almost similar finding was reported by Mech *et al.* (2004a) and Barah *et al.* (2004a). It indicates that muga culture is a traditional practice and almost all the farmers learnt the practice since their young stage. Farming experience showed a positive and significant relationship with the adoption of improved technologies by the farmers. Experience helps an individual to think in a better way and makes a person more mature to take a right decision. Sericulture is an inherited occupation in most of the households and the experience gained over the years

Mass media participation: The distribution of the farmers according to their mass media participation in Table 4.1.1 shows that as many as 30.0 percent had regularly participated to mass media. However, 61.5 percent respondents occasionally and 8.5 percent respondents never participated to mass media. The effectiveness of information varies with type of socio economic status. Considering the wide area coverage, exposure and frequent use of mass media such as newspaper, radio, television, compact disk, leaflets, pamphlets, etc play an important role in the transfer of technology. It may be because of the technological advancement in the recent years. However, coverage mass media programme on muga culture specially in TV, radio and news paper are not sufficient and this may be the reasons behind less participation to mass media among the farmers of the study area.

Extension participation: It was found that 29.5 percent of the muga farmers were regularly, 59.0 per cent occasionally and 11.5 percent had never participated in extension programme. The extension activities like technology demonstration, awareness programme, field day, group discussion, exposure visit, workshop, seminar, etc are play most important role in disseminating the new technologies among the farmers. The success of sericulture largely depends on effective and efficient communication of ideas. 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. Low participation in extension programme may be due to poor economic condition of the farmers which make them compel to attend their routin activities for daily bread and butter.

5.2.: Knowledge level of the farmers on improved technologies of muga culture

Level of knowledge on improved technologies of muga culture is presented in the Table and Figure 4.2.1 indicates that majority of the muga farmers (40.0%) had high level of knowledge followed by medium (32.5%) and low (27.5%) level on improved technologies.

The knowledge possessed by the muga farmers for selected technologies are given in the Table and Figure 4.3.1 revealed that majority of the respondent had high level of knowledge about the spacing of host plants (94.5%), inter-cropping (87.0%), early stage rearing (86.5%), pruning schedule (81.5%), lahdoi (81.0%) and application of FYM & NPK (64.5%). Recommended spacing (3m X 3m) of host plant facilitates to perform many of the activities like cultural operation, intercropping, etc smoothly. The recommended spacing also enhance carrying capacity of silkworm rearing through production of quality leaf yield and facilitate agronomical practices, erection of nylon nets for silkworm rearing, etc. Similarly, intercropping of Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*) and Colocasia (*Colocasia esculenta*) with the som plantation can generate additional farm income. Early stage rearing, pruning schedule and application of FYM & NPK to the host plants are important activities in muga culture. Rearing of early stage muga silkworm (1^{st}-3^{rd} instars) under nylon nets protect the young stages silkworm from pest & predators, direct effect of natural calamities like heavy rainfall, hailstorms, heavy fogs, etc. The suitable period of brushing has been recommended for Jethua (2^{nd} week of April- 1^{st} week of May), Aherua (1^{st} - 4^{th} week of June), Bhodia (3^{rd} week of August) and Kotia (4^{th} week of October-1^{st} week of November). Accordingly, pruning schedule of muga host plants was recommended to obtain quality foliage for the above crops. Plants pruned during summer become ready for rearing after 3-4 months and after 4-5 months in winter-pruned plants. Similarly, application of FYM and NPK during April and September is also necessary for getting quality foliage from the pruned plants (Rajan and Hazarika 2012). Hence, the farmers should have knowledge of improved technologies for better yield as well as better income from muga culture. The high level of knowledge on recommended improved technologies possessed by the farmers may be the result of intensive extension programme *viz.* training, technology awareness, demonstration, exposure visit, etc organized by the scientists of CSB and Department of Sericulture time to time. Further, frequent extension participation, make the farmers educate about the

technologies. Advancement of communication (e.g. mobile phone, internet, etc) also make it easy to aware about the recent technologies among the young farmers which in turn help to learn middle and old age group of farmers. The higher level of knowledge among the farmers in the study area may also be the result of adoption the farmers under different schemes under CDP, Special CDP, etc. which provided oortunity to gain knowledge about the improved technologies. The knowledge level of improved mountage (78.0%), pre-brushing care (74.0%) was also high due to various extensive efforts made towards a change from traditional practice to improved practice by various extension activities as mentioned above. Similarly, in pre brushing care, majority of the farmers had good knowledge about the activities need to be done at the field before brushing of muga silkworm. In the same way, the knowledge about the control of stem borer (63.0%) was also good. Stem borer (*Zeuzera indica*) is a most common and serious pest of muga host plants. The caterpillar feeds on the tissue of the tree trunk and make bores into the main trunk. Ultimately the plants are died. Technology has been developed to control the infestation of stem borer by mechanical means (Plastic wrapping on the main trunk and mud plastering of the tree trunk) up to 68 % and through botanical means (5-15% plant extract of neem, dhatura, titabahak and castor) up to a tune of 80%. These plants are very much familiar to the farmer and easily available at the farmers' level itself. Besides, it is easy to apply in the infested plants. Hence, one can be easily be acquired the knowledge of stem borer control through botanicals after participation in a demonstration programme. Above findings are almost in line with the findings of Rajashekaraiah (1979a), Aswathanarayana (1989a), Shivamurthy *et al*. (1992), Krishnamurthy *et al*. (1999), Sariful Islam (2004), Madhu Prasad *et al*. (2005), Geetha *et al*. (2005), Gope (2006), Lakshmanan and Geethadevi (2007a), Dayananda and Kamble (2008a), Mallikarjuna *et al*. (2009a), Srinivasulu Reddy *et al.* (2010a) reported in mulberry sericulture.

On the other hand, the knowledge about the mother moth examination (24.5%) and egg surface disinfection (33.5%) was found to be less as these

technologies require little scientific knowledge and expertise in handling of microscope. As education levels of many of the farmers are up to secondary level, they are not competent enough to identify pathogens under microscope. Further, it is also time-consuming process and required skill of the farmers. Perhaps, due to these reasons, farmers are not showing much interest to know about the techniques of mother moth examination and egg surface disinfection. Similarly, knowledge of biological control of uzi fly (39.5%) was found to be less among the farmers of the study area. The parasitoid *(Nesolynx thymus*) use for biological control of uzi fly is not accessible at the farmers' level. On the other hand, multiplication of parasitoids is a time consuming and need special skills. This might be the probable reason for which the farmers showing less interest to acquire the knowledge on the technology. Although, these technologies are effective in improving the production, the poor farmers are unable to afford its cost which is relatively high. This may be one of the reasons for not showing the much interest in acquiring knowledge in the above technologies. Munikrishnappa *et al*. (1999) also observed that the farmers in general have better knowledge and adopt the low cost technologies compared to high cost technologies.

5.3. Association between socio-economic characteristics of the muga farmers and their knowledge level of improved technologies

The relationship between the personal and socioeconomic variables of the respondents and their knowledge level are shown in the Table and Figure 4.4.1. The analysis indicated that out of 8 variables, 5 variables such as age, sericulture income, land holding, experience and extension participation showed significant relationship with knowledge level among the farmers. The variables like family size, education and mass media has negative relationship with the knowledge level of the farmers. The probable reason might be that the muga culture is a traditional practice and it is passed from one generation to another generation. As the age increased, the farmers become experienced with the technologies by coming across the activities either at their own farm or in the farm of fellow farmers. Due to prevailing situation of increasing trend of unemployment, many

of the rural people engaged themselves in sericulture utilizing their acquired experience as it gives quick return and better income than many other agricultural crops. Extension is one of the important events to enrich a farmer knowledgeable in a particular field. Thus, frequent contact with the sericulture extension personal and participate in different extension programme make the farmers more knowledgeable about improved technologies of muga culture. The results of the study are in consistency with Shivaraja (1985b), Aswathanarayana (1989b), Satheesh (1990b), Prabhakar *et al.* (1992), Borkar *et al.* (2000), Mahanthesh (2000), Chandrashekar *et al.* (2005) and Vijayakumari and Rajan (2006) reported in mulberry sericulture. On the other hand, as the muga culture is a traditional practice and passed from one generation to another, formal education is not an essential for a person to involve in muga sericulture. One can learn the practice by observing and handling the activities once or twice. Likewise, family size is also not an important factor to have knowledge of improved technologies in muga culture. Sreenivasa (1989a) also stated that family size have no relationship with the knowledge level of sericulturists with regard to silkworm rearing practices. As regard to the mass media, it is agreed that mass media plays an important role in transforming the information among the people. However, it is fact that like agricultural news broadcasting, there is no regular broadcasting programme on muga culture through Radio, TV, Newspaper, etc. Occasionally, some news or programmes on muga culture are broadcasted by the TV and radio channels. Moreover, in many of the farmers' house TV and radio are not available. Hence, mass media do not have significant association with the knowledge level of the muga farmers. The above findings are also in line with the findings of the study carried out in mulberry sericulture by Dayananda (l985), Srinivasa *et al.* (2004), Chandrashekar *et al.* (2005).

5.3.1 Multivariable relationship between knowledge levels of the muga farmers

The extent of adoption of new technologies was influenced by different factors among which, knowledge level was the foremost. The socio-economic status of the muga culture determined their knowledge level and hence a simple

multiple linear regression analysis of the factors influencing knowledge was performed. The data on multiple linear regression analysis of knowledge towards improved technologies presented in the Table 4.4.2 revealed that the regression co-efficient of the personnel and socio-economic variables of the respondents namely age (X_1) and extension participation (X_8) were found to be highly significant at 1.0 per cent level of significance among muga farmers towards knowledge level about improved technologies. While the variables experience in muga culture (X_6), were found significant at 5 per cent level. The age and extension participation showed positively significant relationship. As the age is increased, the knowledge level of the farmers on different aspects of muga culture is increased and the farmers are able to understand the benefit of improved technology of muga culture by participating the extension programme, demonstration or through reading of booklets, pamphlets, etc. Further, experience in muga culture found positive and highly significant at 5.0 % on knowledge level may be due to fact that the farmers have long experience by involving in different activities year after years and could understand the new technologies and its benefit easily. Further, the variables like sericulture income (X_4) and land holding (X_5) were found positive relationship. This may be due to fact that land holding depicted positive and significant association with income (Srinivasa *et al*, 2004). The findings are in accordance with that of Srinivasa *et al*. (1996) and Munikrishnappa *et al*. (2002a). Further, Meenal and Rajan (2007) reported that association between land holding, mulberry area and income obtained with knowledge was just because of the linear and positive link among them. Further, education was found to positive on knowledge level may be due to fact that education of every individual determines their knowledge level and mental status. Normally, educated farmers of the village areas held membership in different social organizations which provided them opportunities to express and exchange their views and enrich their knowledge. On the other hand, it could be observed from the table that family size is negatively associated with the knowledge level. It indicates that involvement of the farmer in muga culture make him

knowledgeable in spite of having less member in the family. As regards to the mass media, it was found that although mass media plays an important role to enrich the knowledge, but it is negatively associated with the knowledge of the farmers on improved technologies of muga culture. This is due to the fact of not getting the regular programme on muga culture in mass media by the farmers as getting by the farmers in other agricultural sectors.

5.4. Adoption level of improved technologies of muga culture by the muga farmers

The data presented in the Table and Figure 4.5.1 revealed that majority (51.5%) of the respondents belonged to low adopter of improved technologies of muga culture while, high and medium adopter was 21.5 and 27.5 percent respectively. The possible reasons for low and medium adoption of improved technologies might be that the technologies are relatively a new concept to many of the farmers and still in the stage of acceptance by the farmers. This implied that farmers need to be educated regarding benefits and advantages of improved technologies for their adoption. High cost involvement in some of the technologies might be one of the explanations. Thus, it could be inferred that majority of the respondents adopted the technologies involving low cost and easily available. Whereas, the technology involving complex knowledge, skill, high cost and inadequate availability of input were found to be adopted by relatively lesser proportion of the respondents.

The data depicted in Table 4.6.1 revealed the extent of adoption of selected improved practices of muga culture among the respondents are discussed as below.

Spacing of host plants: From the data presented in the Table 4.6.1, it could be observed that majority of the respondents (64.0%) were full adopters followed by medium adopters (23.5%) and non adopters (8.5%). Systematic plantation in recommended spacing (3m X 3m) facilitates to smoothly perform cultural operation, agronomical practices, intercropping, etc. Further, plantation in recommended spacing enhanced carrying capacity of silkworm rearing through

production of quality leaf yield and facilitate for erection of nylon nets during silkworm rearing. The higher adoption of technology may be due to have higher level of knowledge of the technology among the respondents as the case shown in Table 4.3.1. The technology was being popularized through different extension programme like, field demonstration, farmers training programs, krishimela, technology awareness programme, etc conducted by CSB and State Sericulture Department since last one and half decades among the farmers. Besides, both financial and technical support was provided to the farmers for adoption of technologies under CDP. However, some farmers are still maintaining the old plantation with scattered spacing as they are reluctant to uproot the existing plantation.

Application of FYM and NPK: The technology was found to be adopted by 43.5% and 8.0% as full and medium respectively among the respondents while, majority of the respondents (48.0%) was found as low adopter of the technology. The reasons may be due to financial constraints for purchasing the inputs or high inclination towards traditional practices. Hence, it is need of the hour to create more awareness among the farmers about the input application and its benefit through different extension programme like Front Line Demonstration, Training, Awareness programme, etc. The result is in conformity with the observation of Mech *et al.* (2004b).

Pruning schedule: Pruning schedule of plants according to the silkworm crops is one of the important activity for production of quality foliage and required leaves for early instars as well as late instars silkworm rearing. However, the extent of adoption of pruning schedule was high as partial (42.0%) followed by full adoption (27.0%). Remaining farmers (31.0%) are found as low adopter of the technology. From the Table 4.3.1, it was found that 81.5% farmers have knowledge about the pruning schedule of muga host plants. The reasons for non adoption and medium adoption of pruning schedule among the large number of farmers may be due to lack of manpower, high inclination towards traditional practices, etc. Hence, create awareness among the farmers about the importance

of pruning through different extension programme like Front Line Demonstration, training, awareness etc is an urgent need.

Control of stem borer: Stem borer is a most common and serious pest of som and soalu. The caterpillar feeds on the tissue of the tree trunk and make bores into the main trunk. Ultimately the plants are died. Technology has been developed to control the infestation of stem borer up to 80% through botanicals (5-15% of crude plant extract of Neem (*Azadirechta indica*), Titabahak (*Adhatoda vasica*) and Castor (*Ricinus communis*). The plant extracts are used as crude extract and details study of the active ingredients of the above plant extracts and their action to the pest of muga host plants has not been made so far. Chemical ingredient present in the leave *viz.*, Azadirachtin ($C_{35}H_{44}O_{16}$) in Neem, Vasicine ($C_{11}H_{12}N_2O$) in Titabahak and Ricinine (C8H8N2O2) in Castor have wide range of insecticidal properties and probably these chemicals are act well for killing the pest. Data presented in the Table 4.6.1, it could be observed that majority of the farmers was non adopter (49.0%) followed by medium adopters (31.5%) and full adopters (19.5%) of the technology. Although, knowledge of the farmers about the technology was high but, adoption level was not encouraging. The reasons for low and medium adoption of technology among the large number of farmers may be not giving much importance in maintenance of plantation. Hence, create awareness among the farmers about the importance of stem borer control through easily available botanicals is most urgent.

Intercropping: The land of som garden is suitable for various vegetable crops and there is sufficient space for taking intercrops between the two rows of plants. Recommended crops like Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*) and Colocasia (*Colocasia esculenta*) are very much suitable as intercrops with the som plantation and gives additional farm income of Rs.6000- 10000 in one ha systematic plantation of som (Rajan and Hazarika 2012). It is evident from the Table 4.3.1 that, 87% farmers had knowledge about the intercropping with the Som. However, the practice was found to adopt fully by 23.5% farmers followed by medium and low (42.0 % and 34.5 %) respectively. Reasons for medium

and low adoption of technology among the large number of farmers may be due to lack of time, available of separate land for vegetable crops, lack of manpower and also reluctant to adopt the new technology. Hence, create awareness among the mass scale of farmers about the benefit of intercropping is also need of the hours.

Pre brushing care : Disinfection of rearing field with slaked lime powder and bleaching powder (9:1) and spray of 0.01% sodium hypochlorite, removal of the dry leaves and twigs, ant nests etc from the plants prior to brushing are most important part of muga culture. These are essential for preventing silkworm from infestation of pest and diseases. The efficacy of sodium hypochlorite in controlling mortality due to viral and bacterial diseases has been reported in muga silkworm (Singh *et al*. 2014). From the Table 4.6.1, it is revealed that majority of the respondents (55.5%) had adopted the technology fully while 18.5% farmers adopted the technology partially. Rest of the respondents (26.0%) were belonged to low adopters of the technology. Muga farmers of the study area are traditional farmers and they know the cleaning of plots, removal of the dry leaves, ant nests etc from the plants before brushing. Disinfection of rearing field with slaked lime powder and bleaching powder (9:1) and spray of 0.01% sodium hypochlorite also adopted by the farmers very fast as it is very much effective to control of viral and bacterial diseases of silkworms and also economically feasible. This was due to the reason that the farmers understood the impact of disinfection on the success of cocoon crop and on the economic returns. Probably due to this fact, majority of farmers adopted the technology fully. The reasons for non and partial adoption of technology among by the farmers may be due to lack of time, non availability of materials, lack of manpower and reluctant to adopt the new technology. Hence, create awareness among the mass scale of farmers about the benefit of pre brushing care is also necessary.

Early stage rearing: The extent of adoption of early stage of rearing was found full in 28.5 percent farmers while medium in 42.0 percent. Low adoption of technology was found in 26.0 percent farmers. An intensive care during early

stage rearing is an important activity of rearing. Rearing of early stage muga silkworm (1^{st}- 3^{rd} instars) under the nylon net reduces young stages loss of silkworm and results in gain of 42-70% cocoon production (Rajan and Hazarika 2012). The muga farmers of the study area also take care of this during their rearing of silkworm. However, nylon net is a costly item and the cost of required nets may not be affordable for all the farmers. Probably, due this reason, many of the farmers are not adopting the technology fully. Whoever the farmers used the technology fully; they used the nylon nets supplied from the CSB and Department of Sericulture under different schemes. Hence, it is necessary to provide required assistance to the farmers for procuring the nylon nets under different schemes. Further, it is equally important to make aware the farmers about the usefulness of using nylon net during early stage rearing of silkworms.

Biological Control of Uzi fly: Uzi fly (*Exorista sorbillans* Widemann*)* is one of the major pest which causes 80-90 % damage of muga cocoons resulting huge loss to farmers. The peak season of infestation of the pest is mainly during winter crops (Rajan and Hazarika 2012). There is no chemical remedy as its damage to muga silkworms also, so biological control is only way to reduced the infestation of uzi fly. But, majority of the farmers (86.0%) were low adopter of the technology whereas 11.0% farmers medium and 3.0% farmers fully adopted the biological control of uzi fly. Although, various awareness programme, training, demonstration, etc conducted for popularizing the technology, only few farmers have knowledge about the technology (Table 4.3.1). Unless the farmers aware the multiplication technique of parasitoids of the uzi fly (*Nesolynx thymus),* they cannot adopt the technology. Further, the parasitoid is not easily available at the farmers' level. That is why, extent of adoption of the technology is very less.

Lahdoi: 'Lahdoi' an anti-muscardine formulation has been developed for control of muscardine disease of silkworm. Application of 0.1 percent of the formulation ensures 40-70 percent Effective Rate of Rearing (ERR) against 100 percent mortality of worms due to the muscardine disease. The formulation is sprayed on the food plants 7 days prior to brushing and transfer of silkworm. The second

spraying is done at 15 days after 1st application. The technology was being popularized since last 10 years by the scientist of CMER&TI, Lahdoigarh in the study area through various extension programmes. From the Table 4.6.1, it is evident that majority of the farmers (44.0%) were belonged to low adopter category of the technology. However, medium adoption of the technology was found in 39.0% farmers and full adoption was found in 17.0% in the study area. Muscardine disease generally prevalent during winter crops (Das *et al.* 2012) and many of the farmers do not take the crop due to prolonged larval duration. Further many of the farmers preferred only commercial crops during October-November and April-May. Hence, very less number of farmers undertakes the crop during winter seasons. Besides, the formulation is not available in the market except at the laboratory of CMER&TI, Lahdoigarh. Another important reason for non-adoption of technology might be height of plants used for rearing by the farmers. As many of the farmers do not prune the plants timely, the heights of plants are not accessible for spraying the formulation. This may be the reasons for low and medium adoption of the technologies among majority of the farmers.

Improved mountage: Improved box type montage is one of the improved technologies for cocooning of muga silkworm. Using the technology, manpower can be saved by 60 percent and space requirement can be reduced by 90 percent. In addition to these production of superior quality cocoons, easy harvesting, less harvesting time, etc are the advantages of the technology. The technology was being popularized since last one and half decades among the farmers in different muga growing areas including the present study area. It could be seen from the Table 4.6.1, that as many as 67.0% farmers are not adopter against 21.5% partial adopter followed by 11.5% full adopter of the technology. Although the bamboo mountage have various advantages, it involves some cost, which is not easily affordable for the farmers. The traditional methods of cocoonage used by the farmers have no cost involvement and easily available. That is why, the extent of technology adoption was not encouraging even though, the farmers of the study area exhibited good knowledge on improved technologies (Table 4.3.1). This

may also be fact that the knowledge acquired by the farmers through effective extension participation had not been transformed into productivity. This may be due to lack of knowledge coupled with unwilling to adopt and also due to higher cost to adopt these technologies. The partial and no adoption in the technologies mentioned above may be because of low or no education and poor extensionparticipation by the farmers in the study area.

Mother moth examination: Pebrine is a serious disease of silkworm caused by protozoan. Technology for detection of pebrine spore by mother moth examination through microscope has been developed and the technology has been transferred to the farmers through training, demonstration, etc. However, it could be seen from the Table 4.6.1, that only 3.5% farmers were found as medium adopter against 96.5% farmers as low adopter of the technology. No farmer was found to adopt the technology as full adopter category. As education levels of many of the farmers had up to secondary level, it is difficult to learn and follow all the procedure of moth examination and detect disease spores under microscope. Further, it is also time consuming process and requires lot of facilities as laboratory. Besides, the technology is highly cost involvement including purchase of microscope, consumable items, chemicals, centrifuge, table, stools, etc to creation of examination facilities in the grainage house. Generally, the farmers adopt lot of traditional practices in silkworm seed production. Perhaps, due to these reasons farmers are not showing much interested in mother moth examination rather they adopt the traditional practices for own satisfaction.

Egg surface disinfection: Once the microscopic examination of mother moth is done, eggs surfaces of the harvested eggs need to be disinfected through washing of eggs in 2% formalin solution for 2-3 minutes followed by washing in soap water for 2 minutes and finally by fresh water till disappearance of formalin smell. Then keep the egg in a single layer on blotting paper and dry in shade. In order to popularize the technology, lot of training and demonstration were organized for the farmers time to time. However, from the Table 4.6.1, it could be

visible that as the mother moth examination had not adopted by the farmers, Egg surface disinfection was not followed by the farmers. It was revealed from the table that almost all the farmers (98.5%) had not adopted the technology. Perhaps, due to high inclination towards traditional practices or not aware the technology extent of technology adoption level is completely low. As such, more awareness programme and training is needed to be conducted for the farmers for popularization the technology properly.

5.5. Association between socio-economic characteristics of muga farmers and their adoption level of improved technologies of muga culture

Data on correlation coefficient test computed for adoption level of farmers presented in the Table 4.7.1 revealed that out of 8 variables, 5 variables showed positive and significant correlation with adoption level and one variable shows negatively significant correlation with the adoption level of farmers. It could be observed that age, sericulture income, land holding, experience and extension participation showed positively significant relationship and education had a negatively significant relation with adoption level of improved technologies of muga culture among the farmers. However, family size and mass media had a negative relationship with the adoption level among muga framers.

As the age is increased, the knowledge and experience level of the farmers on different aspects of muga culture is increased and they are able to understand the benefit of improved technology of muga culture by participating the extension programme, demonstration or through reading of booklets, pamphlets, etc. Hence, as the age is increased, the adoption level of muga culture technology also increased among the farmers. The findings are in accordance with the findings of Geetha (1993) and Srinivasa *et al*. (2003) where they found to have a positive significant relationship of age and adoption level of sericulture technologies.

Improved technologies of muga culture give higher production and higher income and hence, a significant association was found between the income and improved technology adoption in muga culture. Geetha *et al.,* (2001) also found that income had a positive and significant correlation with the level of

adoption of sericulture technology among the farmers in non traditional area of Karnataka. Similar finding was also noticed by Srinivasa *et al.* (2004) in mulberry sericulture.

Similarly, size of land holding directly influenced the farmers to adopt the technologies of muga culture. Since majority of the farmers have knowledge on maintenance of food plantation, they are taking care for maintenance of plantation following the recommended practices to increase the production of quality leaf. The result is in conformity with the findings of Srinivasa *et al*. (2003) and Srinivasa *et al.* (1996) reported in mulberry sericulture. Present finding is supported by the findings of Satheesh (1990a), Gopala (1991a), Anjaneya Gowda (1993), Siddaramaiah and Prakash Kumar (1994) and Munikrishnappa *et al*. (2002a).

Experience, of course is most important factor, which influenced to adopt the technology of muga culture. Many of the time farmers had experience on good crop harvesting due to adoption of improved technology and have experienced of good harvesting in the demonstration plot. That is why, farmers having more experience in muga culture, have shown a higher interest in adoption of improved technology. Experience helps an individual to think in a better way and make a person more mature to take right decisions .Generally economic condition of muga farmers are not improved and many of the time they are not in a position to incur the money for technology of muga culture. Present finding is also supported by the findings of the study made in mulberry sericulture by Geetha (1993), Vijaya Kumari and Rajan (2006) and Sujatha *et al.* (2006a).

In sericulture extension system, Department of Sericulture have a good extension system to provide technological inputs to the farmers. Besides, CSB has conducted different extension programme field day, farmers, day, technology demonstration, technology awareness programme, reshom krishimela, etc covering each and every potential pockets time to time. From the Table 4.1.1, it is evident that many of the farmers had participated these programmes either

regularly or occasionally. Participation of different extension programme, the farmers might have encouraged for adopting the improved technologies for better yield in muga culture. The finding is in accordance with the findings of Singhvi *et al.* (1994a) and Munikrishnappa*et al*. (2002a).

In the present day situation, cost of living among all classes of people of the society is going up everywhere. In such situation, expenditure is very high to run a medium and large size family smoothly. Majority of the families of the muga farmers were belonged to medium size having with 4-5 members and their income from sericulture was found low (Table 4.1.1). In such case, they are not ready to spend additionally for new technology rather they go for traditional practice where money involvement is less or nil. This may be the probable reason for showing negative correlation between the family size of muga farmers and adoption of technologies of muga culture. Meenal and Rajan (2007) also reported that both knowledge and adoption was significantly influenced by most of the socio economic characters except age, education and family size. However, present finding is not comparable with the finding of (Geetha *et al.*, 2001) where it was reported that family form and size had a positive and significant correlation with the level of adoption of sericulture technology.

Mass media plays a vital role in adoption of sericultural technology among the farmers. Satheesh (1990a), Gopala (1991a) and Singhvi *et al.* (1994a) also reported that mass media participation had positive and significant relationship with the adoption of sericulture practices. However, in case of muga cultures, it showed a negative relationship with adoption of new technology. This might be due to non-availability of mass media service for development of sericulture in Assam in a desired level. Hence, there is no influence mass media in popularization and adoption of improved technology of muga culture among the farmers.

5.5.1. Multivariable relationship between adoption levels among different categories of farmers

The data presented in the Table 4.7.2 revealed that the regression co-efficient of the personal and socio-economic variables of the respondents namely

age (X_1), experience (X_6) and extension participation (X_8) were highly significant at 1 per cent level among muga farmers towards adoption level about improved technologies. As the age is increased, knowledge and experience of the farmers is increased and the farmers can take proper decisions about the adoption of technologies. As the technologies are effective for production of better crop, the farmers adopted the technologies. Geetha *et al*. (2001), Rajeev (2004a) and Sujatha *et al.* (2006a) also reported the same findings in mulberry sericulture. As regards to the experience, it has observed that majority of the respondents have high level of experience and therefore they know the problems and facts related to the muga culture from their experience. The farmers have also experienced on impact of improved technologies through participating in different field demonstration programme and this influenced them to adopt the improved technologies for better crops. The sericulture income (X_4) had a positive relationship with the adoption level of technologies among the farmers. Income of a person determines the social and economic status of the family. In light of this fact, muga being a high fetching crop, the farmers adopt the improved technologies to earn more income through better crop performance.

On the other hand, the variables like education (X_2), family size (X_3), land holding (X_5) and mass media participation (X_7) were found negative relationship towards adoption of improved technology muga culture. Education did not influence the technology adoption, may be because of the fact that, muga culture is an inherited occupation in most of the households and experience gained over the years influence knowledge and adoption. Further, family size was found to have negative influence which may be due to not involvement of all the members of a family in the activities and thus contributing negatively. The results of the study are in consistency with Srinivasa *et al* (2004) and Meenal and Rajan (2007). As regards to the land holding, it is fact that small size land holding accommodate less number of plants and it easy to maintenance following the improved practices. Large size land holding accommodate more number of plants and it is also difficult to maintain properly following the improved practices as it

required more manpower as well as higher investment. The mass media did not influence the adoption of improved technologies as it is fact that there is no regular programme for the farmers of muga culture as available for the farmers in other agricultural sectors.

5.6. Traditional practices of muga culture

Muga silkworms are reared in outdoor and the silkworms are highly susceptible to various bacterial, viral, fungal and protozoan diseases. As the muga culture is a traditional practice, lots of traditional practices were found to adopt by the farmers during rearing and seed production. From the findings cited in the Table 4.8.1, it is evident that prior to selection of a healthy brood of silkworm, the farmers strictly observed various symptoms and behaviours from egg to adult (moth) stages to assure better yield in the subsequent crop. Quality silkworm seed plays an important role in success of muga silkworm crop. To prepare the quality silkworm seed, farmers' select healthy brood of silkworm through observing various good symptoms and behaviours of silkworms during its rearing. If any disease infected silkworm larvae are observed, the brood is not considered to rear in the next generation. While select a brood for next crop, the farmers strictly observed movement of newly hatched worms, color of body and head, incidence of diseases, feeding behaviour, growth pattern and sensitiveness of larvae and presence of excreta in the rectum of fifth stage larvae. In general, quick movement of newly hatched worms to the leaf surface, prompt movement of 4^{th} and 5^{th} stage larvae during day time, light green body colour with copper colour head, free from diseases and no mortality, feeding of entire leaf (start feeding from the leaf apex to the leaf midrib and following up to the leaf stalk), uniform growth of larvae, instantaneous response while touch, possessed more than one excreta in the rectum of fifth stage larvae were considered as healthy symptoms and behaviours of silkworms brood and considered for next generation rearing. During cocoon stage the farmers observed the cocoon characters such as uniformity and compactness of cocoons, alive pupae inside the cocoon to determine the healthiness of a brood. Peak emergence of moths at the evening,

deep brown colour of wings, alive moths for 5-6 days after egg laying are considered as healthy symptoms during adult stages. Similarly, uniform egg laying around the *Khorika* , no depression of eggs, etc are the good symptoms of brood observed during egg stage. Naturally, these practices have very much relevancy for harvesting a good muga crop and have scientific inference for which the traditional muga farmers strictly followed them. Quick movement is one of the prime characteristics of a healthy organism in comparison to unhealthy one. Similarly, irregular feeding such as, half fed of leaf is a sign of diseased or unhealthy worms. A normal silkworm has a copper colour head while a diseased or weak larvae posses blackish head capsule, A larva habitually retains excreta in the rectum after excretion indicating normal feeding and digestion. This is due to normal absorption of essential nutrients by their rectal walls. Hence, failure to retain this excreta causing diarrhoea is due to physiological weakness of larva. Diseases disrupt the physiology of the larvae which in turn disrupts growth and moulting. These symptoms and behaviours of silkworm larvae are certainly important to select a healthy brood for next generation. Similar observations were reported by Thangavelu *et al*. (1988b), Bhattacharya *et al.* (1992), Borthakur (2003), Phukon *et al.* (2006) and Sarmah *et al.* (2010).

Disinfection: Disinfection of silkworm seed production house (grainage house) and aliances used in seed production to make free the seeds from diseases. Equally, disinfection of rearing aliances prior to use in rearing of silkworm is important to avoid chances of occurrence of diseases of silkworms during its rearing. From the Table 4.8.2, it is evident that after complete the activities, all the equipment used in silkworm seed production and rearing, were kept over the kitchen fire till further used. By this practice, the aliances are disinfected against pebrine spores and other microbes, which are known to desiccate under high temperature (Unni *et al*. 2009). Plastering of floor and walls of the grainage house with cow dung mixed mud prior to enter seed cocoons, hanged up leaves and twigs of Tulsi (*Ocimum sanctum*) at the walls of the grainage house and sprayed Tulsi leaf concoction on the floor and walls of grainage house during

grainage. Cow dung is a great source of methane (CH4). Microbes found in the cow dung are mostly anaerobic and release methane as by-product of their oxidation activities. When the methane in the cow dung comes in contact with the air and sunlight, it produced formaldehyde which is an antimicrobial and germicidal. It even kills spores of bacteria Thus, the cow dung provides a nature friendly disinfectant. (Anonymous, 2014). Similarly, tulsi have antimicrobial properties and hence, the farmers used to spray Tulsi leaf concoction on the floor and walls of grainage house during grainage to prevent the silkworm seeds from harmful microbes. Phukon *et al.* (2006), Sarmah *et al.* (2010) and Chakravorty *et al.* (2015) also reported the same traditional practices adopted for disinfection of rearing and grainage equipments by the traditional muga farmers in Assam.

Silkworm seed production: Preservation of seed cocoons in proper way for emergence of moths is a most important part of grainage activity and need utmost care and skills of the farmers. From the Table 4.8.3, it is aarent that in traditional method the farmers used to preserve seed cocoon at perforated bamboo cage in single layer. The principle of practice is to provide sufficient aeration for the seed cocoons and to facilitate the moths to emerge from the cocoons freely. Due to low temperature during winter, it takes 30 to 40 days for emergence of moths against 18-20 days during summer. During winter the farmers kept the seed cocoon near the kitchen fire and exposed the cocoon in to sunlight at day time. In kitchen, normally the temperature is relatively more to some extent than other places due to heat generate from kitchen fire and burning of gas time to time. Thus, the, seed cocoons preserved at kitchens and exposing them in to sunlight help the pupae for quick metamorphosis in to an adult. When moths are emergence, they were allowed to couple naturally before midnight. It indicates that the moths which are healthy, respond more to sex pheromonal allurance, thus, resulting in natural coupling. Diseased or weak moths do not show coupling efficiency due to low response to sex pheromone. After 10-12 hours of pairing, copulated moths were exposed to smoke produced through burning of paddy straw for a few minutes at the evening for decoupling. The traditional rearers

believed that de-coupling of moths by this process lay more number of eggs. Normally, pairing of muga moths are retaining for many hours. If the depairing is done mechanically, gonadial organs of the female moths are injured. As a result, egg laying of a moth is interuupted. On the other hand, self depairing of moth using the smokes is avoided injuriness of gonadial organs of the moths, resulting more egg laying. Moths were allowed to lay eggs for maximum three days. After three days of egg laying, female moths were removed from the *kharika* and the eggs along with *khorikas* were kept in dark and shady place till hatching. The rearers also used to hang of tulsi leaves/twigs with the kharikas to prevent disease outbreaks during rearing. This is also due to the fact that tulsi have antimicrobial properties and hence, the farmers kept tulsi leaf or twigs along with the *kharikas* to prevent secondary contamination of diseases from outside. Similar observation was reported by Thangavelu *et al*. (1988b), Bhattacharya *et al.* (1992), Phukon *et al.* (2006) and Chakravorty *et al.* (2015).

Silkworm rearing: There are different identified morphotypes of Som trees based on their shape and size of leafs. Some of them are palatable and some are not palatable to muga silkworm. The recommended varieties of som plants *viz.* S3, S6 and S4 are more palatable and shape of those leaves are resemble with the leaves of Indian ironwood. From the Table 4.8.4, it is evident that farmers preferred those som trees which leaves are resemble with the leaves of Indian iron wood (*Mesua ferrea*). Although, the farmers used this variety of som trees traditionally, but there must have scientific inference for which presently it is recommended as S3 variety of som for better rearing performance of muga silkworm. Again, in many of the times, newly hatched worms were brushed at Dighlati plants (*Litsea salicifolia)* to reduced disease of silkworm. There might be certain chemical component in Dighlati leaf that have antimicrobial properties and act to reduces diseases of silkworms. Before brushing of silkworms, the rearers used to burn dry leaves, undergrowths, twigs and debris in the rearing field to repel pests and predators of silkworms. It is fact that various insect pest like bugs, mantis and predators of silkworms are nested in the muga host plants.

Since, chemical insecticides or pesticides are not possible to use for control these pest and predators, the smoke generated through burning of dry leaves, undergrowths, twigs and debris also help to repel the above pest and predators from the host plant. This practice also helps to kill the hibernated pests in soil and reduce the pest population at later stages of the crop. Besides, as mechanical control, the farmers also removed the nests of ants, spiders, trail of termites, etc which causes serious damage of silkworm particularly in its early stage rearing. This practice is nature friendly and does not causes any adverse effect to silkworm as well as environment. Sometimes, the traditional farmers kept rotten fish or meat to control red ants (*Oecophylla smaragdina* Fabricius**)** nested in the host plants. The red ant causes considerable damage of silkworm both in early and later stages and hence it is required to control them for better yield. While keeping the rotten fish or meat at the tree trunk, the ants are accumulating on them and then it become easy to kill the ants by burn. On the day of hatching, *khariks*' with the hatched worms were hanged at the twigs of the selected host plants or the *khariks*' were tied with the main trunk of the plant. This practice of brushing helps the newly hatched silkworms to distribute proportionately in the host plants. At the time of finish the leaf in the host plants, the worms crawl down to tree trunk for searching leave at another plant. At that time, the farmers picked the worms and put at another plants having with quality leaves. Transfer of worms from one plants to another were done generally at third or fourth stage with the help of triangular trays made up of bamboo called *'Chaloni'.* It is fact that frequent handling of worms or careless picking of worms during transfer might lead to detachment of podias from the body of the worms, thereby, killing them due to excessive flow of heamolymph from the body. Therefore, the farmers used to pick the worms very carefully only once or twice at its 3^{rd} or 4^{th} stage to avoid frequent handlings. During transfer of worms the rearers segregate them based on their size difference which in turn enables them to have a homogenous maturation of worms. Diseased worms because of their physiological imbalance show late moulting and stunted growth. Hence, by this method, diseased worms

are separated from the healthy ones and prevent secondary contamination disease. Moreover, such segregation of worms during transfer also facilitates better collection of mature worms, thereby, giving a much closer aroximation to the mature worms collected and cocoons harvested. Similar observations were also reported by Thangavelu *et al*. (1988b), Bhattacharya *et al.* (1992), Phukon *et al.* (2006), (Unni *et al*. 2009) and Chakravarty *et al.* (2015).

Mounting of ripen worms, cocoon harvesting & stifling: The Table 4.8.5 enlighten that the ripen worms collected at evening with the help of bamboo basket and put them in to mountage (farmers termed as 'jail') for cocooning. The jails were prepared from dry leave and twigs of certain plants locally named as *nahor* (*Mesua ferrea* sp.), *hingori* (*Castanopsis* sp.), *azar* (*Lagerstroemia speciosa*), *bhomlati* (*Celastrus monospermus*), etc. The jails made up of these plants leaves and twigs provide suitable space for formation of cocoons along with its brightness. Besides, these plants are easily available and there is no cost involvement at all. After harvesting, the cocoons were exposed to bright sunlight or hot smoke generate by burning of wood for stifling. After dying of pupae, farmer also used to expose the cocoons in sunlight for 2-3 days to reduce the moisture contents of the cocoons as well as pupae. This practice is useful for preservation of reeling cocoons up to a certain period. If the stifling of cocoons is not done in time, moths will be emerged out by cutting the cocoons. Once the moths are emerged from the cocoons, those cocoons are not suitable for reeling. Further, after stifling, some amount of moisture are retain in the pupae. If the pupae are not dried properly, it will be melted and result in damage of the cocoon shell. Thangavelu *et al*. (1988b), Sarmah *et al.* (2010) and Chakravarty *et al.* (2015) also reported the same observation followed by the traditional muga rearers.

5.7: Cocoon yield under improved technologies and traditional practices

From the Tables 4.9.1 and 4.9.2 it was revealed that average number of cocoon yield per dfl in both Chatua and Bhadia seed crops during 2014 was higher in improved practice (47 & 42) against the cocoon yield per laying in

traditional practice (31 & 20) respectively. Similarly, the average number of cocoon yield in both Chatua and Bhadia seed crops during 2015 was higher in improved practice (45 & 24) against the traditional practice (37 & 19) respectively. Hence, the ERR in both Chatua and Bhadia crops was found higher in improved practice (41.80% & 58.93%) than traditional practice (28.48% & 26.93%) respectively during 2014. Likewise, the ERR in both Chatua and Bhadia crops was higher in improved practice (40.53% & 33.45%) than traditional practice (33.45% & 26.51%) respectively during 2015.

Again, the Tables 4.9.3 and 4.9.4 revealed that under improved practice the average number of cocoon yield per dfl in both Jethua and Kotia commercial crops during 2014 was higher in improved practice (62 & 58) against the cocoon yield per laying in traditional practice (49 & 43) respectively. Similarly, the average number of cocoon yield in both Jethua and Kotia commercial crops during 2015 was higher in improved practice (65 & 52) against the traditional practice (47 & 43) respectively. Hence, the ERR in both Jethua and Kotia commercial crops was found higher in improved practice (55.28% & 68.92%) than traditional practice (43.43% & 58.95%) respectively during 2014. Likewise, the ERR in both Jethua and Kotia commercial crops was higher in improved practice (58.20% & 62.39%) than traditional practice (42.21% & 60.40%) respectively during 2015.

As the muga silkworms are reared in outdoor, sometimes they are exposed to adverse environmental factors like high temperature, storms, rain, etc. Besides, various seasonal pest and predators assault the silkworm during its rearing. Further, the muga silkworms are also highly susceptible to various diseases caused by bacterial, viral and protozoan pathogens. The improved practices of maintenance of muga host plants viz, application of FYM and NPK, pruning of plants according to crop schedule, control of stem borer, etc are effective for production of quality leaf to rear silkworm. Disinfection of rearing field with the mixture of lime and bleaching powder and spray of potassium hypochlorite before brushing of silkworm, reduced intensity of silkworm diseases during its

rearing. In improved practices, the farmers used disease free layings (dfl) produced through examination of mother moths and surface disinfection of eggs. Silkworms were reared on quality leaves produced through pruning of plants according to crop schedule. Nylon nets were used to protect various pest and predators of silkworm. Lahdoi was used to control muscardine disease of silkworm. On the other hand, in case of traditional practice, the farmers never maintained the host plants. Non-application of inputs to the host plants and non attending pruning of plants resulted production of inferior quality of leaf unsuitable for rearing of silkworm. In case of traditional methods, the farmers used to brush the silkworm in a crude method i.e, never used examination of mother moth as well as surface disinfection of eggs. Besides, the farmers never used disinfection of field before and after rearing. Nylon nets could not be used to protect the silkworm from pest and predators due to tallness of plants as they never used to prune the plants. Thus, loss of silkworm due to incidences of pest and diseases was found to be higher in traditional practice against the improved practice. From the Table 4.9.1, it was observed that loss of worms was recorded 15.0 to 18.5 percent due to incidence of pest and 29.8 to 36.5 percent due to incidence of diseases during seed crop rearing. On the other hand, loss of silkworm due to incidence of pest and diseases was found to be less in improved practices. The Table 4.9.2 indicated that loss of worms was 11.4 to 14.6 percent and 13.2 to 28.0 percent due to incidence of pest and incidences of diseases respectively during seed crops. Hence, the ERR during seed crops was found higher and better in improved practices against the traditional practices of muga culture. In the same way, from the Table 4.9.3, it was observed that loss of worms was recorded 11.0 to 15.5 percent due to incidence of pest and 10.0 to 24.7 percent due to incidence of diseases during commercial crops of rearing. On the other hand, loss of silkworm due to incidence of pest and diseases was found to be less in improved practices. The Table 4.9.4 indicated that loss of worms was 7.2 to 8.8 percent and 5.5 to 15.8 percent due to incidence of pest and incidences of diseases respectively during commercial crops. Hence, the ERR during

commercial crops was found higher and better in improved practices against the traditional practices during commercial crops. Similar trend of cocoon production were also reported by Barah *et al.* (2006), Phukan *et al*. (2008) , Mech *et al*. (2008), Kakati (2009), Mech *et al*. 2011, Barah and Mech (2011), Das & Das (2012), Goswami *et al*., (2015) and Mech *et al*. (2015) under traditional and improved practices of muga culture**.**

5.8: Economics of muga cocoon yield under traditional and improved practices

Data presented in the Table 4.9.1-4.9.4, it could be observed that average annual carrying capacity of dfls/layings was found to be varied in traditional and improved practice. In the cases of improved practice, average carrying capacity of dfls was calculated to be 467g in seed and 596g in commercial crop, while in the case of traditional practice, average carrying capacity of layings was 448 nos in seed and 518 nos in commercial crop per year. The crop loss due to incidence of pest and disease of silkworm and other loss was recorded to be very high in traditional but, low in improved practice. As a result, cocoon yield was calculated to be 12067 nos and 22690 nos under traditional practice against 18677 nos and 35332 nos in commercial crops under traditional and improved practice respectively. The table 4.10.5 and 4.10.6 depicted that cost of cocoon production was less in traditional practice due to non adoption of improved technologies. But cost of cocoon production was relatively high in improved practice due to the cost of technologies specially inputs cost of plantation, nylon nets, disinfectants, bamboo mountages, etc. However, adoption of improved technology reduced the crop loss in both seed and commercial crops and resulted higher cocoon yield. Hence, although the cost of cocoon production in improved technology was high but, gave higher net income due to higher cocoon yield. On the other hand, non adoption of improved technology reduced the cost involvement for cocoon production in traditional practice, but gave lower net income due to low cocoon yield. By this ways, the calculated benefit cost ratio (BCR) was higher in improved practice against the traditional practice. In muga culture, the farmers used to conduct rearing at their own level using the own

family labours. Thus, the cost of hired human labours considered for rearing (Rs. 10000 in seed and Rs. 14000 in commercial crop under traditional practices and Rs. 10000 in seed and Rs 13000 in commercial crop under improved practices) can be saved by the farmers and considered as income of the farmers from employment generation in the muga culture. The result was in accordance with the findings of Mech *et al.* (2004c)**,** Barah *et al.* (2006), Mech *et al.* (2008) Kakati (2009), Barah and Mech (2011) and Mech *et al.* (2015). Similar findings was also reported in mulberry sericulture by Kumaresan *et al.* (2002), Bhargava *et al.*(2003) , Rajaram and Jaiswal (2004), Deepa *et al.* (2005), Lakshmanan & Geetha Devi, (2005a), Kasi Reddy *et al.*, (2006b).

5.8. Constraints for non adoption of improved technologies of by the muga farmers

Although various improved technologies of muga culture were recommended for the benefit of farmers, extent of adoption level of technologies by the muga farmers was not encouraging. Data presented in table and figure 4.5.1, it was found that majority of the respondents (51.5%) belongs to low extent of adoption. A considerable amount of respondents was belongs to medium extent of adoption (27.5%) followed by high extent of adoption (21.5%) of the recommended improved technologies of muga culture. The various constraints identified for medium and low adoption of improved technologies of muga culture among the farmers are presented in the table and figure 4.11.1. From the table, it could be noticed that the major constraints for non adoption of technologies are high inclination towards traditional practice, lack of proper knowledge and non availability of silkworm seeds on time. Muga culture is a traditional practice and lot of traditional practices and believes are associated in the culture (Thangavelu, *et al.* 1988b, Bhattacharya, *et al.* 1992 & 1993, Borthakur 2003, Phukon, *et al.* 2006, Dutta, *et al.* 2009, Unni, *et al.* 2009 Sarmah, *et al.*2010, Chakravorty, *et al.* 2015 and Goswami, *et al.* 2015c). Many of time these traditional practices have proved to be successful and sustainable. It is also fact that generally traditional farmers are not immediately ready to accept

a new technology. Often the farmers adopted the technology only after fully aware about the benefit of technology through participation in different extension programme. Similar constraints for non adoption of improved technologies of muga culture were reported by Barah, *et.al* (2004c) and Mech, *et al.* (2004d). Present finding are also supported by the findings of Sujatha, *et al.* (2006c) and Srinivasulu Reddy, *et al*. (2010b) reported in mulberry sericulture.

Lack of knowledge was found as one of the major constraints for low and medium adoption of technologies such as spacing of host plants, application of FYM and NPK to the host plants, pruning schedule, control of stem borer, pre brushing care, early stage rearing, biological control of uzi fly, lahdoi, improved mountage, mother moth examination and egg surface disinfection. Unless a farmer have proper knowledge on recommended doses of NPK and FYM, time of pruning, height of pruning for a plant, use of disinfectant, preparation of disinfectants solution, time of spray, etc it is difficult to adopt the technology effectively. Similarly, use of microscope, preparation of slides, detection of pebrine spores, preparation of formalin solution for washing of egg surface are purely technical activities and farmers should have the proper knowledge to adopt in their field. Puttaswamy (1977), Rajashekaraiah (1979b), Shivamurthy (1988b), Sarkar (1988), Gopala (1991b), Srinivasalu (1991b), Gopala and Krishna (1993), Datta and Dilip Kumarpradhan (1996), Govindaiah *et al.* (1996), Srinivasa *et al.* (l998c), Das and Saratchandra (1999), Ganapathy *et al.* (1999), Munikrishnappa *et al*. (2002b), Narayanaswamy *et al*. (2005b) and Dayananda and Kamble (2008b) also stated that lack of knowledge and technical guidance are the major constraints for non adoption of new technologies by the sericulturist.

Quality silk worm seed (dfl) is most important factor for success of muga crop. High temperature prevailing during summer, often resulting failure of seed crops which in turn resulting non availability of quality silk worm seeds for commercial crop. This situation is continuously occurred during past two decades. Thus, non availability of quality silkworm seeds on time made the muga

farmers dispirit for adoption of technologies. Barah, *et.al* (2004c) also reported the same as inherent and major constrains for non adoption of technologies among the muga farmers.

Other constraints identified for non adoption of technologies are non remunerative, lack of time, non availability of materials, high cost, labour intensive, non availability of own farm and marketing of cocoons. Farmers are generally poor and many of time they needs to engage themselves in different works for their livelihood. Probably due to the fact of this, lack of time was identified as one of the major constraints for low and partial adoption of many technologies. Among the recommended technologies, many of the technologies *viz*. early stage rearing, improved mountage and mother moth examination are involved certain cost and in some cases the cost is very high which is not affordable by the poor farmers. Further, among the recommended technologies, some of the technologies such as application of FYM & NPK to the host plants, pruning of plants, intercropping and mother moth examination are high labour intensive. In such case, poor farmers are unble to engage hired labour at prevailing rate. Thus, high cost involvement and labour intensive technology were found as constraints for low and partial adoption among the farmers.

Many of time, technologies like hyper parasitoids for control of uzi fly, Sodium hypochlorite for disinfection of field, nylon net for rearing of silkworm, formalin for disinfection of egg surface, etc are not readily available for the farmers. Probably, due to non-availability of such materials, the farmers are not in position to adopt the early stage rearing, biological control of uzi fly, mother moth examination and egg surface disinfection. The result is in line with the findings of the study made by Barah *et al*. (2004c) and Mech *et al.* (2004d).

Many of the muga farmers do not have their sufficient land for doing muga culture. In that case, they used to utilize muga host plants either at Govt. farm or private farmers on lease for conduct silkworm rearing. In such cases, the farmers are not interest to adopt certain technologies such as application of FYM & NPK to the host plants, pruning of plants, intercropping, etc. Thus, non

availability of own farm is one of the identified constraints for low and partial adoption of technologies in muga culture. 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 (Mech *et al.* 2007). Due to the reason for non availability of organized muga cocoons market, farmers do not get proper price of cocoon. Many of the time, cocoon produced by the farmers are sold to the commercial reelers at very low price through middle men (Goswami *et al.* 2015d). Thus, the muga cocoons producers (farmers) are often deprive from actual cocoon price and it makes them discouraged for adoption of technologies.