

Study the Problems and Prospects of Rearing of Muga Silkworm (*Antheraea Assama Westwood*) in Boko, Kamrup District, Assam



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Abstract

The golden Muga silk Culture of Assam is as old as Assamese culture. Even today it occupies a very important place in life and culture of Assamese people. Presently, Muga culture has been providing bread and butter to nearly 30,000 families in Assam alone. Assam is the largest silk producing state in the country alone contributes about 99% of the total muga raw silk production. Muga silk is supposed to be one of the costliest fabrics in the textile world. In this report an attempt has been made to highlight the problem and prospects of rearing of Muga silkworm (*Antheraea assama* Ww). The study is based upon some primary and secondary data. According to this data, the farmers of Muga silkworm have faced many problems. These are like, fluctuation of weather, lack of manpower, high price of cocoons, lack of awareness among the farmers about disease free layings (DFL) or absence of integrated pest management (IPM) technique for controlling the pests population, lack of knowledge's in case of advance technology. One of the most frequent problems faced by rearers is the lack of land for host plants. Muga culture is still practiced by the traditional rearers on scattered home plants in a limited scale instead of commercial block plantation. Lack of well-organized seed sector and proper marketing facilities is considered to be another major problem for muga rearers. Because of these types of problems, the production of muga silkworm has declined dramatically. In order to improve the productivity of this silkworm it is important to have a better knowledge of both its host plants and biology. There is a need to popularize new technologies among the rearers of the rural villages for widespread adoption from laboratory to field which is beneficial to rearers to know the proper cultural activities of silkworm rearing and marketing. So, it becomes a duty to the government to promote the industry growth and prosperity.

Keywords: Muga Silkworm, Diseases, Rearers, Technology.

Introduction

Silk has become an inseparable part of Indian culture and tradition. It is the undisputed queen of textiles over the centuries. Though India is the second largest producer in the world after China, it accounts for just five percent of the global silk market, since the bulk of Indian silk thread and silk clothes are consumed domestically. Silkworm rearing, a process of agro-based sericulture industry employed over 700,000 farm families and is mainly concentrated in three southern state of Karnataka, Tamil Nadu and Andhra Pradesh. The states of west Bengal and Assam are important in silk industry and allied activities. The North Eastern Region of India is one of the rich biodiversity amongst the 35 hotspots in the world. This zone and Assam in particular is endowed with a climatic condition favorable for Muga culture and hence, has established as an important cottage industry for the rural folk by providing them sustainable livelihood. The Muga silkworm *Antheraea assamensis*, Helfer belonging to order Lepidoptera of family Saturniidae.

Sericulture is a labour intensive industry in all its phases, namely, cultivation of silk worm food plants (mulberry plant), silk worm rearing, silk reeling and other post cocoon processes such as twisting, dying, weaving, printing and finishing. It is the only cash crop in agricultural sector that gives returns within 30 days. This industry provides employment nearly to three million people in the country. Muga silkworm rearing, reeling and

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weaving of muga silk cloth is associated with the tradition, culture and sentiments of the Assamese people and these are considered to be an important cottage industry in the rural areas of Assam and its adjoining states.

Objectives of The Study

1. To look into the socio-economic status of muga rearers in the study area.
2. To know the constraints faced by the muga rearers during muga rearing.
3. To know the future prospects of muga silkworm rearing in the study area.
4. To know the production of muga cocoon and income of the rearers in the study area.

Review of Literature

Historically, although silk was known to be discovered in China during the reign of Chinese emperor, Hwangti (2640 B.C) with the accidental drapping of a cocoon into a cup of his hot tea. Thus it was showed that silk was discovered in China and silkworm rearing historically started by the Chinese people and then the industry spread from there to other parts of the world, except the muga silk culture. The people inhabiting the region of Assam have carried on the production of muga silk as it is called as a tradition. Muga identified with Asomiya traditional knowledge, expressions of folklore and culture since antiquity.

Helfer (1837) reported rearing of silkworms is the main occupation of many castes of Assam. Bhorali (1967) explained that Assam is the only state in the world where the rare, golden yellow muga silk is raised. The hinder land of upper Brahmaputra River has moist climate which is conducive to the development of muga culture. The area has luxuriant growth of Som (*Machilus bombycina*) plants which is the main food plant of muga silkworm.

Dutta (1983) conducted a study entitled "Economics of Silk Production in Assam", which provides a brief note about the silk production and its related aspects in Assam. He gave a depth analysis and tried to find out the prospects of it through the assessment of the net income per family of silkworm rearer with the help of primary data. But the sample used in his study was inadequate, which he himself admitted later (Dutta, 1988).

Sahu *et al.* (2000) mentioned about 6 crops of muga silkworm – Katia (October-November), Jarua (December-November), Chotua (February-March), Jethua (April-May), Aherua (June-July), Bhodia

(August-September). In addition they informed that several overlapping crops were reared in this region. They studied the seasonal variation in certain parameters like egg, larval, pupal period's moth emergence, fecundity hatchability of eggs, effective rate of rearing, cocoon weight, shell weight etc.

Khanikor *et al.* (2006) was conducted rearing of muga silkworm on Som plant two cycles of successive crops, viz, 'Jethua or Spring cycle', 'Katia or Autumn cycle'; each cycle consisting of one commercial crop and four seed crop.

Muga is concentrated in Assam in the districts of Tinisukia, Dibrugarh, Sivsagar, Jorhat, Golaghat and Kamrup. According to the annual report, Directorate of Sericulture, Assam, 2016-17, 291592 sericulture families from 10746 sericulture villages produces 2477 MT and 140 MT and 50 MT of eri, muga and mulberry raw silk respectively (Anonymous, 2017).

Materials and Methodology

A brief description of the research methodology adopted for conducting the investigation is presented under the following headings :

Primary Source

The study is mainly based on field level primary data and secondary data. For the collection of primary data about the traditional muga culture, Kamrup District has been selected purposively. For convenience of survey one development block was selected from Kamrup District of Assam. Again Ten (10) traditional muga silkworm rearing villages have been selected. From each village ten (10) muga rearers have been selected for field survey and interview method. A questionnaire was prepared to collect primary information of 100 sample respondents which was selected randomly.

Secondary Source

The data was collected from Regional Muga Research Station, Central silk Board, Boko, Directorate of Sericulture, Govt. of Assam, Khanapara, Guwahati, Statistical Handbook of Assam. Data also collected from various books, journals both officials and non official records and newspaper etc.

Location of The Study

The study on problem and prospects of rearing of Muga silkworm were carried out in Boko Development Block of Kamrup District, Assam, India, 25° 59' 0" N latitude, 91° 16' 0" E longitude.

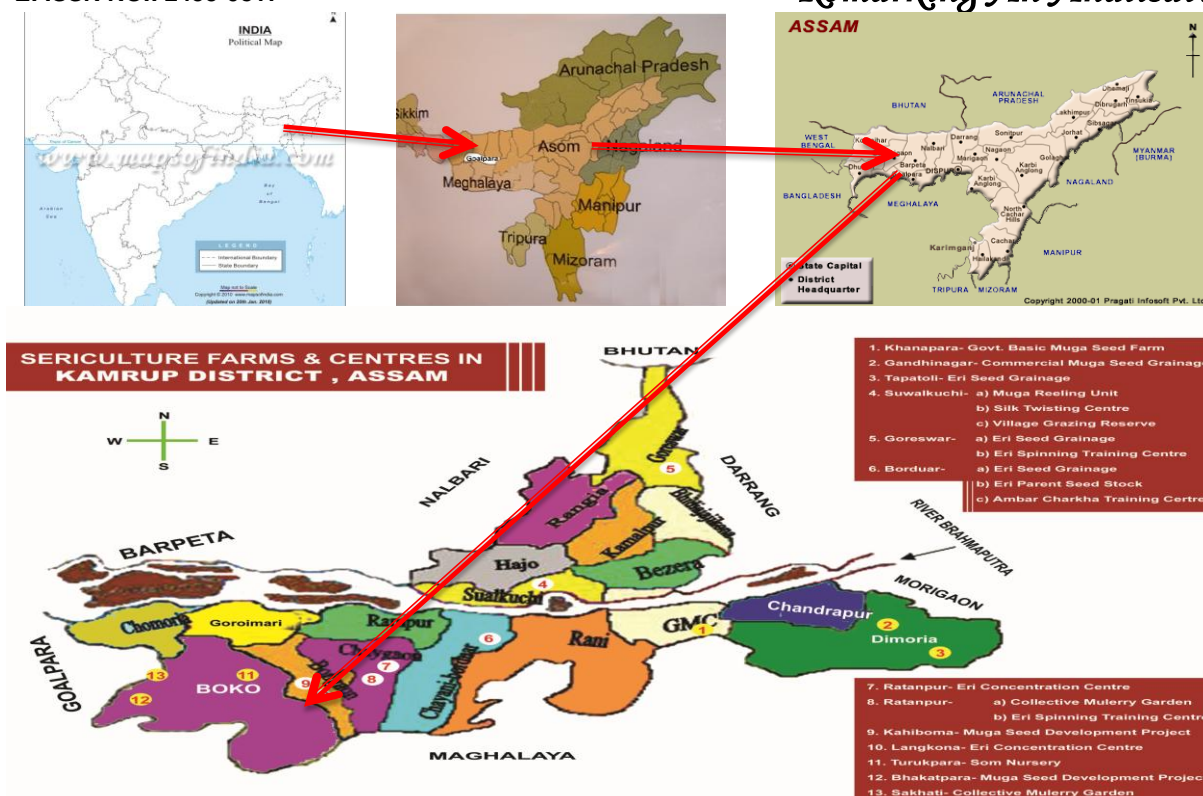


Plate 1: Showing the Study Area Boko, Kamrup, Assam

Results

The present study was undertaken to evaluate the problems and prospects of muga silkworm rearing in Kamrup District, Assam. Accordingly, an investigation was carried out during the June, 2016 to May, 2017 in different muga growing areas of Boko Development Block Kamrup , Assam. The data were collected and recorded as required for analysis.

The present study area is the potential muga silkworm growing areas of Boko Development Block of Kamrup District. Kamrup District lies between 25.46° N to 26.49° N latitude and 90.48° E to 91.50° E longitude. The Kamrup District is located on southern bank of River Brahmaputra and covering different caste and races. The district is surrounded by Udalguri and Baksa District on the north, Darrang District and Kamrup Metropolitan District on the east, Meghalaya on the south and Goalpara and Nalbari District on the west. There are 50 numbers of villages involved in muga culture under Boko Development Block. In this block 560 rearers are involved in muga culture. This block having highest numbers of rearers in Kamrup District.

Socio-Personal Characteristics of Muga Silk Worm Rearers

Age

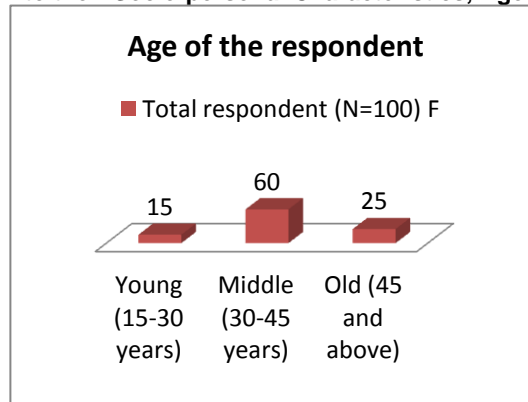
The age -wise distribution of the respondents is presented in table- 1 and figure- 1. The data in the table indicates that 15 per cent of the respondents belongs to young age group i.e. in the age group of 15-30 years, 60 per cent of respondents belongs to middle age group (30-45 years) and only 25 per cent

of respondents belongs to old age group (45 years and above).

Table 1: Distribution of Respondents According to their Socio-personal Characteristics, Age

Characteristics	Total respondent (N=100)	Percentage
AGE	F	%
Young (15-30 years)	15	15
Middle(30-45 years)	60	60
Old (45 and above)	25	25

Figure 1: Distribution of Respondents According to their Socio-personal Characteristics, Age



Educational Qualification

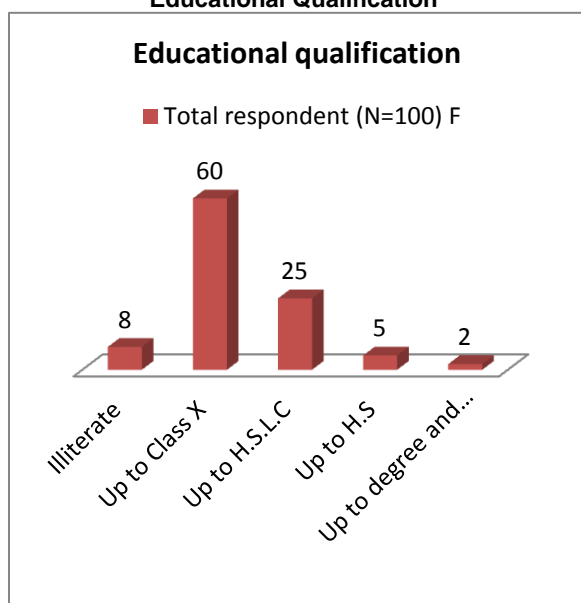
Table- 2 and figure- 2 reveals that 2 per cent of respondents had education up to degree and above followed by 5 percent, 25 percent and 60 per cent who had education up to H.S, H.S.L.C and up to class

X respectively where 8 percent respondents are illiterate.

Table 2: Distribution of Respondents According To Their Socio-Personal Characteristics, Educational Qualification

Characteristics	Total Respondent (N=100)	Percentage
Educational qualification	F	%
Illiterate	8	8
Up to Class X	60	60
Up to H.S.L.C	25	25
Up to H.S	5	5
Up to degree and above	2	2

Figure 2: Distribution of Respondents According to Their Socio-Person Characteristics, Educational Qualification



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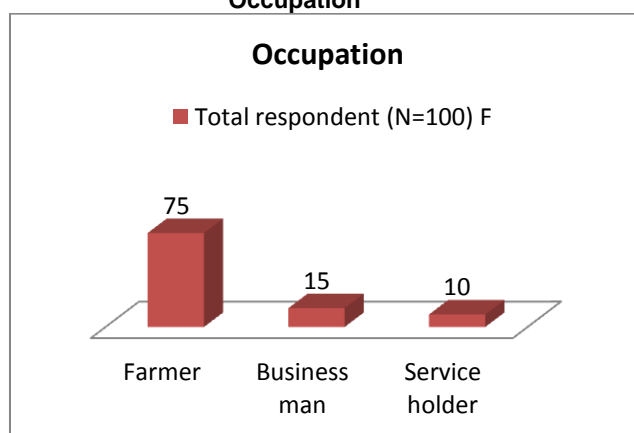
Occupation

The table- 3 and figure- 3 reveals that 75 per cent of respondents from tribal villages were farmer, 15 percent were business man and 10 per cent were service holder.

Table 3: Distribution of Respondents According to Their Socio-Personal Characteristics, Occupation

Characteristics	Total respondent (N=100)	Percentage
Occupation	Frequency	%
Farmer	75	75
Business man	15	15
Service holder	10	10

Figure 3: Distribution of Respondents According to Their Socio-Personal Characteristics, Occupation



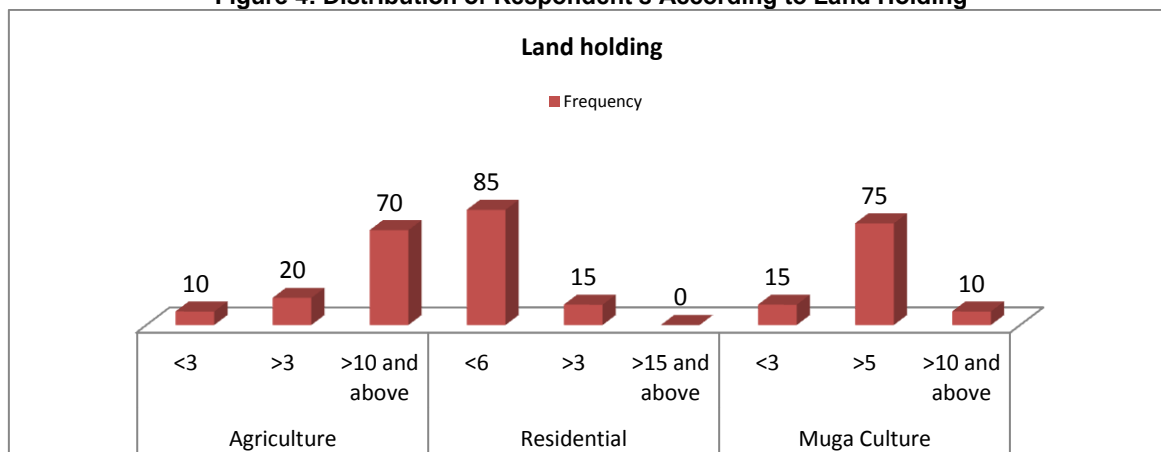
Distribution of Respondent's According to Land Holding

The table- 4 and figure- 4 reveals that 10 per cent of respondents having less than 3 bigha , 20 per cent having 3 to below 6 bigha and 70 per cent having more than 10 bigha of agricultural land. 85 per cent of respondents having less than 6 bigha , 15 per cent having 3 to below 6 bigha and 15 per cent of respondents having less than 3 bigha , 75 per cent having 5 to below 10 bigha and 10 per cent having more than 10 bigha of sericultural land.

Table 4: Distribution of Respondent's According to Land Holding

Type of land	Land holding (bigha)	Frequency	Percentage (%)	Total (n)
Agriculture	<3	10	10	100
	>3	20	20	100
	>10 and above	70	70	100
Residential	<6	85	85	100
	>3	15	15	100
	>15 and above	0	0	100
Muga Culture	<3	15	15	100
	>5	75	75	100
	>10 and above	10	10	100

Figure 4: Distribution of Respondent's According to Land Holding



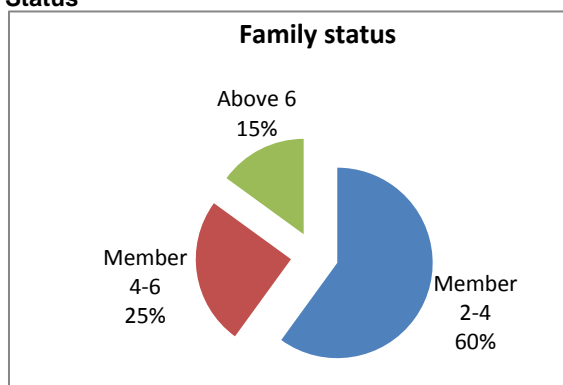
Distribution of Respondents According to Their Socio-Personal Characteristics, Family Status

The family member distribution of the respondents is presented in table- 5 and figure- 5. The data in the table indicates that 60 per cent of the respondents belongs to small family i.e. 2-4 members, 25 per cent of respondents belong to middle family i.e. 4-6 members and only 15 per cent of respondents belongs to large family i.e. above 6

Table 5: Distribution of Respondents According to Their Socio-Personal Characteristics, Family Status

Characteristics	Total respondent (N=100)	Percentage
Family status	Frequency	%
Member 2-4	60	60
Member 4-6	25	25
Above 6	15	15

Figure 5: Distribution of Respondents According to Their Socio-Personal Characteristics, Family Status



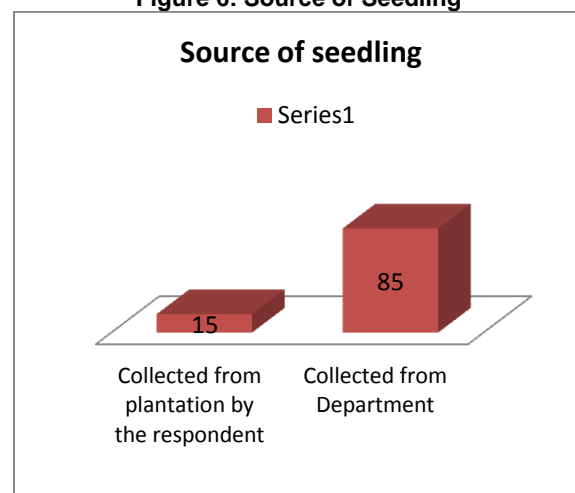
Source of Seedling

The table- 6 and figure- 6 shows that majority of the respondents 85% collected from Department of Sericulture, 15% seedlings collected from muga food plantations by respondents.

Table 6: Source of Seedling

Source of Seedling	Frequency	Percentage (%)	Total (n)
Collected from plantation by the respondent	15	15	100
Collected from Department	85	85	100

Figure 6: Source of Seedling



Type of Food Plantation

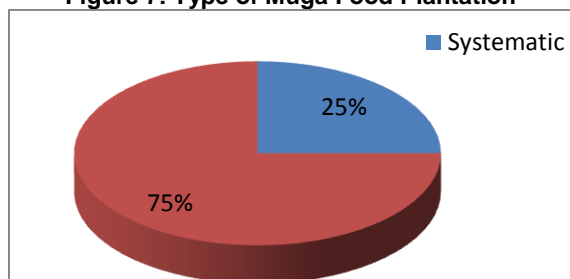
The table- 7 and Figure-7 shows that all the respondents having Som plants in which 25% of plants under systematic plantation and 75% of plants under sparse plantation.

Table 7: Type of Food Plantation

Type of food plantation	Variety	Frequency	Percentage (%)	Total (n)
Sparse	Som	75	75	100
	Soalu			
Systematic	Som	25	25	100
	Soalu			

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Figure 7: Type of Muga Food Plantation



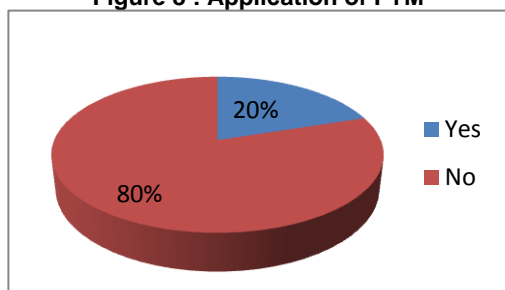
Application of Farm Yard Manure (FYM)

The table-8 and figure-8 show that 20% of the respondents apply FYM where 80% of the respondents not used FYM in their food plants.

Table 8: Application of FYM

Application of FYM	Frequency	Percentage (%)	Total (n)
Yes	20	20	100
No	80	80	100

Figure 8 : Application of FYM



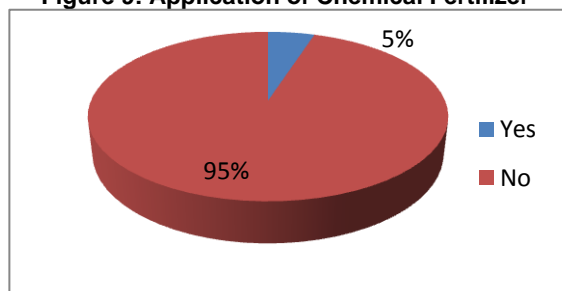
Application of Chemical Fertilizer

The table- 9 and figure- 9 show that 95% of the respondents not apply chemical fertilizer where only 5% of the respondents used chemical fertilizer in their food plants.

Table 9 : Application of Chemical Fertilizer

Application of Chemical fertilizer	Frequency	Percentage (%)	Total (n)
Yes	5	5	100
No	95	95	100

Figure 9: Application of Chemical Fertilizer



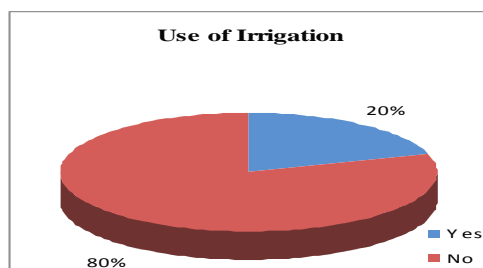
Use of irrigation

The table- 10 and figure- 10 shows that most of the respondents, 80% do not have irrigation system in their garden where 20% of the respondents having irrigation system.

Table 10: Use of Irrigation

Use of Irrigation	Frequency	Percentage (%)	Total (n)
Yes	20	20	100
No	80	80	100

Figure 10: Use of Irrigation



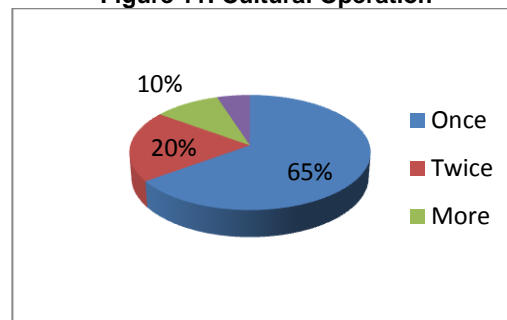
Cultural Operation

The table- 11 and figure- 11 show that 65% of the respondents practiced cultural operation once in a year, 20% of the respondents practiced twice, 10% of respondents practiced more than twice and 5% of the respondents do not practiced any cultural operation.

Table 11: Cultural Operation

Cultural operation	Frequency	Percentage (%)	Total (n)
Once	65	65	100
Twice	20	20	100
More	10	10	100
None	5	5	100

Figure 11: Cultural Operation



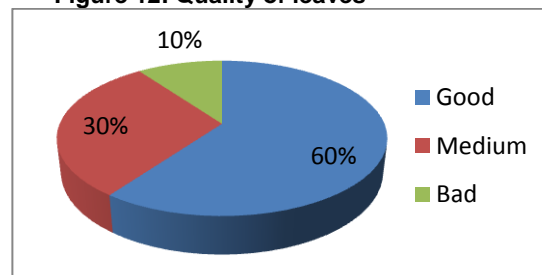
Quality of Leaves

The table- 12 and Figure- 12 shows that 60% of the respondents having good leaves, 30% medium and 10% of leaves are bad.

Table 12: Quality of Leaves

Quality of leaves	Frequency	Percentage (%)	Total (n)
Good	60	60	100
Medium	30	30	100
Bad	10	10	100

Figure 12: Quality of leaves



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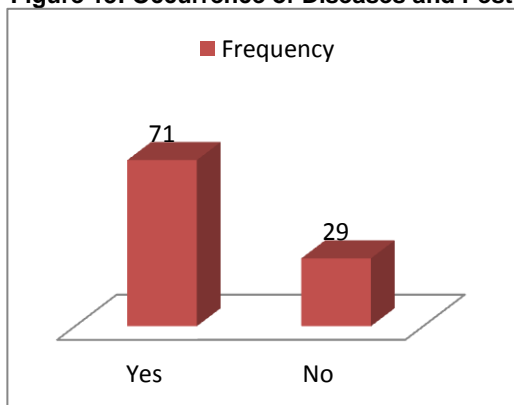
Occurrence of Diseases and Pest

The table- 13 reveals figure- 13 shows that, 100% of respondents says that 71% of diseases and Pest occurred in their food plants and 29% are the disease free lays.

Table 13: Occurrence of Diseases and Pest

Occurrence of diseases and Pest	Frequency	Percentage (%)	Total (n)
Yes	71	71	100
No	29	29	100

Figure 13: Occurrence of Diseases and Pest



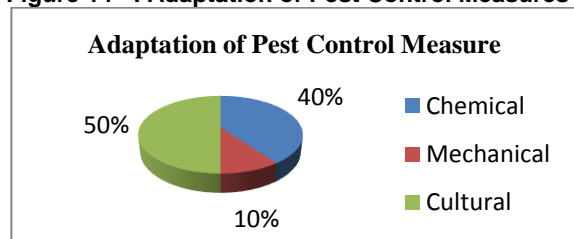
Adaptation of Pest Control Measures

Table-14 and figure-14 shows that 40% applied chemical measure, 10% mechanical and 50% applied the cultural measure.

Table 14 : Adaptation of Pest Control Measure

Adaptation of Pest Control Measures	Frequency	Percentage (%)	Total (n)
Chemical	40	40	100
Mechanical	10	10	100
Cultural	50	50	100

Figure 14 : Adaptation of Pest Control Measures



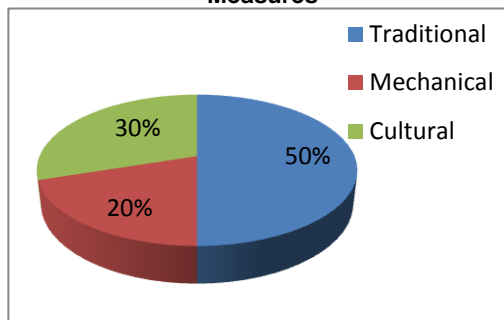
Adaptation of Plant Protection Measures

The table- 15 and figure- 15 shows that 50% of respondents followed traditional method, 20% followed mechanical and 30% of the respondents adopt cultural measures to protect their plants.

Table 15: Adaptation of Plant Protection Measures

Adaptation of plant protection measures	Frequency	Percentage (%)	Total (n)
Traditional	50	50	100
Mechanical	20	20	100
Cultural	30	30	100

Figure 15: Adaptation of Plant Protection Measures



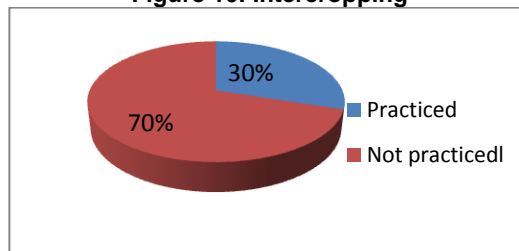
Intercropping

The table-16, figure-16 and Plate- 17 shows that 30% of respondents practiced intercropping where 70 % of the respondents not practiced intercropping.

Table 16: Intercropping

Intercropping	Frequency	Percentage (%)	Total (n)
Practiced	30	30	100
Not Practiced	70	70	100

Figure 16: Intercropping



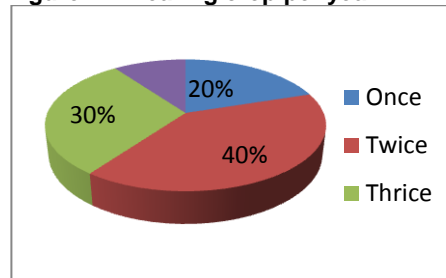
Rearing Crop per Year

The table- 17 and figure- 17 shows that 20% of respondents reared once, 40% twice, 30% thrice and 10% of the respondents rearing practiced more than trice in a year.

Table 17: Rearing crop per year

Rearing crop per year	Frequency	Percentage (%)	Total (n)
Once	20	20	100
Twice	40	40	100
Thrice	30	30	100
More	10	10	100

Figure 17: Rearing crop per year



Annual Income

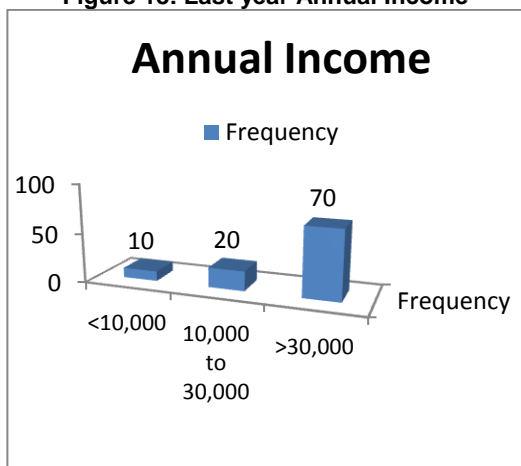
Table- 18 and figure- 18 shows that annual income of 10% is below 10,000, 20% between 10,000-30,000 and 70% is above 30,000.

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Table 18: Annual Income

Annual Income(Last year)	Frequency	Percentage (%)	Total (n)
<10,000	10	10	100
10,000 to 30,000	20	20	100
>30,000	70	70	100

Figure 18: Last year Annual Income



Problem Faced

Table 19: Problem Faced

Problem faced	Frequency	Percentage (%)
Unavailability of systematic plantation	75	75
Remoteness of the area of cultural operation	78	78
Non-availability of seed cocoons	85	85
Higher price of seed cocoons	91	91
Difficulty in handling large number of moths for examination within a short and limited period.	65	65
Lack of manpower	52	52
Fluctuation of weather	56	56
Occurrence of disease	78	78
Occurrence of pest	75	75

Discussion & Conclusion

The present study was undertaken to evaluate the problems and prospects of muga silkworm rearing in Kamrup District, Assam. Accordingly, an investigation was carried out during the June, 2016 to May, 2017 in different muga growing areas of Boko, Kamrup, Assam. As the age group, 15 per cent of the respondents belongs to young age group i.e. in the age group of 15-30 years, 60 per cent of respondents belongs to middle age group (30-45 years) and only 25 per cent of respondents belongs to old age group (45- years and above). According to the land holding of the farmers, 10 per cent of respondents having less than 3 bighas, 20 per cent having 3 to below 6 bighas and 70 per

cent having more than 6 bighas of agricultural land. 85 per cent of respondents having less than 6 bighas, 15 per cent having 3 to below 6 bighas and 15 per cent of respondents having less than 3 bighas, 75 per cent having 5 to below 10 bighas and 10 per cent having more than 10 bighas of sericultural land. According to Neog and Giridhar (2013) Muga culture is still practice on scattered plants. Large scale commercial plantation is not yet practiced. So, production of host plant is not adequate to its production potential. In the present study all the respondents having Som plantation, among these only 25% under systematic plantation and 75% of plants are sparse plantation. Majority of the respondents collected seedling i.e. 85% from the Department of Sericulture and 15% seedlings collected from muga food plantation area. Some farmers have the sufficient plantation area, but exact implantation strategy was absent. In case of, application of chemical fertilizer, 95% of the respondents not apply chemical fertilizer where only 5% of the respondents used chemical fertilizer in their food plants. Generally the farmers do not apply any chemical methods. Among all the respondents, 80% do not have irrigation system in their garden. In this field they do not apply any mechanical methods. 30% of respondents practiced intercropping where 70 % of the respondents not practiced intercropping

Cultural operational knowledge is also most important in the rearing of muga silkworm. In case of cultural operation, 20% of the respondents practiced cultural operation once in a year, 65% of the respondents practiced twice and 3% of the respondents do not practiced any cultural operation. So, only some farmers practiced this operation twice in a year.

As the farmers mainly dependent upon the cultural and traditional measures in case of pest control and also protection of muga host plants which results decrease production. According to Neog and Giridhar (2014) there is a gap between leaf yields in muga host plant against its potential. This is mainly because farmers not willing to practice the recommended package of government either due to strong inclination towards traditional method of cultivation or high cost of input. Chetia (2013) in her report mentioned that he major problem among the farmers is lack of proper training by which they can improve their rearing and reeling skill. It commonly seen that muga sericulture is confined among the older and weaker section of the society which are not aware of this proper education, mechanical knowledge, technical field and also most of the farmers are not aware of the fund and facilities available of the government to help them. Therefore, only few farmers apply the advance technological method. Same was found in present study. Only 2 % of respondents had education up to degree level and above 5% up to H.S, 25% up to HSLC and 60% and up to class X, where 8 per cent respondents are illiterate. Therefore, it shows that majority of the farmers do not have sufficient educational qualification. That is why the farmers do not get the proper knowledge of this field. 75 per cent of

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respondents in the study were farmers, 15 per cent were business man and 10 per cent were service holder. It shows that the economic conditions of these farmers are not so good. In the present study 10% of farmer's annual income is below 10,000, 20% between 10,000-30,000 and 70% is above 30,000. In the field of rearing practice, 20% of respondents reared once, 40% twice, 30% thrice and 10% of the respondents rearing practiced more than trice in a year. Because of this lack of rearing practice, it affects on the good production of cocoons. Therefore, the farmers purchase seeds from the Government as well as private seed suppliers on credit.

In the present study it was found that 75% farmers not planted muga host plant on commercial scale, 78% have the problem of remoteness of the area of cultural operation, 85% is the non-availability of seed cocoons, 91% faced the higher price of seed cocoons, 65% have the difficulty in handling large number of moths for examination within a short and limited period, 52% have the lack of manpower, 56% faced the fluctuation of weather, 78% faced the occurrence of disease and 75% faced occurrence of pest. As the farmers facing these constrains in cultivation which results inadequate production.

Actually, there is not any mechanism for fixing the price of cocoons. Due to the absence of any regulatory authority and well established market mechanism the cocoon producers are deprived of the optimum price. Though the price of Muga yarn as well as Muga fabrics has increased over the years and also the price of cocoon has slightly increased. There is no facility for stifling and storing the cocoons for the farmers. Neog and Giridhar (2014) also mention that there is lack of appropriate system for cocoon and silk marketing in muga sector.

Acknowledgements

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References

1. Anonymous, 2017: Annual Report, Directorate of Sericulture, Govt. of Assam, Guwahati -22.
2. Baishya, P. (1986): The role of small scale and cottage industries: A case study in Kamrup district of Assam, unpublished Ph. D. thesis submitted at Gauhati University, Guwahati, Assam, Pp. 18-19.
3. Bharali, N. (1968): Scope of development of muga industry in Assam, *Indian Silk*. 7 (7):11-12.
4. Borah, A., Phukan, S. N., and Samson, M. V. (1988): Variation in cocoon characters of *Antheraea assama* Ww. during different seasons. *Sericologia*. 28(2): 215-218.
5. Bora, D. S. (2006): In Muga Silkworm (*Antheraea assama* Ww.) (Ed B.G.Unni) Regional Research Laboratory, Jorhat, Assam: 67- 74.
6. Bora, A., Samson, M. V., Borah, B., Bhuyan, N. (1988-89): Studies on preservation of muga cocoons of higher altitude and low temperature. *Ann. Report RMRS, CSB, Boko, Assam*: 32-33.
7. Bora, A, Borah, B. R., Sengupta, A. K.(1990) : Studies on preservation of muga cocoons of

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higher altitude. *Ann. Report RMRS, CSB, Boko, Assam*: 15-16.

8. Bora, A., Singh P. K., Borah, B., Sengupta, A. K. (1992): Studies on preservation of muga cocoons at low temperature. *Ann. Report RMRS, CSB, Boko, Assam*: 10-11.
9. Chetia, R. (2013): Traditional knowledge and problems involved in muga culture of Assam: A case study of Golaghat District. *International Journal for Basic Sciences and Social Sciences*. 2(2): 129-134.
10. Chowdhury, S.N. (1964): The ecology of muga culture, D.Sc. thesis, University of Calcutta, Calcutta: 131-148.
11. Chowdhury, S. N. (1965): Observations on nutrition of muga worm of *Antheraea assama* Ww. *Proc. Third Intern. Conf. Beirut*: 1-6.
12. Chowdhury, S. N. (1981): Muga Silk Industry. Directorate of Sericulture, Govt. of Assam, Guwahati: 1-177.
13. Chowdhury, S. N. (1982): Muga Silk Industry, Directorate of Sericulture, Government of Assam, Shillong (Meghalaya), India.
14. Chowdhury, S. N. (1992) : A Silk and Sericulture, Directorate of Sericulture, Government of Assam, India : 44-86.
15. Devi, D. (1999) : "Eri silk of North East Region: Scope for its Improvement", paper presented in the seminar on "Strategies for Development of Sericulture in Assam" held on 3.4.1999 at the Regiona Science Centre, Khanapara, Guwahati, Assam, P. 02.
16. Dutta, P. C. (1983) : Economics of Silk Production in Assam, Agro-Economic Research Centre and Assam Agriculture University, Jorhat , Assam, P. 13.
17. Deka, M. (1976): Muga culture, Department of Sericulture, Government of Meghalaya, Shillong: 13-39.
18. Gait, E.A. (1905): History of Assam (Revised by B.K. Barua and H.V.S. Murthy).
19. Helfer, T.W. (1837): On the indigenous Silkworms of India. *The Journal of the Asiatic Society of Bengal (Calcutta)*, VI (I): 38-47, pl. V-VI. 104.
20. Ito, I. (1963): Nutrition of silkworm. *Indian J. Seric.*, 1: 15-17.
21. Kakati, P. K. (2002): Adoption of prophylactic measures to contain muga silkworm diseases. *Indian Silk*. 41(1) :19-21.
22. Kakati, P. K., Sankar, M., Murthy, B. N . , Hazarika, U. and Chakravorty, R. (2004) : Floral wealth of North East India with particular reference to food plants of serigenous insects. Paper presented in the National Symposium on Recent Trends in Plant Sciences, held on 29th to 31st October.
23. Kumar, R., Rajkhowa, G., Goswami, D. and Singh, B.K. (2017): Studies on Different Cocooning Device in Muga Silkworm (*Antheraea assamensis*, Helfer). *Biological Forum – An International Journal*. 9(1). 0975-1130 : 01-06

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24. Neog, K., Giridhar, K. (2014): Trends and potentials of eri and muga sericulture in North-eastern states of India .*Indian Silk*. 5 (53) : 52-55
25. Robinson, W. (1841, 1975, reprint): *A Descriptive Account of Assam*, Sanskran Prakasan, Delhi, P. 70.
26. Sahu, A. K., Singha, B. B. and Das, P. K. (2000): Phenological studies in muga silkworm, *Antheraea assama* Ww. (Lepidoptera: Saturnidae), in relation to its rearing and grainage behavior. *Intern. J. of wild Silkmoth & Silk*. 5: 25 - 31.
27. Sahu, A. K., Singha, B. B., Kumar, N. (1999): Preservation of seed cocoons during summer. *Ann. Rep. RMRS, Boko, Assam*.
28. Saikia, J. N. (2011): Supply chain linkages and constraints in natural silk sector of Assam: A study of muga and eri silk. *Excel International Journal of Multidisciplinary Management Studies*. 1. 3: 176 -194.
29. Saikia, M., Ghosh, K., Peigler, S. R. (2016): Factors affecting on quality muga silkworm (*Antheraea assamensis* Helfer) seed crop production: A review. *Journal of Entomology and Zoology Studies*. 4(6): 806-810.
30. Siddique, S. A. (2000) : "Role of Sericulture in the Economic Development of Assam" paper presented in the State level Seminar on "Fireworks and Endi-Textile Industries of the Barpeta District", sponsored by University Grant Commission and organised by M. C. College, Barpeta during 25-26 November 2000, Pp. 1-3.
31. Thangavelu, K., Chakraborty, A. K., Bhagowati, A. K., Isa Md. (1988): *Handbook of Muga Culture*. Central Silk Board, Bangalore: 9-14.
32. Thangavelu, K., Chakravarty, A. K., Bhagawati, A. K., and Isa, Md. (1988): *Hand Book of Muga culture*, CSB, Bangalore: 9-11, 102.
33. Watt, G. (1893): *A Dictionary of Economic Products of India* .Supdt. Govt. Print. Calcutta. 6(3):174-183.