

Trend and Instability in Sericulture Production in Assam, India

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Abstract

Sericulture, an age-old tradition of the village population of Assam, has enormous importance in terms of employment generation in the North-Eastern region of India and fulfilling the demand for silk both internally and internationally. In this context, the paper is an attempt to examine the trend and instability of sericulture in production and employment generation in Assam. On the basis of secondary data it has found that within Assam the raw silk production on an average has a positive growth and an upward trend has also observed in terms of total raw silk production of the state. However, there is not a continuous or smooth growth rather there is fluctuation in the overall production of raw silk. The growth in Eri silkworm (*Philosamia ricini*) has recorded highest as compared to Muga (*Antheraea assamensis*) and Mulberry (*Bombyx mori*). The area under silkworm host plantation recorded a high degree of variation. The number of family engaged in raw silk production over the time period has recorded a negative growth on average in terms of Muga and Mulberry and is positive in terms of Eri.

Key words: Sericulture; Muga and Eri; Socio-economic constraints; Climate Change.

Introduction

Asia is the major producer of silk with 98.5 percent of total global output and within this region India is the second largest producer (Bhat, 2014). India, is the producer of all five known commercial silks has a rich and complex history of silk production and silk trade. After China it occupies second position and the largest consumer of silk in the world, with a total of 34,903 MT silk production and contributing 18% to world production during 2021-22 (Central Silk Board). The major silk-producing states in India are Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal, and Jammu & Kashmir (UT) specialized in the production of mulberry silk (Bhat, 2014). In terms of non-mulberry silk or Vanya, silk production Assam leads the list. Karnataka contributes highest to the India's total silk production. In 2020-21 its raw silk production was 11191 MT contributing 32% to the total. As per CSB (2022), mulberry production is the highest i.e. 25818 MT (2021-22) followed by Eri (*Philosamia ricini*), 7364 MT. The silk industry of our country is one of the largest foreign exchange-earners (Baruah, 2010). The silk exports of India were valued at US\$ 248.56 million during 2021-22 (ISEPC). Moreover, silk industry is providing employment to large number of families in India (Roy and Sarkar, 2015). In Jammu and Kashmir, India more than 3000 families engaged in silk industries (Khan et al., 2016). Due to the large production of silkworms, handloom industry also growing and becomes a second largest employment provider in rural India after agriculture (Goswami, et al., 2017). In the Northeastern region of India, more than 65 percent household engaged in handloom sector.

Being too sensitive, temperature and humidity greatly influence the production of silk, even a slight fluctuation can imbalance the growth of silkworms (Das et al., 2023). The mulberry silkworm is the most affected one among all as is fully domesticated. The northeastern region of India is favorable for Vanya or non-mulberry silk production. Assam is especially known for its golden fiber Muga silk. The scientific names of those silkworms produced in Assam are *Philosamia ricini* or known as Eri silkworm, *Antheraea assamensis* known as Muga and *Bombyx mori* known as Mulberry.

The existing studies revealed that the silk industry in Assam had flourished and progressed even during the time period of Ahoms (Gogoi, et al. (2017)). Special attention and incentives were provided for the growth and development of the sector by the Ahom kings. Even during British rule, the status of the silk industry didn't fade. However, during the period of 1886-1888, a declining trend was observed in spite of several efforts. But after independence, with the establishment of the Central Silk Board (CSB) in 1949 various schemes and measures were undertaken to support the sericulture sector in Assam, especially the Eri and Muga silk. Assam contributes 95 percent and 65 percent of the county's total Muga and Eri production (Directorate of Sericulture, Assam, 2021). As mentioned in the report of Directorate of Sericulture, Assam produces both mulberry and Vanya silk but Muga and Eri are the two types that dominate Assam's total production of silk. The state enjoys a precious position in terms of Muga silk and therefore Muga is said to be the pride of Assam. Assam is the world's largest producer of the famous and the rarest golden Muga silk (Singh et al., 2022) and achieved Geographical Indication (GI) for it in the year 2007. Assam land is highly suitable for producing Muga and Eri silk and therefore termed as the homeland of these two types of silk. The commercial production of Muga silk is mainly confined to Upper Assam while seed cocoon production is generally confined to Lower Assam (Brahma, 2016). Thus, sericulture has lot of opportunity in employment and entrepreneurship (Khan et al., 2016).

Considering the wide aspect of sericulture, knowledge about its current status or present scenario is of utmost importance. Sericulture being indigenous to Assam has a wide prospect with great potential to bloom, development of the sector can be very fruitful in enhancing the rural economy of Assam as well as building up India's position in the world silk market. Therefore, this study might be helpful in understanding Assam's present status of the Sericulture sector, its importance, and the various issues hindering the rapid growth of the sector. So that these problems come to notice and further suitable efforts can be taken for the expansion of the sector and Sericulture is maintained as the vibrant sector of Assam's economy in the future too.

The basic aim of the paper is to examine silk production in Assam. The following objectives are undertaken for the purpose of the study:

1. To analyze the trend of sericulture production in Assam.
2. To identify the causes of instability in silk production in Assam.

The paper has been structured into four broad sections. Followed by introduction the second section discussed about the materials and methods. The third section mainly discussed about the results and analysis. Lastly, the fourth section concluded with brief findings and recommendations.

Materials and methods

The present paper is solely based on Secondary data sources. In order to fulfil the mentioned objectives, time series data for two years on different varieties of raw silk production, the area under silkworm food cultivation, cocoon production, and family engagement in sericulture activities have been collected for the time period 2010-11 to 2021-22 (CSB, Annual report, 2022-23, <http://csb.gov.in/wp-content/uploads/2024/01/AR-2022-23.pdf>). Data on the area under silkworm food plants, production of raw silk, obtained from Statistical

Handbook of Assam (Directorate of Economics and Statistics, Assam), Economic Survey of Assam, information from the website of Directorate of Sericulture (<https://sericulture.assam.gov.in/information-services/research-and-development>), Assam, periodicals, magazines, and reports of Central Silk Board (CSB) were immensely helpful in obtaining the valuable information for the purpose of analysis. Unpublished documents, articles and websites of online search such as IBEF (India Brand Equity Foundation), and the Ministry of Textiles, Shodhganga, Google Scholar have also played an active role in gaining information related to the set objectives.

For the purpose of analysis, basic statistical techniques such as Descriptive statistics, inferential statistics, graphical and tabular methods have been used. The descriptive statistics such as Mean, Standard Deviation (S.D), Coefficient of Variation (C.V), Annual Growth Rate (AGR), and Compound Annual Growth Rate (CAGR) have been taken into consideration. For presentation graphs such as Column Bar Charts and Line graph have been used.

A. Annual Growth Rate (AGR)

In this paper, AGR in equation (1) has been applied in order to know the annual growth rate of raw silk production, cocoon production, the area under silkworm food plantation, and family engagement in silk production to identify the annual growth rate that occurred over a time period 2010-11 to 2021-22. The formula for AGR is:

$$AGR = \left(\frac{\text{Present value} - \text{Past value}}{\text{past value}} \right) * 100 \quad \dots\dots\dots (1)$$

B. Compound Annual Growth Rate (CAGR):

In the present study, CAGR (equation 2) is used to know whether production has increased or decreased over the time period. If CAGR is positive it implies on an average the production has increased over the time period and if it is negative it shows a decline in production.

$$CAGR = \left(\frac{\text{Ending Value}}{\text{Beginning Value}} \right)^{\frac{1}{N}} - 1 \quad \dots\dots\dots (2)$$

C. Coefficient of Variation (C.V):

The coefficient of variation (C.V) technique is used to know the variation and instability in variety-wise raw silk production in Assam, cocoon production, the area under the silkworm food plant, and the number of families engaged in the sericulture production (equation 3).

$$C.V = \frac{S.D}{MEAN} * 100 \quad \dots\dots\dots (3)$$

D. Trend Analysis

Through the least square method of the time series, trend of raw silk production in Assam have been analyzed. A Linear trend line is estimated to show the trend for the given time period. The linear regression equation to estimate the trend is in the form (equation 4):

$$Y = a + bX \quad \dots\dots\dots (4)$$

Where, Y = raw silk production in Assam and X (explanatory variable) = time period

Results and Discussion

The practice of sericulture is concentrated in the villages of Assam and has been engaged with this culture for ages. The state is capable of producing all four types of silk but Eri and Muga have their unique place¹. Both Muga and Eri have the greatest potential to generate employment. Almost 30,000 families are directly or indirectly engaged in Muga culture in Assam (Das, 2000). A large portion of the unemployed people including women is involved in different sericulture activities. Like mulberry in traditional states of India such as Karnataka, Andhra Pradesh, Tamil Nadu, and West Bengal, Muga and Eri in Assam, are important activities of sericulture to generate employment in rural areas (Bhattacharyya, 2015).

As per CSB (Central Silk Board) during 2022-23 (till June 2022) Assam has contributed 24.26% and 16.33 in the FY2021-22 to the country's total raw silk production. Among the major silk-producing states Assam is capable of holding itself at the 3rd position after Karnataka and Andhra Pradesh.

From the table above it can be stated that from 2018-19 to 2021-22 the percentage share of Assam to the raw silk production of the state has been increasing, ranging from 5026 MT in 2018-19 to 5700 MT in 2021-22. There is a positive growth in terms of share of raw silk production of Assam to the country's total raw silk production.

Performance of Variety-Wise Silk Production

To have a detailed understanding of the status of sericulture in Assam, the trends and performance of the production of raw silk within the state must be taken into consideration. The following table 2 is constructed to show the variety-wise raw silk production of Assam during the period 2010-11 to 2021-22.

The production of raw silk in Assam is exhibited in Table 1. Table 2 reveals the variety-wise silk production of Assam during the period 2010-11 to 2021-22. The production of different varieties of silk, their contribution to total silk production, and the annual growth rate of different silk production are also shown. Eri has the largest contribution to the total silk production of the state over the period of time. Muga being the second largest contributor to the total silk production has however shown a decline in its percentage share to the total raw silk production of the state. The annual growth rate of Muga is also fluctuating and is negative in the year 2021-

¹ Scientific name of Eri silkworm is *Philosamia ricini*, Muga is *Antheraea assamensis* and Mulberry is *Bombyx mori*.

22. The total raw silk production of Assam ranges from 935.4 MT in 2010-11 to 5655.1 MT in 2021-22. The annual growth rate of total raw silk production in Assam was 74.15% during 2012-13. Thereafter, instability in the annual growth rate has been observed. In the year 2014-15 and 2018-19, the state witnessed a negative annual growth rate of -7.51% and -25.2% respectively. The AGR increases to 46.02% in 2019-20 but since then it is declining. In the year 2021-22, the production of raw silk is maximum i.e. 5655.1MT with an annual growth rate of just 1.9%. Among the different varieties of silk Eri is the highest-producing silk in the state. The contribution of Eri to the total raw silk production of Assam is also maximum. It has also observed that the production of raw silk has been increasing throughout the years but declined in the year 2018-19. Muga is the second contributor to the raw silk production of Assam, however, the Muga silk is much behind the Eri silk. A steady increase in its production has been observed throughout the years due to increase in demand. In the year 2021-22, the Muga silk production reduced to 210.5MT i.e. a 12% negative annual growth. Pat or mulberry silk is the least produced silk of Assam. The production of mulberry in Assam showed a steady rise till 2019-20 except for the year 2014-15 but a drastic fall in the year 2020-21 which further continued to fall in the year 2021-22.

Table 1: Share of Assam to India’s Raw silk production

Year	Raw silk production (MT)	Raw silk production in India (MT)	% Share to the country’s raw silk production
2018-19	5026	35468	14.17
2019-20	5316	35820	14.84
2020-21	5462	33770	16.17
2021-22	5700	34903	16.33

Source: Annual Report 2022-23, Central Silk Board.

Table 2: Variety-wise silk production in Assam (in MT)

YEAR	ERI	AGR	MUGA	AGR	MULBERRY	AGR	TOTAL	AGR
2010-11	810.98(86.69)	-	113.28(12.1)	-	11.14 (1.19)	-	935.4	-
2011-12	1061.61 (89.40)	30.90	114.56 (9.64)	1.12	11.25 (0.94)	0.98	1187.42	26.94
2012-13	1934 (93.50)	82.17	109.00 (5.27)	-4.85	25.00 (1.20)	122.2	2068	74.15
2013-14	2545.6 (94.28)	31.62	127.20 (4.71)	16.69	27.24 (1.01)	8.96	2700.04	30.56
2014-15	2345 (93.91)	-7.8	126.00 (5.05)	-0.94	26.00 (1.04)	-4.55	2497	-7.51
2015-16	2554.78 (94.17)	8.94	127.00 (4.68)	0.79	31.02 (1.14)	19.3	2712.8	8.64
2016-17	3468.25 (95)	35.75	129.60 (3.55)	2.04	49.64 (1.36)	60.02	3647.49	34.45
2017-18	4650 (95.55)	34.07	156.96 (3.22)	21.11	59.50 (1.22)	19.86	4866.46	33.41
2018-19	3421.71 (94.01)	-26.41	157.00 (4.31)	0.025	61.00 (1.67)	2.52	3639.71	-25.2
2019-20	5048.8 (94.99)	47.55	197.29 (3.71)	25.66	68.70 (1.29)	12.62	5314.79	46.02
2020-21	5275.74 (95.06)	4.49	240.455 (4.33)	21.87	33.405 (0.60)	-51.4	5549.6	4.41
2021-22	5420 (95.84)	2.73	210.5 (3.72)	-12.45	24.6 (0.43)	-26.35	5655.1	1.90

Source: Statistical Handbook of Assam, 2021-22 **Note:** The values in the parenthesis are the percentage to the total raw silk production.

Table 3: Descriptive Analysis of Raw Silk Production in Assam

Period 1 (2010-11 to 2015-16)				
TOOLS	ERI	MUGA	MULBERRY	TOTAL
CAGR (%)	21.08	1.9	18.6	19.42
MEAN (SD)	1875.33 (765.49)	119.51 (8.13)	21.94 (8.57)	2016.77 (779.96)
CV (%)	40.81	6.8	39.06	38.67
Period 2 (2015-16 to 2021-22)				
TOOLS	ERI	MUGA	MULBERRY	TOTAL
CAGR (%)	7.7	8.4	-11.04	7.6
MEAN (SD)	4547.4 (892.81)	181.96 (41.135)	49.47 (17.2)	4778.85 (920.25)
CV (%)	19.6	22.6	34.77	19.25
Overall (2010-11 to 2021-22)				
TOOLS	ERI	MUGA	MULBERRY	TOTAL
CAGR (%)	17.2	5.3	6.8	16.2
MEAN (SD)	3211.37(1604.94)	150.73(43.165)	35.7 (19.35)	3397.817 (1655.937)
CV (%)	49.9	28.6	54.2	48.7

Source: Authors own calculation based on table 2. Note: CAGR - Compound Annual Growth Rate, SD - Standard Deviation CV - Coefficient of Variation

A descriptive analysis is done to analyze the status of silk production in Assam so that growth and instability among the varieties of silk production can be determined throughout the time period (Bhat and Choure, 2014). The table 3 describes some important facts. Dividing the overall time period into two periods Period 1 (2010-11 to 2015-16) and Period 2 (2015-16 to 2021-22) the instability in growth and variation in production can be depicted.

In period 1, it has been observed that the CAGR in the case of all three varieties of silk production in Assam is positive which implies the production of all three varieties has increased over the period 2010-11 to 2021-22. The reason behind the increasing production of silk is the increase in demand for the cloths produced from silk. Another reason behind this increased demand is the increase in export. The CAGR is found to be highest in the case of Eri production (21.08%) and least in the case of Muga (1.9%). However, the total raw silk production over the period has a positive CAGR of 19.42 percent. In period 2, the CAGR in the case of Eri and Muga silk production is positive which implies that Eri and Muga silk production has increased by 7.7 percent and 8.4 percent respectively. But in the case of Pat or Mulberry production, the CAGR is negative which implies that on average the mulberry production has declined by 11.04 percent over the period 2015-16 to 2021-22. In period 2 production of raw silk may be decrease because of **Covid Pandemic** that arise in the first of 2020. However, there is a positive CAGR in the case of production of all three varieties of raw silk over the period 2010-11 to 2021-22. The total raw silk production has increased by 16.2 percent. This is because, products from Eri, Muga and mulberry is considered as most valued and hence demand for the silk products are increasing day by day.

From the table, it is also observed that there is more instability or variation in total raw silk production in Assam in period 1 as compared to period 2. This is mainly because of instability in climate conditions and temperature. Good climatic conditions lead to more production and vice versa. Moreover, lack of support from the government also may influence the growth of the sericulture sector. Among the three varieties of silk, Eri has the highest C.V. in period one whereas in period 2 more variation is observed in the case of Mulberry. Thus, from 2010-11 to 2021-22 more variation in the production of Eri and Mulberry is observed. Though there is an increase in the production of total raw silk in Assam there is instability in the growth of different varieties of silk over the two periods. The reason behind this instability may be the lack of market opportunities for those products. Market plays an important role for any product for selling at appropriate price. If the market opportunity is not available then the products will not get its demand.

Trend Analysis of Raw Silk Production in Assam

For trend analysis we have first conducted hypothesis testing and then regression analysis done. The null and alternative hypothesis taken for hypothesis testing are stated as

H₀: The trend of raw silk production in Assam is not significant.

H₁: There exists a significant trend in raw silk production.

Trend line Equation:

$$Y = 519.52 + 442.82X \dots\dots\dots (5)$$

The summary output table states that there exists an increasing upward trend. The value of R Square is 0.93 which implies that 93% of the variation in raw silk production is defined by the time variable which is significant at p<0.05. Therefore, we reject the null hypothesis and can conclude that there exists a significant trend in raw silk production in Assam with respect to the time variable.

Table 4: Summary Output

R	R Square	Adjusted R square	Std. Error of the Estimate
0.96	0.93	0.92	460.778

Predictor(X): Time variable (Constant)

	Coefficients	Standard Error	t Stat	P-value
Constant	519.52	283.590	1.832	0.096
Time Period	442.82	38.532	11.49	0.000

Dependent Variable(Y): Raw Silk Production

Source: Author’s own calculation from time series data on Silk Production obtained from Statistical handbook of Assam (<https://des.assam.gov.in/documents-detail/statistical-hand-book>).

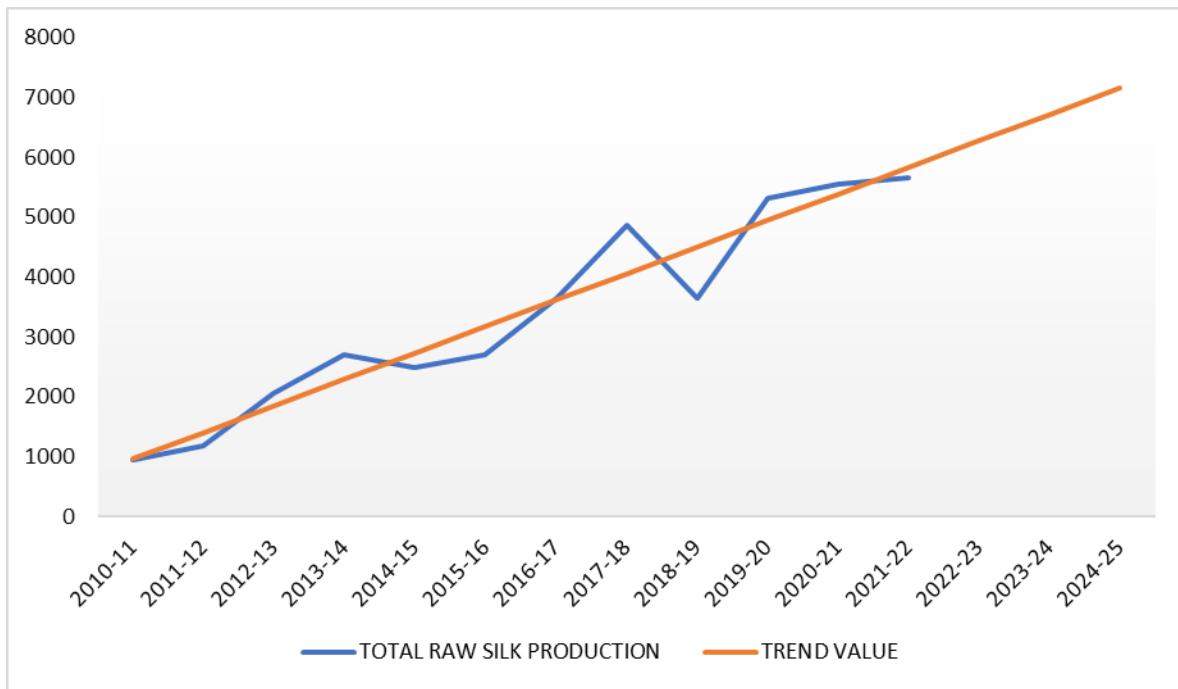


Fig 1: Trend and Prospect of Raw Silk Production in Assam

Source: Statistical Handbook of Assam, 2010 to 2023. (<https://des.assam.gov.in/documents-detail/statistical-hand-book>)

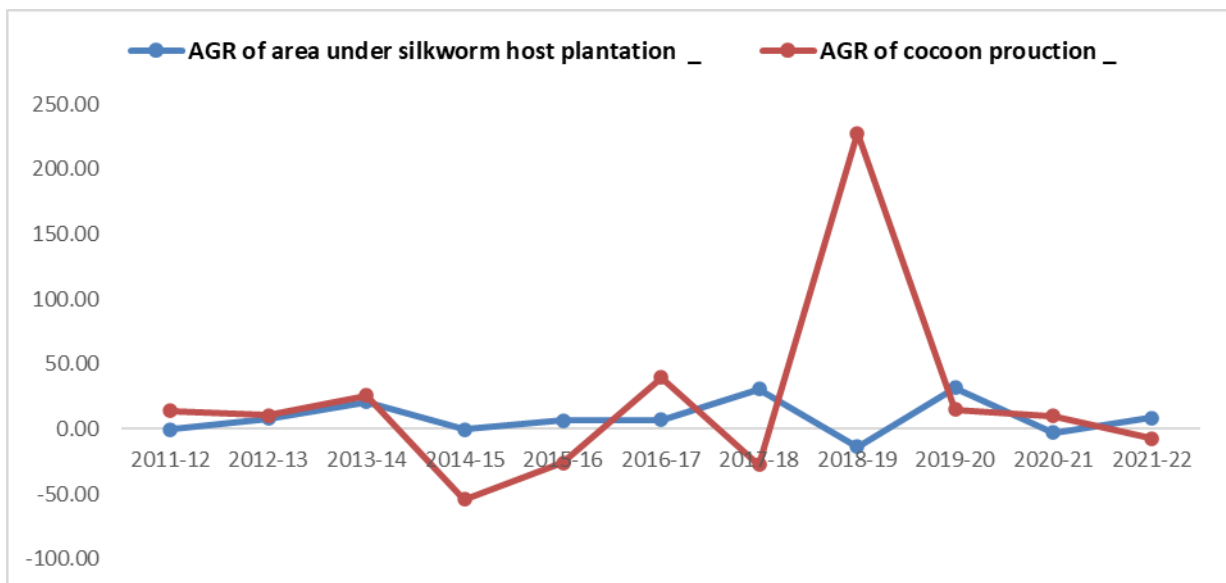


Fig 2: Annual Growth of the area under of silkworm host cultivation and Cocoon Production

Source: Statistical Handbook of Assam, 2010 to 2023. (<https://des.assam.gov.in/documents-detail/statistical-hand-book>)

Fig 1 reflects the trend of raw silk production in Assam. Though the production of Raw silk in Assam is fluctuating over the years the trend of total raw silk production as shown in the figure through a trend line follows an upward increasing trend. A future projection has also been done which shows that raw silk production in Assam has enough potential to rise.

The Figure 2 shows the growth of area under silkworm host plantation and cocoon production. The annual growth rate of area under silkworm food plantation has a positive growth up to 2012-13 but a sudden

decline has been seen. However, till 2016-17 it has a significant rise but thereafter the annual growth is fluctuating. In case of total cocoon production the annual growth is almost positive except for 2014-15, 2016-17 and 2020-21. The figure depicts that there is more fluctuation in the annual growth of cocoon production. However, CAGR in case of both Cocoon production and area are positive i.e. on an average area under host plantation and cocoon production has increased. The degree of variation is more in case of area under host plantation this may be due to various reasons like frequent flood and devotion of land to other activities.

From the Table 5 and Figure 4 it can be stated that the number of family engaged in Eri culture is highest among the two others. The total number of family engaged in sericulture has declined over the years attributed by decline in family engagement in Eri production. Though, the CAGR in case of total family engagement is positive i.e. 1.44 that means on an average the number of family engaged in sericulture production has increased by 1.44 %, but the CAGR in case of Muga and Mulberry is negative which implies that over the period 2010-11 to 2021-22 the number of family engaged in Muga and mulberry production has declined by 4.97% and 5.58 percent. The reason behind this low family engagement may be the increased in the manufacturing products that leads to decrease in demand for the Silkworm products. Another reason behind this may be the Covid Pandemic that arise at the end of this period. However, it has observed that family engaged in Eri and Muga is related to the growth of production of Eri and Muga. Thus family engaged influenced the production.

Table 4: Number of Family Engaged in total Raw Silk Production

YEAR	ERI	MUGA	MULBERRY	TOTAL	AGR
2010-11	182979	39444	31711	214690	—
2011-12	183000	39750	31766	254516	0.15
2012-13	199763	59874	31955	291592	14.6
2013-14	191566	57966	32541	282073	-3.26
2014-15	552063	32045	68298	652406	131.29
2015-16	425382	32632	38887	496901	-23.84
2016-17	271318	20541	27546	319405	-35.72
2017-18	249295	27690	29059	306044	-4.18
2018-19	240939	30164	29905	301008	-1.65
2019-20	249615	30710	29205	309530	2.83
2020-21	294419	29231	8207	331857	7.21
2021-22	239810	31653	28473	299936	-9.62
CAGR	2.52	-4.97	-5.58	1.44	

Source: Statistical Handbook of Assam, 2010 to 2023. (<https://des.assam.gov.in/documents-detail/statistical-hand-book>)

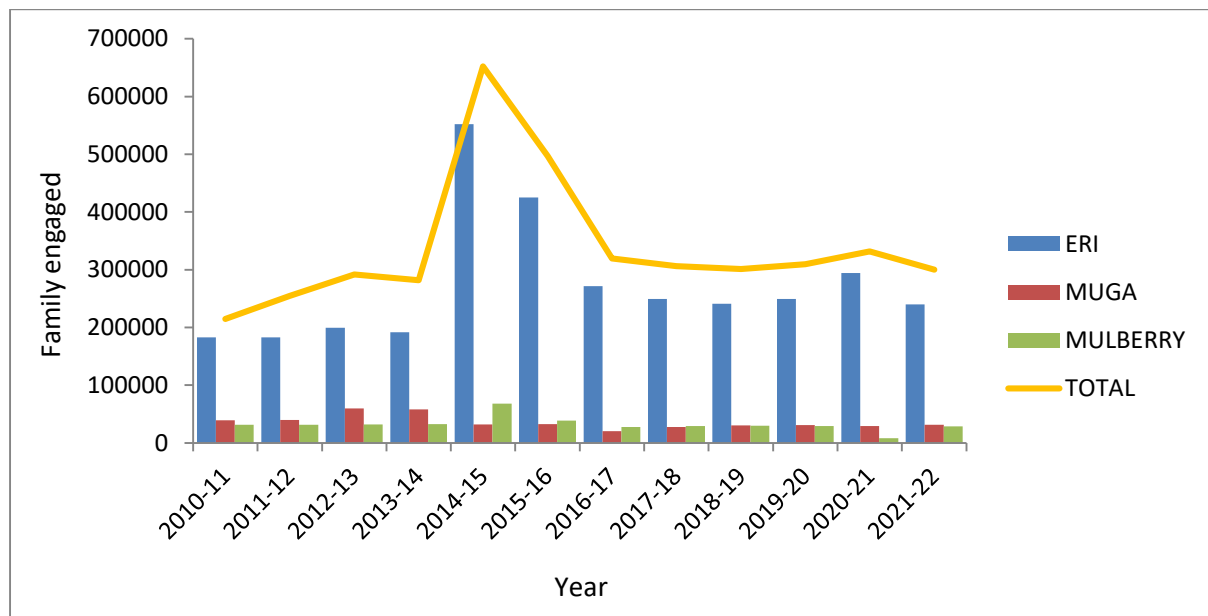


Fig 4: Family engaged sericulture production in Assam

Source: Computed from table 5

Conclusion

The major findings of the paper are that within Assam the raw silk production on an average has a positive growth and an upward trend has also observed in terms of total raw silk production of the state. However, there is not a continuous or smooth growth rather there is fluctuation in the overall production of raw silk. The growth in Eri has recorded highest as compared to Muga and Mulberry. The area under silkworm host plantation recorded a high degree of variation. The number of family engaged in raw silk production over the time period has recorded a negative growth on average in terms of Muga and Mulberry and is positive in terms of Eri. It was found that although the central government as well as the state government has taken several measures and schemes to promote raw silk production in Assam, but due to information gap most of the rearers were unable to avail the opportunities. The fluctuation and instability basically vulnerable to certain constraints which include the environmental as well as socio-economic constraints such as Changing climatic condition, frequent occurrence of flood (Akhtar, 2015), lack of capital (Hatibaruah et al., 2021), lack of insurance facility, pesticides used in the production process are some of the basic issues faced in terms of Sericulture production. While estimating the future trend it has been observed that Sericulture production within the state has the potential to rise if subjected to proper planning and implementation. Though the environmental constrains cannot be controlled to a large extent but more stress can be put to manage the socio-economic constraints so that the stability in production and the risk of loss to the seri growers can be ensured (Saikia et al., 2016; Devi, et al., 2021). Apart from this, the authority can adopt some policies for smooth growth of the sericulture sector, such as easy access to credit, provision of insurance facilities to the rearers is to be given top most priority, formation of a committee or group to bridge the information gap between the rearers and government, afforestation etc. Importance should be given on transforming sericulture from a rural home based activity to widely commercialized business activity. Apart from that public-private partnership should be encouraged in the production process of sericulture sector (Bhat, 2014).

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Conflict of Interest

The authors declare no conflicts of interest.

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