

An Economy of Reeling, Spinning, and Weaving in Vanya Silk with Reference to Muga and Eri Silk

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Abstract This paper aims to analyze the economy of reelers, spinners, and weavers who are an integral part of the silk industry. The study used both primary and secondary data. Primary data has been collected from 572 respondents from five (5) major handloom-producing districts namely Kamrup Rural, Nalbari, Dhemaji, Kokrajhar, and Udalguri districts of Assam. The income determination of different groups of workers is analyzed by taking the Analysis of Covariance (ANCOVA) method. The study found differences in income among reeler and spinner, reeling and spinning in the machine and traditional device. Income of the reeler is also found to have negatively increased by age whereas experience is found to influence the income positively. In the case of spinner education, age, and experience are not found to influence their income. The study also shows differences in income among Muga weavers and Eri weavers, and on the basis of different products. Education and training are found to be insignificant and have no role in the determination of the income of weavers. Age is found to be negatively significant, indicating an increase in income at a diminishing rate. The results also show the income of the weaver to be determined positively by design since the wage rate for products with design is higher.

Keywords Silk, Weavers, Reelers, Spinners, Income

1. Introduction

Indian handloom industry had a glorious past. In ancient

times Indian fabric was exported to Rome, Egypt, and China [1]. However, during the British rule, the Indian handloom sector had faced tough competition from machine-made fabric affecting inversely to the age-old handloom sector. Mahatma Gandhi and some of his followers encouraged the handloom industry and introduced a few looms at Satyagraha Ashram at Sabarmati. To boost the handloom sector, they set an objective that they were to clothe themselves entirely in cloth manufactured by their own hands [2]. In the period 1901-1961, the occupational distribution of the workforce in India was characterized by a high share in agriculture, (70 to 75 percent), a low share in manufacturing (9-10 percent), and a moderate share in services around (16-20 percent) [3]. The Handloom sector has a multidimensional role in the economy of India from employment generation to the reduction of economic disparity between rich and poor, and rural and urban. The strength of the handloom industry lies in its uniqueness, versatility, and tradition [4]. According to the handloom census 2019-20 the handloom sector creates around 35 lakhs of direct employment. If other industry stakeholders are considered-other textile manufacturers, fashion designers, etc., this number will be much higher because it includes other textiles, making this the second-largest source of employment for the rural population after agriculture [5]. The most important motivating factors that motivate handloom owners and workers are family support followed by self-interest and unemployment [6].

India produces all four varieties of natural silks namely mulberry silk, Tasar silk, Muga silk, and Eri silk. The Tasar,

Eri, and Muga silk are non-mulberry silks that are wild silks and are also known as Vanya silk [7]. Non-mulberry sericulture has been given much importance in recent years, in different states [8]. Indian silk weavers have captured world interest with their traditional motifs, which are renowned for their aesthetic value, demonstrating richness, the multiplicity of our color, and the artistry of the weavers [9]. Though Assam produces all four varieties of silk yet major emphasis has been given to the production of Muga and Eri silk. Its contribution to Muga and Eri production is 95 percent and 65 percent of the country's total production [10]. Since time immemorial women, irrespective of caste and social status, have been producing the daily requirement of their clothes and apparel and have been taking pride in their work. During the Ahom regime, Ahom Kings patronized the silk handloom industry in the state. The professional weavers known as Taties had satisfied the needs of the royal families and other prominent people [11]. This weaving tradition has been handed down from generation to generation by the womenfolk who excelled in the production of extremely beautiful designs in their looms [12]. Skill in the art of weaving and spinning has always been held to be one of the highest attainments of a woman [13]. It is worthy to mention here that almost every household in the rural area of the state is connected with the weaving industry [14]. Weaving activity in India as well as in Assam is for self-consumption as well as for commercial sales [15]. Until the beginning of the 20th century whole of the cloth requirement of every family of Assam are secured from the family handloom [16]. Though handloom is concentrated mainly in the rural areas then also some commercial handloom weaving centers are growing in the town and cities of Assam, providing job opportunities to 1948834 people in the state in 2017-18[17].

2. Process of Reeling and Spinning Silk

2.1. Preparation for Muga Reeling

Silk reeling is the process used for unwinding the silk from the cocoon economically by different methods. Nowadays, various methods are used in different countries to meet different varieties of the cocoon [18]. Generally, after harvest, the brownish-yellow cocoons are locally stifled by exposure to direct sun for one week. Then these cocoons were sold to the traders/master weavers. Nowadays the rearers of Muga silk give importance to reeling looking at the profitability of reeling yarn compared to selling cocoons. For determining reliability, the person needs to press the stifled cocoon, and if the pupa is crushed easily cocoon is considered not reliable. When the pupa inside the cocoon gives a hard feeling, it indicates the reliability of the cocoon. For storing cocoons, a wire mesh cage of size 4.50 X 3.00 sq. meters having 3 tiers is

used. By storing this process cocoon can be fully protected from harm. About size 3.00-4.50 lakh cocoons can be stored in one cage for a year. Now for reeling, the Muga cocoon shell is softened by cooking in a single open pan for an unwinding of filaments. For cooking 500 cocoons, about 10 liters of water is placed in the 15-liter capacity pan with 25-50 grams of soda. Cocoons are cooked by boiling alkaline water for 15-30 minutes, to secure uniform softening of the shell without bursting the cocoons. Cooked cocoons are individually defloshed by hand and the end of the continuous filament is searched.

The Muga reeling is generally done by the rearers themselves. In some places of Assam, a large section of commercial rearers do the work as their profession. Muga cocoons are reeled in a hot water bath at 60 °C. Reeling 5000 nos. of quality cocoon yields one kilogram of reeled yarn. Well-cooked cocoon shells are converted into reeled yarn on reeling devices. Yarn is honked onto a 1.5-meter standard reel in hanks/skeins of 20-30 grams. 56 percent of Muga reeling is done on "Bhir" the traditional age-old device and the remaining 44 percent of reeled yarn is done by CSTRI motorized cum paddle operated machine [19]. The productivity of "Bhir" is very low (80 grams per day) and the quality of the yarn is also not uniform. However, the weavers prefer to use the untwisted yarn produced on "Bhir" for weft, which accounts for 60 percent of the total. CSTRI motorized cum paddle operated machine productivity of weft yarn is much higher (150 gram/per day) [20]. In eight hours about 500 cocoons can be reeled and 100 gm of yarn is recovered. On the other hand, the CSTRI machine can reel 154-160 grams of Muga yarn in eight hours [21].

2.2. Reeling Devices

a. Bhir

Bhir is the most primitive device which is playing a very important role in reeling Muga yarn. In this machine, unwinded filaments are combined by twisting thread on reelers inclined arms with rolling friction. Bhir is a low-height machine, which needs a space of 2.50 X 1.00 sq. meters. For conducting the reeling activity two persons are needed; one finds out the filament from the cocoon and combines them, and the other twists the arms with rolling friction. This reeling system causes health hazards on reelers' arms like cuts, skin irritation, etc.

b. CSTRI, Muga reeling-cum-twisting machine

This is a four-spindle Muga reeling-cum-twisting machine. The machine is based on a ring spindle twisting system. The high, width and length of the machine is 1.5-meter, 1.00 meter and 75 cm. respectively. In general, the machine is operated by power along with the option of pedal driving. The machine is made of iron and is becoming popular amongst the reelers and can be warped

because of its better twist and strength. In this case, single person can conduct the process. 5000 quality cocoons yield one kg silk yarn and for this the reeler gets Rs. 3500/.

2.3. Preparation for Eri Spinning

Spinning is the process of producing a single yarn out of a continuous filament of the cocoon. Eri cocoons are open-mouthed and not composed of continuous filaments. So, eri silk filament is not wrapped like Muga, Mulberry, and Tasar cocoons. Therefore, eri cocoon cannot be reeled but spun like cotton. The major portion of eri cocoons produced in this region is locally spun through a traditional device known as Takuri/ Takli. Weavers' cooperative society has also been playing a vital role in the country's economy by spinning (the case of eri silk) activities including weaving is largely supported by women [22].

2.4. Spinning Devices

a. Takli

Takli is a conventional hand-spun spinning a 'Drop Spindle' and traditionally hand-spun directly from the cocoon by using this device. By using this device, one can have spun 30-40 gm in 8 hours.

b. CSTRI Spinning Wheel

Central Silk Board, Central Silk Technological Research Institute (CSTRI), Bangalore developed improved spinning machines that give higher productivity than the traditional spinning device Takli. In this method, eri cocoons are boiled for one hour with soap and soda solution. After that soft and degummed cocoons are washed with hot and cold water to remove all the soap and soda content from the fiber. Then the soft cocoons are flattened in water and make a lump. One lump contains 25-50 cocoons, and the lumps are then dried. The dried lumps are then stretched to open fiber and fed into a motorized/motorized cum pedal-operated spinning machine. This machine-produced yarn is uniform compared to Takli-produced yarn. The productivity of the machine is around 150 gm in 8 hours.

3. Categories of the Worker in the Handloom Industry

The handloom industry consists of mainly five types of workers namely owners, reelers, spinners, weavers, and helpers. Again, the handloom industry can be owned by individual persons, the Private sector or groups of individuals, and the cooperative sector. Individual people are those who have looms in their homes. They weave for self-consumption and sometimes in order to fulfill their needs they sell their product in the local market. They own the instrument of production and raw material for weaving.

Private own sector is those weavings owned by organizations/NGOs, or groups of individual persons. Such weaving is established for commercial purposes as well as to promote weaving culture and to generate employment. The cooperative sector is formed to protect the interest of the weavers. This is the major section that accounted for a large proportion of weavers. The weavers may be both full-time and part-time in this sector and these weavers are known as the primary weaver's society. They mostly weave for commercial purposes [23].

The Owner of the handloom is called Mahajan. The owner has the chief role in operating the handloom sector, they procure the instrument and raw material needed for weaving and produced handloom products by hiring weavers or by weaving themselves. Generally, the family members also act as a weaver. The study has taken three (3) categories of handloom workers; they are reeler, spinner, and weaver. The reelers and spinners are engaged in pre-loom activities like reeling and spinning yarn. Reeling is done in the case of Muga silk and spinning in the case of Eri silk. Weavers are those who are hired on a contractual basis or on monthly by the owner of handloom for the purpose of weaving cloth [24]. Many factors influenced reelers to adopt the reeling profession in the Muga silk industry. Reeling is done through two methods (i) traditional device Bhir and (ii) CSTRI Muga reeling-cum-twisting machine. Under reeling units in the study area, 70 percent of reelers are female, reeling in the traditional device, Bhir. The cost of the Bhir is very low and can be made at home too according to their need, minor changes can be made for more comfortable and convenient use. No major training is required to reel in the traditional device, Bhir. At a time two reelers are needed (in the case of Bhir) for doing the reeling activity, so the income of reeling is divided between them. They can reel a maximum of 100 grams of silk in a day. Reeling through Muga reeling-cum-twisting machine is impossible without training and a single reeler can handle it. In this device, one reeler can reel 150 grams of silk per day. So, the reeler through the machine can earn more than the reeler using the traditional reeling device Bhir. The male-female ratio of reeler is 50/50 in the sample area and they work full time. Spinning is also done by two methods (i) traditional device called Takri and (ii) CSTRI Spinning Wheel. Spinning is mostly done by a female. The same is the case with the traditional device takuri/takri, it is low in cost and the device can be made at home. Spinning activity with takri is mostly done at home which is considered time-saving and cost-saving with no strict schedule for work. However, spinning in a CSTRI machine is done in the workplace with proper training. Weavers are the main category of workers in the Handloom sector. Weavers weave different types of cloth that suit different occasions and seasons, for their own as well as for commercial purposes. The weavers usually receive a wage for piece rate (per piece) which depends on the complexity of design, quality, sizing, length of cloth and kind of loom used, etc. The wage structure of

weavers in the handloom sector again depends on different types of products and materials used. There are wage rate differences for different types of products in the handloom sector however the product rate/piece rate is the same for all weavers irrespective of caste, creed, gender, and religion. There are some products that are rated meters-wise. Most of the handloom sector in study districts hired helpers to assist owners and weavers. They are monthly rated workers and their wage is very negligible.

In this paper, the investigator tried to analyze the economy of reeling, spinning, and weaving. The study is mainly focus on hired reelers, spinners and weavers of those sectors who weave for commercial purposes rather than individual weavers who weave for self - consumption.

4. Methodology

The study used both primary and secondary data. Primary data has been collected from 572 respondents.

Respondents are categorized into three groups name reeler (110), spinner (62), and weaver (400) collected from five (5) major handloom producing districts namely Kamrup Rural, Nalbari, Dhemaji, Kokrajhar, and Udalguri district of Assam, India. Districts, blocks and villages are selected purposively taking into account the weaving activities and selection of respondent are done through simple random sampling. Of total 400 weavers, 40 percent are male and 60 percent are female weaver, in case of reeler and spinner 70 percent and 95 percent respectively are female. Secondary data has been collected from different sources such as the statistical handbook of Assam and Bodoland Territorial Region (BTR), Assam Khadi and Village Industries Board (AKVIB), Central Silk Board (CSB), Assam Apex Weavers Artisans Cooperative Federation Ltd (ARTFED), Bodoland Regional Apex Weavers and Artisans Cooperative Federation (BRAWFED), Director of Sericulture, Government of Assam (GOA), Director of Sericulture, Government of BTC and Block Development offices.

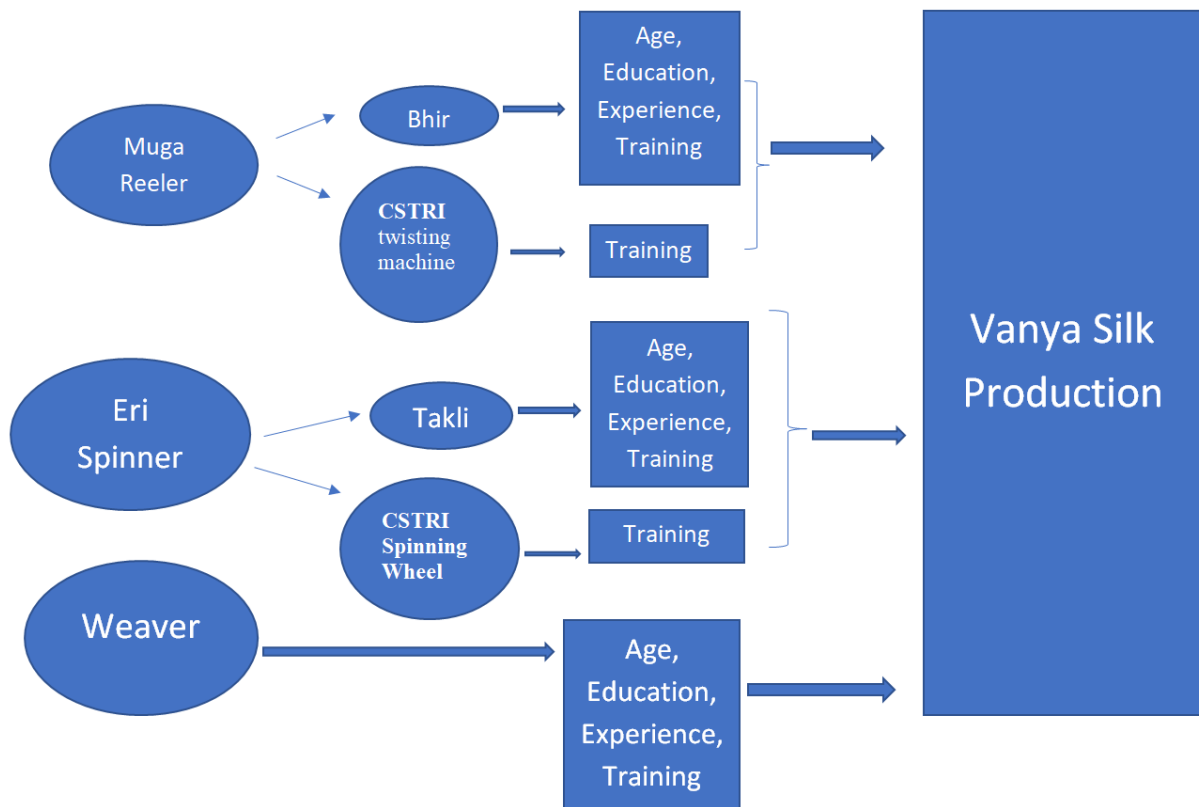


Figure1. Conceptual framework of the study

4.1. Statistical Tools Employed in the Study

The income determination of different groups of workers is analyzed by taking Analysis of Covariance (ANCOVA). ANCOVA model is nothing but the regression model containing mix of some explanatory variables that are quantitative and qualitative variables [25]. The model is presented below

$$y_i = \alpha + \beta_1 D_1 + \beta_2 D_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 M_1 + \beta_8 M_2 + \beta_9 M_3 + \beta_{10} w + u_i \quad (1)$$

Where y_i income per day for i^{th} respondents ($i=1, 2, 3, \dots, 572$)

D_1 is dummy variable or weaver, $D_1 = 1$ for Muga weaver, 0 for Eri weaver

The mean income for Muga weavers is

$$Y = \alpha + \beta_1 \quad (1) = \alpha + \beta_1 \quad (2)$$

and Mean income for Eri weavers is

$$Y = \alpha + \beta_1 \quad (0) = \alpha \quad (3)$$

So, β_1 is the slope coefficient that tells by how much the mean income of Muga weaver differs from the mean income of Eri weaver. The coefficients of the dummy variable are known as the differential intercept coefficients.

D_2 is dummy for gender, $D_2 = 1$ for female, 0 for male

The mean income for female weavers is

$$Y = \alpha + \beta_2 \quad (1) = \alpha + \beta_2 \quad (4)$$

and for Male, it is

$$Y = \alpha + \beta_2 \quad (0) = \alpha \quad (5)$$

x_3, x_4, x_5, x_6 is explanatory variables for education, training, age, and experience

M is a dummy variable for varieties of products namely sari, mekhela-sador, Dokna, and shawl

$M_1 = 1$ for sari and 0 otherwise

$M_2 = 1$ for mekhela-sador and 0 otherwise

$M_3 = 1$ for Dokna and 0 otherwise

The average value of the shawl will be $E(Y/M_1=0, M_2=0, M_3=0) = \alpha$ (shawl is benchmark category with all dummies)

$$\text{Average value for Sari} = E(Y/M_1=1, M_2=0, M_3=0) = \alpha + \beta_7 \quad (6)$$

$$\text{Average value for Mekhela- Sador} = E(Y/M_1=0, M_2=1, M_3=0) = \alpha + \beta_8 \quad (7)$$

$$\text{Average value for Mekhela- Sador} = E(Y/M_1=0, M_2=0, M_3=1) = \alpha + \beta_9 \quad (8)$$

The regression model (varieties of products) has 4 categories, so we use the '4-1' dummy variable. If we use 'k' dummy variables for k categories, then we will face the problem called dummy variable trap. (Shawl is the benchmark category with all dummies)

w is cloth with design, and u is the error term.

4.2. Test of Multicollinearity

To identify the problem of Multicollinearity in the model, Tolerance and Variance Inflation Factor (VIF) values are accessed. VIF of above 5 or 10 and the tolerance of less than 0.20 or 0.10 are often regarded as indicating multicollinearity. The variables indicating multicollinearity in our study have been dropped to make the model free from the multicollinearity problem.

5. Discussion and Result

5.1. The Economy of Reeling, Spinning, and Weaving

In Assam reeling, spinning and weaving is been adopted as a profession since time immemorial by the indigenous people. These activities provided employment and earning to a large folk and particularly to women both in rural and urban areas, enhancing their social and economic lives. This very nature of the industry has attracted the attention of central and state governments and particularly the sericulture department of the State to recognize the industry as one of the most appropriate avenues for socio-economic development in a largely agrarian economy like India and where unemployment is a major problem. In recent years, the number of weavers and rearers clusters have been created under various centrally sponsored schemes and other rural development schemes to uplift the efficiency relating to weaving, spinning, and reeling activities.

Table 1 shows the number of employees needed for reeling per kg of Muga yarn. As per the field study, with the traditional device, Bhir, a maximum of 100 grams can be reeled and a reeler can earn a maximum of Rs. 175 and a Minimum of Rs. 88 in a day, which is lower than the minimum wage of a non-agricultural unskilled worker of Rs. 350 per day [26]. Employment generated in reeling through Bhir for 1 kg yarn is 40 man-days at maximum and 20 man-days at minimum. However, the employment generation and productive capacity through Muga reeling-cum-twisting machine is much higher than the traditional device Bhir. The machine can produce 150 grams per day and the reeler can earn Rs. 525. The machine needs only 6.67 man-days to reel 1 kg yarn.

With traditional devices, Takli a maximum of 40 grams and a minimum of 30-gram eri silk can be spun and a spinner can earn a maximum of Rs. 90 and a minimum of Rs.45 (as depicted in table 2) which is much below the Government minimum wage rate. Comparing Muga reeler and Eri spinner in traditional machine Bhir and Takli, it is found that Muga reeler can earn almost two times higher than eri spinner. Employment generated for spinning 1 kg yarn eri silk by Takli is 33 man-days at maximum and 25 man-days at minimum. However, with the CSTRI spinning wheel, 150 grams can be produced in a day and the spinner can earn Rs. 225. In both traditional and modern devices, the Muga reelers are in a better position in earning income.

Table 3 depicted the prices of a cocoon, raw silk per kg of Muga and Eri. The average price of Muga reeling cocoons was Rs.1700 per thousand cocoons in 2013-14 and has increased on average by Rs.3000 in 2019-20 (Rs. 4500). Cocoon prices during the period had increased by 2.65 times. Muga raw silk (warp) on average had increased from Rs. 8000 in 2013-14 to Rs. 22450 in 2019-20. The price of Muga raw silk had increased by 2.8 times during these 7 years. Muga raw silk (weft) prices have also increased by 1.8 times during the same period.

The price of an Eri cut cocoon of superior quality was on average Rs. 550 per Kg in 2013-14, which had increased to Rs. 850 in 2019-20, increased by 1.55 times. Again, the

price of raw silk (spun yarn) had increased from Rs. 1400 to Rs.2700 on average, showing an increase of 1.93 times.

The table 4 presents the net profit earned in reeling 5000 cocoons. The total expenditure needed for reeling including cocoon price, labor cost, and other required items like soap, fuel, etc. amounted to Rs. 8100, whereas raw silk (warp) price is Rs. 25000, giving a net profit of Rs. 16900. This earning has encouraged the reeler to reel the cocoon at home and sell it as yarn or silk fabric.

Spinning 1 kg of Eri silk needs a total expenditure of Rs.2563 including labor costs and others, giving a net profit of Rs 1437 (as depicted in table 5).

Table 1. Number of employments in reeling per kg Muga yarn

	Bhir (two persons)	Muga reeling-cum-twisting machine
Max produced in a day (in gm)	100	150
Minimum produced in a day (in gm)	50	-
Maximum income of a reeler in a day (in Rs) per gm Rs 3.5 per gm per day	175	525
Minimum income (in Rs.) of one-reeler in one day	88	-
Maximum employment in reeling 1 kg yarn in mandays	40	6.67
Minimum employment to reeling one kg yarn in mandays	20	-

Source: Author compilation from a field study

Table 2. Number of employment in spinning per kg Eri yarn

	Takli	CSTRI Spinning Wheel
Maximum produced in a day (in gm)	40	150
Minimum produced in a day (in gm)	30	
The maximum income of a spinner in a day (in Rs) per gm is Rs 1.5 per gm per day	90	225
Minimum income (in Rs)	45	
Maximum employment in reeling 1 kg yarn (in Mandays)	33	6.67
Minimum employment in reeling 1 kg yarn (in Mandays)	25	

Source: Author compilation from the field study

Table 3. Prices of cocoon Raw Silk per kg of Muga and Eri

Particulars	Unit	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Muga								
Reeling Cocoon	Rs/1000 No	1400-2000	1200-2200	1300-2150	1600-3500	1800-4000	1800-6000	3000-6000
Raw Silk (Warp)	Rs./Kg	10,000-15,000	14,000-18,000	12,500-15,500	14,200-18,000	13,000-22,000	16,500-20,000	19400-25500
Raw Silk (Weft)	Rs./Kg	8,000-12,000	12,000-16,000	11,000-14,000	12,500-15,500	12,000-20,000	16,500-20,000	17000-19000
Eri								
Cut Cocoon (Superior Quality)	Rs./Kg	460-640	460-700	600-800	550-850	700-900	700-900	750-950
Raw Silk (Spun Yarn)	Rs./Kg	1,200-1600	1400-2800	1600-3300	1800-2600	2100-2700	2250-2800	2500-2900

Source: Central Silk Bengaluru

Table 4. Profit in reeling cocoon to Muga yarn

Muga	Unit	Price of cocoon	The average price of a cocoo	Labor cost	Requiring expenditure on fuel, soap, etc.	Total Cost	Price Raw Silk (Warp)	Net profit
Reeling Cocoon for Weft	5000 No	3000-6000	4500	3500	100	8100	25000	16900

Source: Author compilation from a field study

Table 5. Profit in spinning cocoon to Eri yarn

Muga	Unit	Price of Cut Cocoon	The average price of Cut Cocoon	For 1 kg yarn Need to Cut a Cocoon	Price of Cut Cocoon for 1 kg yarn	Labor cost	Requiring expenditure on fuel, soap, etc.	Total Cost	Price Raw Silk	The average price of Raw Silk (Warp)	Net profit
Cut Cocoon	Rs./Kg	750-950	850	1.18	1003	1500	60	2563	3000-5000	4000	1437

Source: Author compilation from a field study

Table 6. Weaver income from different products

Item	Wage Rate (Rs)	Unit	Mandays	Income of Weaver Per Day	Item	Wage Rate (Rs)	Mandays	Income of Weaver Per Day
Muga				Eri				
Sari with blouse (Designed)	4000	1	15	267	Stole Designed	350	2	175
Mekhela Sadar and blouse (Designed)	3500	1	12	292	Shawl designed	450	2	225
Plain width 39 inches	150/MT	2	1	300	Dokna with full Designed	660	3	220
Dokna Designed	3000	1	10	300	Dokna with border Designed	450	2	225

Source: Author compilation from a field study

Table 7. Descriptive statistics for different workers

		N	minimum	maximum	mean	Standard deviation
Reeler	Income	110	88	525	155.209	101.161
	Education	110	0	4*	2.218	1.144
	Training	110	0	1	0.318	0.275
	Age	110	30	65	45.003	9.002
	experience	110	1	15	4.554	1.869
Spinner	Income	62	45	225	80.500	67.786
	Education	62	0	4*	2.354	1.255
	Training	62	0	1	.1774	.3851
	Age	62	32	66	52.064	9.091
	experience	62	3	25	5.064	.9896
Weaver	Income	400	175	350	249.162	31.346
	Education	400	0	4*	2.440	.8736
	Training	400	0	1	.0300	.1708
	Age	400	23	59	39.852	9.794
	experience	400	1	25	4.554	1.860

Source: SPSS Output

Note: 4* indicates bachelor's degree

Sari¹, Mekhela², and Dokna³ are the main products produced from Muga Silk. The wage rate is different for these products (as depicted in table 6). Sari with blouse (designed) has a fixed wage rate of around Rs. 4000 and to weave this product 15 man-days (approximately) is needed. In the case of Mekhela, the wage rate is fixed at around Rs.3500 and 12 man-days are needed to complete 1 piece. Muga Dokna required around 10 man-days and the wage rate is fixed at Rs. 3000. So, based on the fixed-wage rate and mandays, the income of Muga weavers for a sari, mekhela, and Dokna is calculated as Rs. 267, Rs. 293 and Rs. 300 respectively in a day. However, the wage rate for plain Muga cloth of 39 width inches is fixed at Rs 150 per meter and weavers can weave 2 meters in a day, earning a wage of Rs. 300 a day.

Different types of products are produced from Eri silk. However, the study has taken only stole, shawl, and done with and without design. The wage rate fixed for stole (designed) is fixed at Rs. 350 and 2 man-days are needed to complete it. If the stole is plain, the wage rate is slightly lower which is fixed at Rs. 200 and single man-days are required for it. In the case of Dokna with full design, and done with border design, the wage rate is fixed at around Rs. 660 and Rs. 450 respectively needing 2 man-days to produce the same. When the daily wage of silk weaver is calculated, it is obtained as Rs. 175 for stole (design), Rs. 225 for a shawl (design), Rs. 220 for Dokna with full

design and Rs.225 for Dokna with a border design. Comparing Muga and Eri weavers, it is understood that Muga weaver earnings are better than the other.

Descriptive statistics for different workers are shown in table 7.

Table 8 presents the income of different categories of workers. On average, reeler earns Rs. 209 in a day. When the gender of the weaver is taken into account, male reelers are found to earn more than female reelers by Rs. 32.82. Reeling is done in Bhir and CSTR I reeling machine. Reeling in Bhir does not necessitate training; however, reeling in a machine needs training. Reeler reeling in Muga-reeling twisting cum machine is found to earn better as evidenced from the field study. The regression results suggest that the reelers who are trained earned more than the other by Rs. 265.51 and are found to be significant at the 1 percent level. Income of the reeler is also found to have negatively increased by age whereas experience is found to influence the income positively.

The average income of a spinner is Rs. 41.060 in a day. However, no earning difference is observed between males and females. Education, Age, and experience are also not found to influence the income of spinner. But those spinners spinning in CSTR I machines need training and their income is found to be more than the other by Rs. 176. 62, that is trained spinner earned Rs. 217.68 in a day.

1 sari: a piece of garment worn by Indian subcontinent women wear around their bodies

2 Mekhela: Traditional garment worn by Assamese women, consisting of a length worn from the waist to ankles and often pleated

3 Dokna: Traditional dress of Bodo women wore to cover body from chest to legs by tying one round at a time in the waist

Table 8. Regression result showing income of different categories of workers

Category of worker	Variables	Coefficient	t	sig	Collinearity statistics	
					Tolerance	VIF
Reeler	Constant	209.439	6.117	.000***	-	-
	Gender	32.826	2.786	.006***	.601	1.663
	Education	5.330	1.370	.174	.907	1.103
	Training	265.511	14.222	.000***	.681	1.469
	Age	-2.710	-4.772	.000***	.688	1.453
	experience	5.753	2.007	.047*	.626	1.596
R square=.817, Adjusted R square=.808, F=92.976, Sig=.000						
Spinner	Constant	41.060	8.792	.000***	-	-
	Gender	.762	.261	.795	.728	1.373
	Education	.548	1.236	.222	.935	1.070
	Training	176.62	97.877	.000***	.600	1.666
	Age	.092	1.354	.181	.756	1.323
	experience	.390	.651	.518	.826	1.210
R square=.996 Adjusted R square=.996, F=3156, sig=.000						
Weaver	constant	291.739	46.275	.000***	-	-
	Weavers	27.760	7.819	0.000***	.354	2.821
	gender	-10.101	-3.129	.002**	.433	2.311
	Education	.894	.732	.465	.985	1.016
	Training	5.471	.871	.38	.973	1.028
	Age	-1.504	-13.39	.000***	.926	1.080
	Experience	-5.579	-.1915			
	Sari	-4.456	-1.256	.361	.513	1.950
	Mekhela-Sador	5.588	1.856	.210	.531	1.885
	Dokna	7.761	2.874	.064	.785	1.274
	Design			.004*	.846	1.183
	R square=.556, Adjusted R square=.545, F=54.165, Sig=.000					

Source: SPSS Output *** significant at 1 percent, ** significant at 10 percent, *significant at 5 percent

The income earned per day for Eri and Muga weaver can be analyzed from regression results. On average weavers earn Rs. 291.73 in a day, since the attribute assigned to Eri weaver is 0 and Muga weavers is 1, earning for Muga weavers per day as per regression result is more than Eri weavers by Rs. 27.78 which amounted to the average earning of Rs. 319.49, holding other variables constant. In the case of gender, 1 is assigned to females and 0 for males, and the results show the earnings of females to be less than males by Rs. 10.10, which is Rs. 281.638 on average. Education and training are found to be insignificant and have no role in the determination of the income of weavers. Age is found to be negatively significant, indicating an increase in income at a diminishing rate. The investigator also tried to capture the daily income of weavers based on four products namely Sari, Mekhela-sador, Dokna, and Shawl⁴(all the products are fully designed). Without taking into account the fabrics, it is found that for weaving sari,

weavers earn a daily income of Rs. 286.15, for Mekhela -Sador Rs. 287.289, for Dokna Rs. 297.327 and shawl Rs. 291.739. The results also show the income of the weaver to be determined positively by design since the wage rate for products with design is higher.

5.2. The Problem Faced in Reeling, Spinning, and Weaving

The major problems identified in reeling and spinning during field study are problems in cocoon procurement since cocoon supply fluctuates depending on weather conditions. It is also observed that during summer due to high temperature, the death rate of silkworms is high affecting inversely the production of cocoons. Flood and heavy rainfall are common in the study region, and due to these silkworms are washed out. During processing also constraints such as Poor-quality cocoons, scarcity of labor, etc. are identified. Apart from this problem, problems like fluctuation in silk prices, non-availability of market

⁴Shawl: A large piece of cloth/garment worn by female around their shoulder

information, and transportation problems are common. The study also observed that Muga silkworm suffered heavily from Pebrine disease locally known as photuka, affecting the production as well as supply of cocoon. In the case of reeler, it is observed that most of the reeler reel under master weaver/Mahajan using Bhir or Muga reeling-cum-twisting machine. It is observed that instead of reeling cocoon for wage if they could buy cocoon, reel it and sell the yarn by themselves, they could have earned more income.

Eri silkworm also suffered heavily because of Pebrine and Flacherie disease affecting the production of eri cocoon. It is evident from a field study that eri spun by traditional device Takli is drastically reducing due to low productivity and the device has a very little scope for improvising the tiny tool. As a result, the spinner has been shifted from traditional to CSTR spinning machines. Moreover, the Government has also provided heavy subsidies on the machine where the spinner needs to pay only Rs. 1000 (field visit) to get it. It is also seen that machine-cut yarn is more even as compared to conventional ones, so same with the weaving cloth. However, in the study region, it is observed that eri spinning machines encounter different technical problems followed by a lack of skilled workers.

The demand for Muga and eri silk is growing day by day and it is gaining popularity as high-end fashion fabric both in India and abroad. But the production of this silk is not increasing as expected. There is a gap in demand and supply of yarn and it has led the producers, weavers, and traders to fail in exploiting the market potential.

As experienced from the field study, most of the weaving hubs are seen without proper electricity connection and workers have to work in a hot and humid, congested, and poorly ventilated workplace. They are usually exposed to a high noise level due to the sound of the loom machines which causes speech interference, annoyance, and headache during working hours [27]. The study has revealed the health hazards faced by weavers/reelers/spinners. The common problems reported were dizziness, irritation in the eyes, watering eyes, numbness in the finger, headache, body pain, cramps in the body, blurred vision, tingling of fingers, and chest pain. The seasonal variation, health-related issues, high temperature, and heavy rain, cold foggy weather have affected their performance and productivity.

Low wage is one of the main issues workers face in handloom, leading the number of handloom workers to steadily decrease over time. At the same time, the younger generation did not want to practice this craft because other jobs generate better incomes. The Assam Government policy of minimum wage for Handloom weaving establishments (with effect from 1 June 2020) is Rs. 645.19 per day for highly skilled, Rs. 501.83 for skilled/clerical, Rs. 401.45 for semi-skilled/unskilled supervisory and Rs.344.08 for unskilled do not meet in any case to the present study [28].

6. Conclusion and Recommendation

Reeling, spinning, and weaving are an ideal part of the Vanya silk industry. The industry is possible to create employment and earnings for reelers, spinners, weavers, and other allied workers. Since they are the backbone of the industry, their socio-economic conditions should be taken care of for the proper development of the sector.

It is observed that in the case of reeler and spinner, reeling and spinning with a machine enhance more earning, and reeling not under master weavers ensure more profitability. In this case, to stable the supply chain of yarn and make it available to the reeler and spinner, the government should provide more storage facilities for the cocoon. The reeler/ spinner should also be motivated and demonstrated with the adoption of improved technology.

To reduce health-related problems, an improvement in the working environment and compatibility of the device used is necessary, which would help mitigate the reeler/spinner and weaver discomfort. This would further increase the weavers' productivity, performance, and income.

To overcome the constraint related to silk raw material, yarn and fabrics, and cocoon production, the government should take care of high-quality standards seed, by setting up more numbers of testing centers in different places. A silk research center should also undertake research on demand patterns, designs, weaving technology, raw materials, market orientation, and training facilities.

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