Competitive Research Grant

Sub-Project Completion Report

on

Development of Modern Reeling Machine and Its use For Quality and Quantity raw silk production in The Field.

Project Duration

May 2016 to September 2018

Silk Technology Department, Bangladesh Sericulture Research and Training Institute Rajshahi.

Submitted to

Project Implementation Unit-BARC, NATP 2 Bangladesh Agricultural Research Council Farmgate, Dhaka-1215

September 2018

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Acronyms

BSRTI   Bangladesh Sericulture Research And Training Institute

BSDB   Bangladesh Sericulture Development Board

DG   Director General

BARC   Bangladesh Agriculture Research council

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Executive Summary

The project entitled "Development of Modern Reeling Machine and Its Use for Quality and Quantity Raw Silk Production in the Field Level" was approved in May 2017 and signed between Bangladesh Sericulture Research and Training Institute (BSRTI) and PIU-BARC, NATP 2 authority. Total estimated cost of the project was Tk.1536045.00 (Fifteen Lac thirty six thousand and forty five) only. The main objectives of the study was:

> ➢ To produce quality raw silk through developing modern reeling machine.
> ➢ To improve renditta.
> ➢ To minimize the reeling cost.

The reeling machine and technologies which are mostly used in Bangladesh are not suitable for quality and quantity raw silk production. So, it was urgent and time needed demand for the silk reeler to replace the existing reeling machine and reeling technology for quality and quantity raw silk production. For considering the above factors the present project was implemented and improved modern reeling machine was fabricated by BSRTI. The raw silk produced in this machine is superior to raw silk produced in the existing reeling machine with respect to quality and quantity. This study reveals that renditta, raw silk recovery %, reelibility %, waste % in modern reeling machine were 9.83, 34.29%, 69.72%, and 21.87% respectively and that of multi-end reeling machine were 11.24, 33.37%, 65.94% and 22.69% in the laboratory level. On the other hand, in the field level for the farmer-1 (R_1) renditta, raw silk recovery %, reelibility %, and waste % were 10.33, 33.81%, 88.61% and 22.56% respectively and for the farmer-2 (R_2) renditta, raw silk recovery %, reelibility %, and waste % were 10.02, 33.79%, 67.93 % and 22.82% respectively. The results also showed that the raw silk reeling performance per 8 hours through modern reeling machine was 5.01 kg and that for multi-end reeling machine was 3.90 kg in laboratory level from the green cocoon. It was also observed that the average size (d), size deviation, maximum size deviation, wanding breaks, tenacity (g/d), elongation % and cohesion of reeled silk were 21.19, 1.94, 2.63, 7.00, 3.03, 18.08 and 44 respectively in modern reeling machine and those for multi reeling machine was 21.99, 2.77, 8.25, 12.67, 2.82, 16.69 and 38.33 respectively. In the field level for farmer (R_1) the average size (d), size deviation, maximum size deviation, wanding breaks, tenacity (g/d), elongation % and cohesion of reeled silk were 21.45, 2.13, 2.64, 10.33, 3.00, 16.93 and 42.44 respectively and for farmer (R_2) those were 21.44, 2.28, 2.61, 12.67, 2.89, 16.46 and 38.11 respectively. Considering of the reeling performances and raw silk quality, the modern reeling machine is better than multi reeling machine for quality and quantity of raw silk production.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:** Development of Modern Reeling Machine and Its Use for Quality and Quantity Raw Silk Production in the Field Level.
2. **Implementing organization**: Bangladesh Sericulture Research and Training Institute (BSRTI)**,** Rajshahi.
3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s**):

Principal Investigator. Md. Abdul Alim
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4. **Sub-project budget (Tk):**
   4.1 Total: Tk. 1536045.00
   4.2 Revised (if any): Tk. 1536045.00
5. **Duration of the sub-project:**
   5.1 Start date (based on LoA signed): 17 May 2017
   5.2 End date: 30 September 2018
6. **Justification of undertaking the sub-project:**

Goal of sericulture mostly depends on maximum production of raw silk with minimum cost. Quality and quantity of raw silk production depends upon the type of reeling machine, appliances, cocoon quality, and skillness of reelers. In Bangladesh about 75% raw silk is produced by traditional crude reeling machine called "Katghai" which produces coarse type raw silk containing 35 denier with wide variation. The other qualities like evenness ,neatness, winding break etc are also very poor. Proper selection of reeling machine, allied appliances and reeling technologies are essential for quality raw silk production. Considering the present condition of reeling facilities and cocoon quality in different rearing season's of

Bangladesh, proper reeling technology should be adopted and conventional reeling machine should be improved for quality and quantity raw silk production. For this reason, this project has been proposed which will be helpful for use and adaptation of developed reeling appliance and technology for improvement of raw silk quality and cost minimization.

In Bangladesh cocoon reeling is practiced with kathghai and cottage reeling machine without controlling the quality. As a result the silk produced by the reeler cannot be used as warp in fabric weaving. In spite of development of improved methods and reeling techniques most of the reelers are still following traditional reeling methods. Reeling of cocoons in cottage machine and traditional charka/kathghai will not ensure quality silk production. The performance of silk reeling and quality raw silk production mainly depends on cocoon quality, reeling device and process of reeling, reeler skillness and quality control (Sonowalker*et al.1990*, Shreshail*et al.1995*, Subhas*et al.1994*, Halliyal*et al.1999* and Qader*et al.2004*).

The quality of raw silk produced in cottage basin was better than that of silk produced from katghai/charkha/thai reeling machine but yet it could not meet the standards of International grade. reported that in India raw silk produced in cottage and domestic basin was better than the silk of charkha production but this raw silk could not meet the standard of International market.

Multi-end reeling machine is a modern device in India and China and used for reeling bivoltine cocoons for better quality raw silk production. But in Bangladesh, weather is superior to multivoltine cocoon production which are lower in yield, poor productivity and shows many variations in cocoon sizes that influences reeling performance and silk quality. Bangladesh Sericulture Research and Training Institute (BSRTI) Developed a 01 (one) basin morden reeling machine with re-reeling unit with standard mechanism to overcome this problems. For end casting of cocoon filament during reeling is generally practiced by hand but in new machine Z-bow has been introduced for casting. Due to this Z-bow, timely casting of new filament and filament size control easier which is suitable to produce quality raw silk from commercially available hybrid/bivoltine cocoon.

7. **Sub-project goal**: : Quality raw silk production.
8. **Sub-project objective** (s):
➢ To produce quality raw silk through developing modern reeling machine.
➢ To improve renditta.
➢ To minimize the reeling cost.

9. **Implementing location** (s): Bangladesh Sericulture Research and Training Institute, Rajshahi

10. Methodology in brief

10.1 Design and Fabrication of modern reeling machine: Drawing and design of modern reeling machine was completed first. According to drawing and design one reeling machine was fabricated. After fabrication, the performance of the reeling machine has been tested in laboratory. After getting satisfactory result another two reeling machines had been fabricated accordingly for use in the field. Out of three reeling machine one machine used in BSRTI laboratory and another two has been distributed to reelers in the field for demonstration and   commercial reeling.

10.2 This modern reeling machine consists of following facilities: Steam supply unite has been added which is new idea. Steam unit used (20kg) to boil silk cocoons and also for reeling. Dual drive system of both by hand and power, low consumpsion of fuel, proper tensions of filament, l-2 reeler per basin for economic production.

The structural design of the reeling machine is made of mild Iron angle and steel which helps is smooth running. A re-reeling unit has been incorporated with main frame for easy re-reeling during reeling with same operatative cost.

Reeling basin: The reeling basin is made of aluminum with an optimum dimension of 70x35x10cm accommodate with eight reeling ends. The basin has been set in the machine with removable facilities so that it can easily be removed as and when needed. The reelers may sit or stand during reeling in front of the basin.

Side brushing chamber : A small side brushing chamber is built by the side of reeling basin for brushing the dropped cocoon.

Jetteboute: Jetteboute is made of high density plastic with brass hollow pin for long durability and provided efficient mechanisms. It is located at the height of 12-18 cm above the reeling water level. An endless spring wire drives Jetteboute to rotate easily at high speed.

Porcelain buttons: Porcelain buttons with appropriate holes are used in the machine and fixed to the sleel clip holders, which are 8 cm height from the jetteboute rail with 2.0 gm weight each.

Croissure pulley: A tavellette' type of croissure is maintained by means of croissure pulleys to facilitate smoother thread movement during reeling and also to maintain appropriate tension level. It's weight is 18 gm each. The distance between the top and bottom croissure pulley is about 12-13 cm and first pulley to porcelain buttons is about 8 cm at the height of 4 cm above the buttons.

Traverse mechanism: A planetary traverse system has been incorporated for suitable distribution of thread on the reel with cam and gear arrangements.

Reel: High quality small aluminum rell with smooth surface has been used. The circumference of reels is 65 cm.

Steam chamber: Reeling machine has been in cooperated with steam heating system for boiling cocoon and basin water. High quality steam chamber included for boiling reeling water. A safety valve, pressure meter, a steam control valve are attached with the machine.

Chula: A gas cylinder facilited Chula has been used for boiling water**.** The Chula has option for heat control switch which is used to control for required tempreture for cocoon boiling for reeling.

10.2 Method of Performance evaluation:

10.2.1 Comparative reeling performance: This experiment was conducted both in the laboratory and field level to find out the reeling performance using commercial cocoons. One Modern reeling machine was installed at BSRTI laboratory and two machines in reeler's house in the field level of Bholahat, Nowabgong district. The reeler's house were designated as BR_1, BR_2, respectively and considered as replications. Reeling activity was done at the same time at BSRTI Lab with existing multi-end reeling machine with same commercial cocoons and it is considered as control. Reeling, performance has been evaluated during three commercial rearing seasons viz; Augrahani , Chaita, Jaistha.

10.2.2 Data Collection: Data has been collected throughout the whole reeling period. To evaluate the performance of newly developed modern reeling machine both cocoon characters and comparative reeling performance the following parameter has been considered.

10.2.3 For cocoon characteristics: Single cocoon weight (SCW), single shell weight (SSW), raw silk recovery %, reelability %, filament length (FL), non-breakable filament (NBFL), single filament denier (SFD).

Single cocoon weight (gm): An average weight of 80 single cocoons was weighted and mean value is recorded as follows:

Single shell weight (gm): An average of 80 single shell has been weighted and mean value is recorded.

Shell ratio percentage (SR%):

$$SR \% = \frac{Average\ weight\ of\ single\ shell}{verage\ weight\ of\ single\ cocoon} \text{ x } 100 \text{ -------------------------------(1)}$$

Reelability (%):

$$Reelability \% = \frac{No\ of\ cocoons\ reeled}{No\ of\ total\ casting} \text{ x } 100 \text{ -------------------------------(2)}$$

Filament length (m): 20 cocoons has been taken randomly from each replication and dried in a dryer. Then cocoons has been reeled with an individual cocoon reeling machine and average filament length has been recorded.

Non-breakable filament length (m):

$$NBFL = \frac{Reelability \%}{100} \text{ x Filament length } \text{ -----------------------------------(3)}$$

Single filament denier (d): The denier of the filament may be defined as the weight in grams of 9000 meter filament.

$$Denier = \frac{Weight\ in\ gm\ of\ filament\ length}{Total\ weight\ of\ filament\ in\ meter} \text{x } 9000 \text{ --------------------------(4)}$$

For comparative reeling performance: Renditta, Reeling wastage % , Raw silk %, Raw silk production/8hrs (kg), Average quality of cocoon used/day (kg), Average quantity of cocoons used/day/basin (kg) was recorded.

Raw silk (%):

$$Raw\ silk \% = \frac{Weight\ of\ raw\ silk\ obtained}{Weight\ of\ fresh\ cocoon\ used} \text{ x } 100 \text{ --------------------------(5)}$$

Renditta:

Renditta may be defined as the number of kgs of cocoons producing one kg of raw silk.

Quality characteristics of silk reeled on modern reeling machine and multi-end reeling machine: Average size deviation, size deviation, maximum size deviation, winding breaks, tenacity (g/den), Elongation and cohesion.

All the parameters were determined according to Sonwalkar (1988) and Shamachary (1986) and Quader *et.al* (2004). The raw silk produced from the study has been tested for different quality parameters as per standard method.

The main objective of this project is replacement of conventional reeling machine and reeling technology. So, modern reeling machine has been fabricated having dual operating system with re-reeling and steam chamber facility. Comparative reeling performance has been done with developed modern reeling machine to evaluate its performance. Two reelers in Bholahat, Chapai Nowabgang district has been select to execute the experiment. The experimental performance has been compared with the laboratorial performance of existing multi-end reeling as a control

11. Results and Discussion:

Appendix Fig.1

The data on cocoon characteristics are given in the Table 1.

Table 1 . Average Cocoon Characteristics for Seasonal Collected Cocoon.

Parameters		SCW (g)	SSW (g)	SR %	FL (m)	NBFL (m)	SCFD	DFC%
Location	Season							
BSRTI lab, Rajshahi	S_1	1.86	0.33	18.76	650	450	3.41	7.11
	S_2	1.63	0.32	18.67	630	435	3.42	8.23
	S_3	1.53	0.35	17.66	600	420	2.99	8.91
Mean ± SD		1.67 (±) 0.17	0.38 (±) 0.03	18.37 (±) 0.61	627 (±) 25.16	435 (±) 15.33	3.27 (±) 0.25	8.08 (±) 0.91

|**Note: SCW= Single cocoon weight, SSW=single shell weight, SR=raw silk recovery %, FL= filament length, NBFL= non-breakable filament, SCFD= single cocoon filament denier, DFC= Defective cocoon percentage, g= gram, m=meter, S_1=Season 1 , S_2= Season2, S_3= Season3.**

It is observed from the table that the mean single cocoon weight, single shell weight and shell ratio were 1.67g, 0.38g and 18.37% respectively. It was found that mean filament length, non-breakable filament length and single cocoon filament denier were 627m, 435 m and 3.27 respectively. The defective cocoon percentage was obtained 8.08% on the basis of total number of cocoons. Among the three seasons average best performance was in season S_1 where the average single cocoon weight, shell ratio, filament length and non-breakable filament length were 1.86 g, 18.76 %, 650 m and 450 m respectively (Table-1).

11.1 Comparative reeling performance:

This experiment was conducted both in the laboratory and field level to find out the reeling performance using commercial cocoons. One Modern reeling machine was installed at BSRTI laboratory and two machines in reeler's house in the field level of Bholahat Nowabgong district. The reeler's house were designated as BR1,BR2, respectively and considered as replications. Reeling activity was done at the same time at BSRTI Lab with existing multi-end reeling machine with same commercial cocoons and it is considered as control. Reeling performance has been evaluated during three commercial rearing seasons viz; Augrahani , Chaita. jasta.

Table 2. Comparative reeling performances of the modern reeling machine and multi-end reeling machine

	Parameters	Seasons	Renditta	Raw silk recovery (%)	Reelability (%)	Waste (%) on raw silk weight	Raw silk production/8 hrs/8ends (kg)	Avg. quantity of cocoons used/day/basin (kg)
BSRTI lab, Rajshahi	Modern reeling machine	S$_1$	9.09	35.4	70.60	21.25	1.5	5.13
		S$_2$	9.40	35.47	70.55	21.50	1.4	4.70
		S$_3$	11	32	68	22.6	1.1	5.2
		Mean ± SD	9.83 (±)1.02	34.29 (±)1.90	69.72 (±)1.49	21.78 (±)0.72	1.33 (±)0.20	5.01 (±)0.27
	Multi-end reeling machine(control)	S$_1$	10.24	33.23	68.12	22.57	1.0	3.68
		S$_2$	10.50	33.64	65.59	23.10	0.98	4.03
		S$_3$	13	33.23	64.1	22.4	0.97	4
		Mean ± SD	11.24 (±)1.52	33.37 (±)0.24	65.94 (±)2.03	22.69 (±)0.36	0.98 (±)0.20	3.90 (±)0.19
Field level	R$_1$	S$_1$	9.38	34.00	70.50	22.00	1.40	5.07
		S$_2$	9.60	34.43	69.33	22.50	1.35	5.02
		S$_3$	12	33	66	23.2	1.2	5.03
		Mean ± SD	10.33 (±)1.45	33.81 (±)0.73	88.61 (±)2.33	22.56 (±)0.60	1.32 (±)0.10	5.04 (±)0.02
	R$_2$	S$_1$	9.32	34.21	70.00	22.27	1.38	5.05
		S$_2$	9.78	34.63	68.78.	22.90	1.20	4.96
		S$_2$	11.5	32.55	65	23.3	1.1	4.93
		Mean ± SD	10.2 (±)1.15	33.79 (±)1.10	67.93 (±)2.60	22.82 (±)0.52	1.23 (±)0.14	4.98 (±)0.06

Note: R$_1$= Replication 1, R$_2$= Replication 2 (Two reeling machine in reelers house in the field level)
S$_1$=Season 1 , S$_2$= Season2, S$_3$= Season3.

Table 2 represents the reeling performance of cocoons on Modern Reeling Machine and Multi-end reeling machine respectively. From the reeling results mean renditta, raw silk recovery %, reliability %, waste % were found 9.83, 34.29%, 69.72% and 21.78% in Modern Reeling Machine in the laboratory level but in Multi-end reeling machine it was obtained 11.24, 33.37%, 65.94%, 22.69% respectively which varied between seasons due to cocoon quality. On the other hand the reeling performance of Modren Reeling machine in the field level renditta, raw silk recovery %, reliability %, waste % were to be found 10.33, 33.81%, 88.61% and 22.56 % R$_1$ respectively. In the field level in case of replication R$_2$ renditta, raw silk recovery %, reliability %, waste % were 10.02, 33.79%, 67.93% and 22.82% respectively.

Here Renditta defined that the number of kgs of cocoons producing one kg of raw silk and Reelibility means-

$$\text{Reelability \%} = \frac{No\ of\ cocoons\ reeled}{No\ of\ total\ casting} \times 100$$

In case of modern reeling machine, all of the reeling parameters except raw silk production/8 hrs/08 ends and average quantity of cocoons used/day/basin shows highly significant at Multi-end reeling machine all parameters shows same significance level except reliability% and average quantity of cocoons used/day/basin.
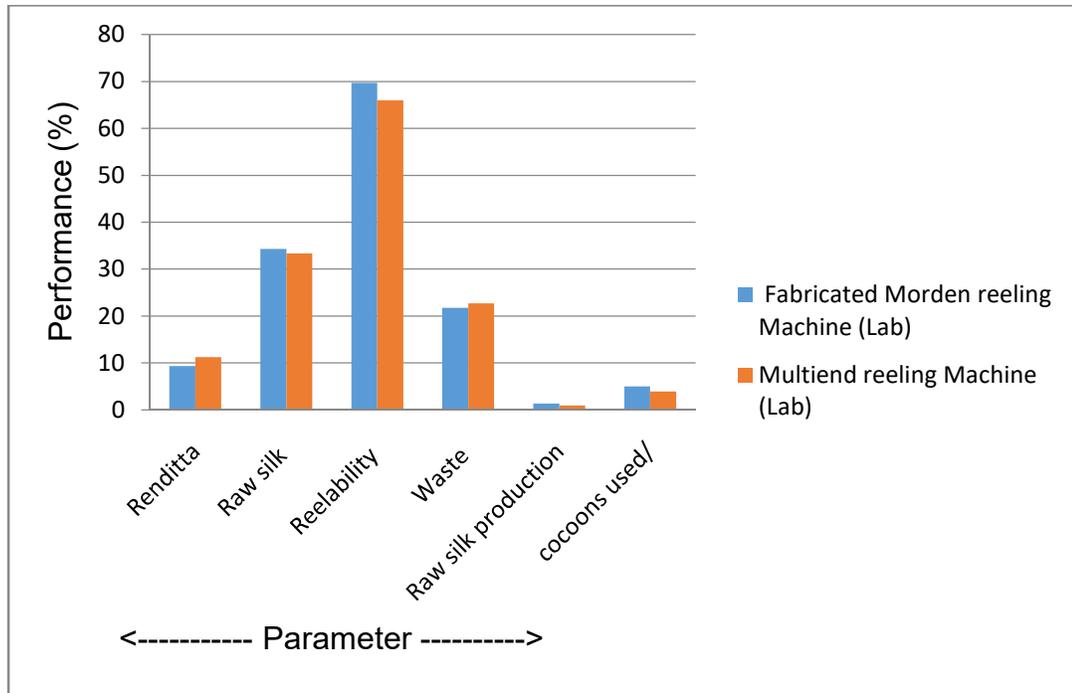
Figure 2. Comparative reeling performance of modern and multi-end reeling machine in laboratory level.
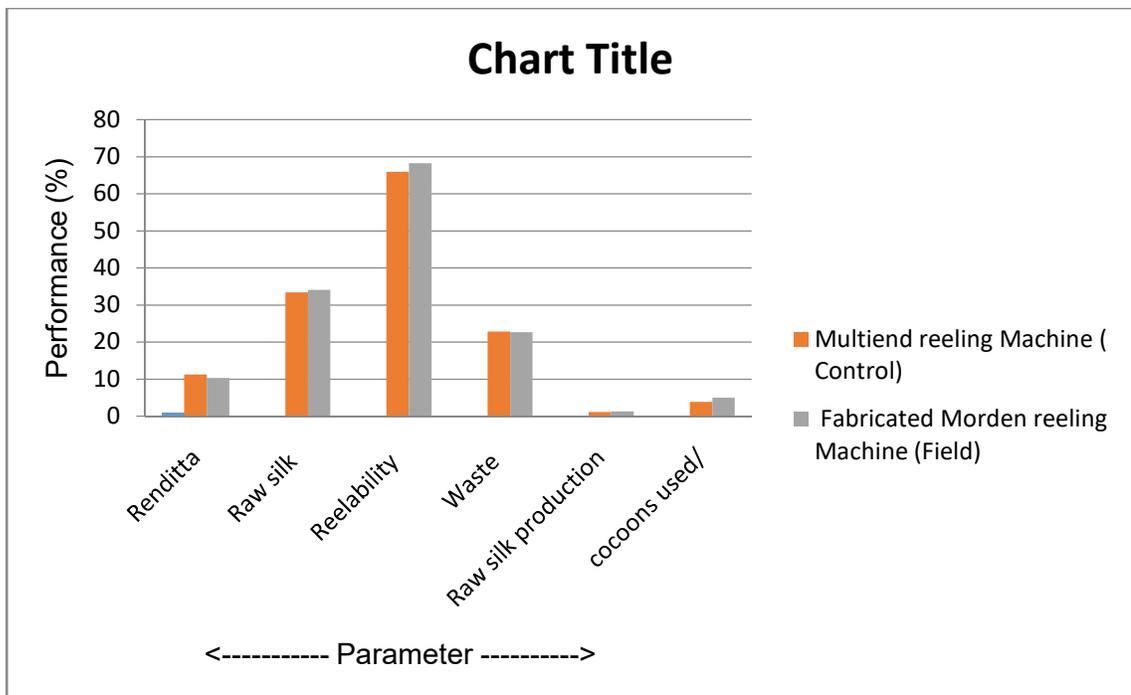

Figure 3. Comparative reeling performance of modern and multi-end reeling machine (control) in field level.

From the Table 2 it was also observed that Modern reeling machine shows better reeling performances compare to the multi-end reeling machine which correlated with the results of Sonwalkar et al. (1983) and Hariraj et al. (1992).

In the present study variations of reelabillity % was observed between locations and within season, which are in agreement with Sinobwalkar et al. (1983) who commented that it may be due to cocoon drying, cooking and reeling methods used. It was also observed from this Table that mean production of raw silk per 8 hours reeling of multivoltine cocoon was obtained about 1.334 kg in modern reeling machine and 0.980kg in multiend reeling machine. Hariraj et al. (1992) and Sonwalkar et al. (1990) noted that they obtained 1.14 kg and 1.00 kg raw silk per 8 hours reeling of multivoltine hybrid cocoon in improvedmultiend reeling machine, which correlates with present findings. So, the reeling performance of multivoltine cocoon on BSRTI fabricated moden reeling machine was found more satisfactory than existing multiend reeling machine.

In the present study variations of reelabillity % was observed between locations and within season, which are in agreement with Sinobwalkar et al. (1983) who commented that it may be due to cocoon drying, cooking and reeling methods used. So, the reeling performance of multivoltine cocoon on BSRTI fabricated modern reeling machine was found very satisfactory than existing multi-end reeling machine.

Characteristics of silk reeled on modern reeling machine and multi-end reeling machine:
Average size deviation, size deviation, maximum size deviation, winding breaks, tenacity (g/den), Elongation and cohesion.

Table 3. Comparative quality characteristics of silk reeled on modern reeling machine and multi-end reeling machine

	Parameters	Seasons	Avg. size (d)	size deviation	Maximum size deviation	Winding breaks/40 skeins	Tencity (g/d)	Elongation	cohesion
BSRTI lab, Rajshahi	Modern reeling machine and	S_1	21.44	1.95	2.36	05	3.45	18.51	45
		S_2	20.70	1.98	2.56	06	3.08	18.52	44
		S_3	21.43	1.9	2.96	10	2.9	17.2	43
		Mean ± SD	21.19 (±)0.24	1.94 (±)0.04	2.63 (±)0.31	7 (±)2.64	3.03 (±)0.11	18.08 (±)0.76	44 (±)1
	multi-end reeling machine	S_1	22.98	2.81	3.87	16	2.91	16.90	39
		S_2	21.50	2.70	2.80	15	2.80	16.78	38
		S_3	21.49	2.8	3.12	16	2.75	16.4	38
		Mean ± SD	21.99 (±).85	2.77 (±)0.06	8.25 (±)0.55	12.67 (±)4.86	2.82 (±)0.08	16.69 (±)0.26	38.33 (±)0.57
Field level	R_1	S_1	21.50	2.50	2.65	07	3.05	17.40	43
		S_2	20.75	2.27	2.9	08	3.26	17.4	43.66
		S_3	22.1	1.63	2.38	16	2.7	16	40
		Mean ± SD	21.45 (±)0.67	2.13 (±)0.45	2.64 (±)0.26	10.33 (±)4.93	3.00 (±)0.28	16.93 (±)0.80	42.44 (±)2.11
	R_2	S_1	21.34	2.45	2.55	10	3.05	17.20	41
		S_2	20.9	2.48	2.91	12	2.93	16.17	37.66
		S_3	22.1	1.9	2.38	16	2.7	16	35.67
		Mean ± SD	21.44 (±)0.61	2.28 (±)0.33	2.61 (±)0.27	12.67 (±)3.05	2.89 (±)0.18	16.46 (±)0.64	38.11 (±)2.69

Table 3 exhibited the quality characteristics of reeled silk of Modern reeling machine and Multi-end reeling machine. From the Table it was observed that mean size (denier) and size deviation were found 21.19 and 1.94 in modren reeling machine and 21.99 and 2.77 in multi-end reeling machine respectively which indicates that the reeler was able to maintain all 08 ends with required number of cocoons per end during the reeling period on multi-end reeling machine. It was also found that mean tenacity and elongation percentage were 3.03 (g/d) and 18.08% in Modern reeling machine, whereas it was 2.77 (g/d) and 16.69% in multi-end reeling machine respectively. From the results it is clearly observed that denier, size deviation, tenacity and elongation percentage of raw silk reeled on modern reeling machine showed better results compared to multi-end reeling machine. It is also observed that in modern reeling machine the field level performance viz: average size deviation, size deviation, maximum size deviation, winding breaks, tenacity (g/den), elongation and cohesion were for R_1- 21.45, 2.13, 2.64, 10.33, 3.00, 16.93 and 42.44 respectively and for R_2 was 21.44, 2.28, 2.61 , 12.67, 2.89, 16.46 and 38.11 respectively.
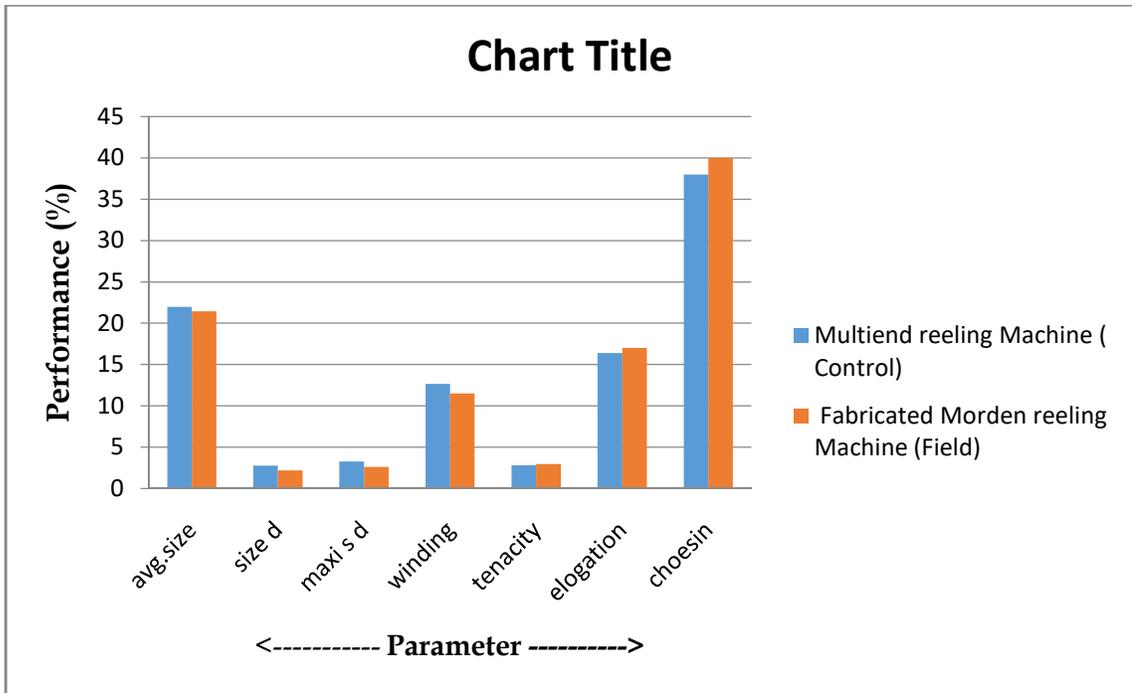
Figure 4: Comparative quality characteristics of modern reeling machine and multiend reeling machine
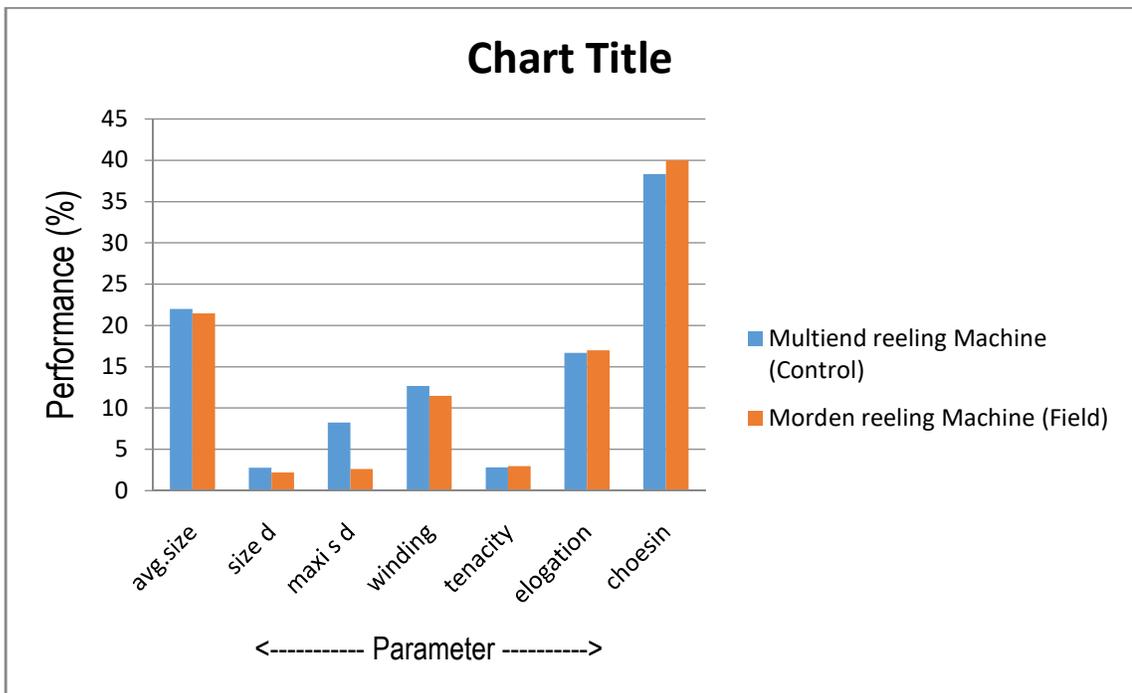

Figure 5: Comparative quality characteristics of modern reeling machine (Control) and multiend reeling machine (Field)

All the parameters were determined according to Sonwalkar (1988) and Shamachary (1986) and Quader *et.al* (2004). The raw silk produced from the study has been tested for different quality parameters as per standard method.

From the above discussion it was suggested that the BSRTI fabricated modern reeling machine is an improved reeling appliances which can be used commercially to get high quality of raw silk production through all seasons in Bangladesh.

12. Research highlight/findings (Bullet point – max 10 nos.):

> ➢ The rendita of raw silk was found 9.83 comparatively improved fabricating with the modern reeling machine.
> ➢ The raw silk recovery (%) was higher (34.29) in fabricated modern reeling machine.
> ➢ The reliability (%) of silk was higher (69.72) through fabricated modern reeling machine.
> ➢ The waste (%) of cocoon was lower (21.78) in fabricated modern reeling machine.
> ➢ The tenecity (%) 3.03, elongation 18.08 and cohesion (%) 44.00 were also comparatively better in fabricated modern reeling machine
> ➢ The overall raw silk production was comparatively higher (1.53) in fabricated modern reeling machine than the multiend reeling machine.
> ➢ Reeling cost the fabricated modern reeling machine was lower.

B. Implementation Position

1. **Procurement:**

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	camera -01 P^H meater-2	34400	camera -01 P^H meater-2	34400	100% achived.
(b) Lab &field equipment	Design , Fabrication reelig machine-03 sets	509700	Design , Fabrication reelig machine-03	509700	100% achived
(c) Other capital items					

2. **Establishment/renovation facilities: N/A**

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training	0	5	05	5 days	Five participants who is related with reelig activities has been included for this course (five days).
(b) Workshop					

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	122908	122908	122908		100	
B. Field research/lab expenses and supplies	986127	962750	962750		100	
C. Operating expenses	139630	138870	138378	492	99.65	
D. Vehicle hire and fuel, oil & maintenance	60000	49800	49800		100	
E. Training/workshop/seminar etc.	77500	73999	73999		100	
F. Publications and printing	80000	16600	16600		100	
G. Miscellaneous	35480	29240	29240		100	
H. Capital expenses	34400	31992	31992		100	

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
To produce quality raw silk through developing modern reeling machine	Design and drawing, Fabrication of reeling machine, reeling test,	Testing of reeling performance throw fabricated reeling machine.	Quality raw silk has been produced successfully
To improve renditta.	Testing of reeling performance.	Renditta was improved.	Quality raw silk production.
To minimize the reeling cost.	Renditta was Improved	Reeling cost minimized.	Quality raw silk is produced at lower costs.

E. Materials Development/Publication made under the Sub-project: N/A

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	N/A	-	-
Journal publication	N/A	-	-
Information development	N/A	-	-
Other publications, if any	N/A	-	-

F. Technology/Knowledge generation/Policy Support (as applied):

i. **Generation of technology (Commodity & Non-commodity)**
   A modern reeling machine have been designed, fabricated and tested.
ii. **Generation of new knowledge that help in developing more technology in future**
   1. Reeling machine has a great impact on quality and quantiy raw silk production.
   2. Scope of more research has been developed for further development of reeling machine and technology in future.
iii. **Technology transferred that help increased agricultural productivity and farmers' income**
   Lower reeling cost and quality silk production will enhance farmer income.
iv. **Policy Support**
   Need financial support to develop human and technological research

G. Information regarding Desk and Field Monitoring

1) **Desk Monitoring**[description & output of consultation meeting, monitoring workshops/seminars etc.):
2) **Field Monitoring (time& No. of visit, Team visit and output):**

Team Visit	Time	No. of visit	Output
PIU-BARC, NATP-2	07.09.2017 20.02.2018	02	Satisfactory
Internal Monitoring by Director (BSRTI) and DG (BSDB)	08.11.2017 15.02.2018 12.07.2018	03	Satisfactory
Other Visitors: 1. Professors and Students, Department of Agronomy & Agricultural Extension, Rajshahi University.	15.02.2018	01	Satisfactory

I. Lesson Learned/Challenges (if any)

i) Understanding about a successful project monitoring and auditing process.
ii) Management process and technique for executing of a project.

J. Challenges (if any)
1. Such types of study was totally new idea in Bangladesh, so needs liberal supports for further development.
2. Limitation of time for executing this research.
3. Timely delivery of the fund at every stage of implementation of the project.
4. Fund disbursement procedure was troublesome to continue the project timely.
5. Shorter duration for such project.

Signature of the Principal Investigator
Date …………………………

Seal

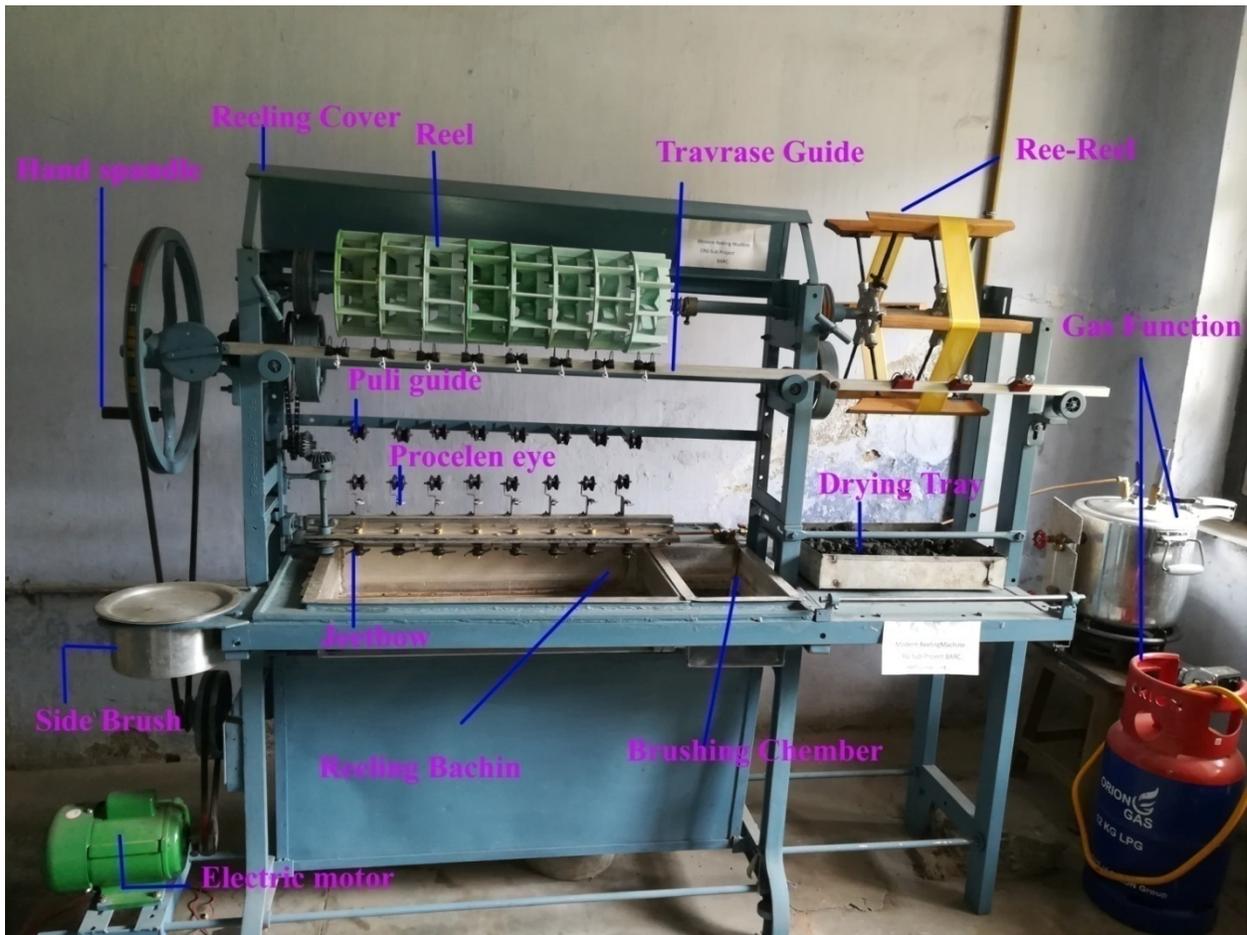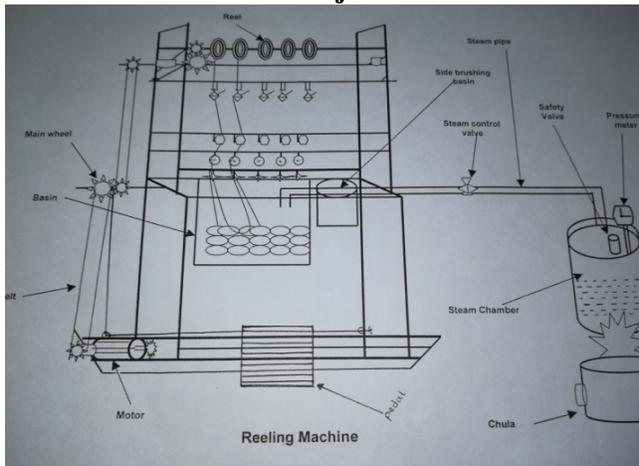Counter signature of the Head of the
organization/authorized representative
Date …………………………..

Seal

Fig 1:   Fabricated Modern Reeling Machine.

Pictorial View of the Project Activities:
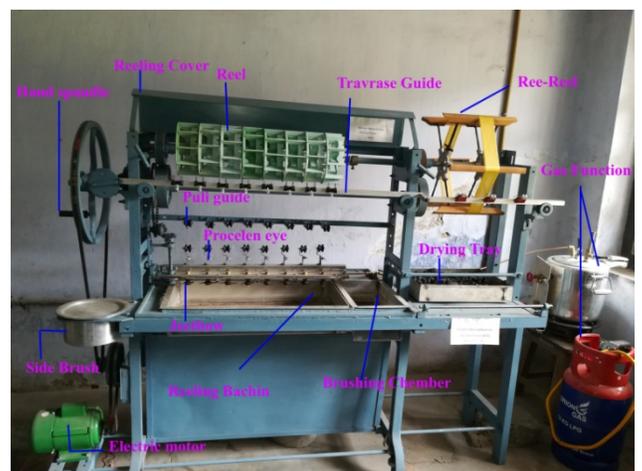

(A) Design

(B) Modern reeling machine

(C) Cocoon drying

(D) Cocoon sorting

(E) Monitoring

(F) Fabrication Reeling Machine

(G) Field Trail-R$_1$

(H) Field Trail-R$_2$

(I) Certificate giving ceramony

(J) Trainee

Bibliography:

Abraham,E.G. Nagaraju,J. Salulke,D. Gupta,H.M, and Datta,R.K.(1995).Purification and partial characterization of an induced antibacterial protein in the silkworm.J.Invertibr.Pathol.65.17-24.

Angus,T.A.1954. A bacterial toxin paralyzing silkworm larvae.Nature172:555.

Angus,T.A.1967. Comparative toxicology of the parasporal inclusiolns of the three entomophagous bacteria.J.Invertibr.Pathol.9:256-260.

Angus,T.A.Heimpel, A.M.1959.Inhibition of feeding and blood p^H change in Lepidopterous larvae infected with crystal forming bacteria.Canad.Entomol.91:352-358.

Chittra,C.Karanth,N.G.K. and Vasanthrajan,V.N.1975. Disease of mulberry silkworm,*Bombyxmori* L. J.Sci.Ind.Res.34.386-401.

Fast,R.M.Adams,J.R. and Heimpel,A.M.1967.Dissolution of the toxic parasporal crystal from *Bacillus thuringiensis*varpacificus by the gut secretions of the silkworm,*Bombyxmori* L. J.Invertibr.Pathol.9.488-499.

Iwanami,S. Enomoto,S and Tomita,K 1985. Death of larvae and pupae of the silkworm,*Bombyxmori* L. caused by bacterial contamination of the innerside of the cocoon. JSericult.Sci.Jpn.54(4).278-283.

Krishnaswami,S. Narasimhanna,M.N.Suryanarayana,S.K and Kumararaj,S.1978. Sericulture Mannual 2-Silkworm rearing.(FAO, Agriculture Services Bulltin.15(2).

Matsumoto,T.Zhu,Y.F and Kurisu,K. Mixed infection with infections virus and bacteria in silkworm,*Bombyxmori* L. .J.Sericult.Sci.Jpn.54(6).453-458.

Ohba,M. Aizawa,k.and Sudo,S.1984.Distribution of*Bacillus thuringiensis* in sericultural farms Fukuoka prefecture.japan.Proceedings of the Association for plant protection of Kynshu.30.152-155.

Ouo,M.Iwanami,S. and Enomoto,S. 1965. Experiment of causing septicemia in the silkworm larvae by the inoculation Aeromonas per os.Bull.Seric.Exp.Stn.19(4).485-498.

Padau,L.E.Ohra,M.and Aizawa,K.1984.Isolation of *Bacillus thuringiensis*strain (Serotype 8a:8b) highly and selectively toxic against mosquito larvae .J.Invertebr.Pathol .44(1).12-17.

Ramakrisshnan, N.1968.Observation on the toxicity of *Bacillus thuringiensis* for the silkworm,*Bombyxmori* L. J.Invertebr.Pathol.10.449-450.

Sawamura,S. 1903.Investiation on Flacherie.Bull.Coll.Agri.Tokyo.Imp.Univ.5(4).403-448

Sawamura,S. 1905.on the large bacillus observed in flacherie. Ibid. 6(4).375-386.

Sawamura,S. 1906.Note on bacteria pathogenic to silkworm Ibd.7(1).106.

Sinobwalkar et al. (1983)

Sonowalker*et al.1990*, Shreshail*et al.1995*, Subhas*et al.1994*, Halliyal*et al.1999* and Qader*et al.2004*

Sonwalkar (1988) and Shamachary (1986) and Quader *et.al* (2004)

Sonwalkar et al. (1983) and Hariraj et al. (1992).

Stark,P.and Sherman,J.M.1935. Concerning the habitat of *Streptococcus lactis* .J.Bacteriol.30.639-646.

Steinhaus,E.A. and Elizabeth,A.J.1954. Further observations on *Bacillus thuringiensis*Berliner.and other spore forming bacteria.Hilgerdia.California Agric.Exp.Stn.23(1):1-21.

Steinhaus,E.A. Principles of Insect Pathology.(McGraw Hill Book Co. Inc.New York.1949.pp.587-601.

Steinhaus,E.A.1943. A study on bacteria associated with thirty species of insect .J. Bacteriol.42,757-790.

Steinhaus,E.A.Cited in Insect Pathology Vol.1.Edited by E.A.Steinhaus.(Academy Press Ins.New York).1983.pp.18.