

Competitive Research Grant

Sub-Project Completion Report

on

Innovation of dyed jute knitted fabric in textile technical sectors

Project Duration

7th November 2017 to 30th September 2018

Pilot Plant & Processing Division
Bangladesh Jute Research Institute
Manik Mia Avenue, Dhaka-1207



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



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Citation

Innovation of dyed jute knitted fabric in textile technical sectors
Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
New Airport Road, Farmgate, Dhaka – 1215
Bangladesh

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National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
New Airport Road, Farmgate, Dhaka – 1215
Bangladesh

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Acronyms

BJRI= Bangladesh Jute Research Institute

CRG = Competitive Research Grant

PCR = Project Completion Report

BSCIC = Bangladesh Small and Cottage Industries Corporation

DRS = Dry Relaxed State

WRS = Wet Relaxed State

HS = Heat Setting

DY = Dyeing

M:L = Material (fabric) to Liquor (water) ratio

COM = Compacting

K_c =Course per inch× loop length in inch.

K_w =Wales per inch× loop length in inch.

S=Course per inch×Wales per inch.

K_s =S x (loop length in inch)²

K_c/K_w =Loop Shape Factor

GSM = Gram per Square Meter

WPI = Wales per Inch

CPI =Coursesper Inch

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Executive Summary

Knitted fabrics are produced by intermeshing the yarns which can be made from natural, synthetic, or regenerated fibers. The raw material types and structures give different properties for the yarns used in knitting. The variation in yarn properties results in variation of Jute knitted fabrics properties such as dimensional, mechanical, comfort, and appearance. Mechanical properties, particularly strength and elongation, are the most important performance properties of knitted fabrics which governs the fabric performance in use by causing a change of dimensions of strained knitted fabrics. A change of dimensions of strained Jute knitted fabric can be defined by increasing dimension in one direction as dimension in other directions is decreasing. In many cases, it is important to know how much the knit will deform in one or another direction. On the other hand it is known that, in various knitting structures, knitted fabrics are characterized in different extensibility (in a course and wale directions) and maximum force to rupture. Processes of deformation of knitted fabrics are described in concept of extensibility of knitted fabric and the deformation can be determined and influenced by different factors.

References investigated the effect of knit structures and raw materials on plated knitted fabrics tensile properties and the results showed that the tensile strength and elongation at break of plated single jersey and rib knitted fabrics are different due to the variations in physical and chemical properties of cotton, silk, polyester, polyamide, viscose, bamboo, and their blends at different ratio and count. The mechanical property of knitted fabrics is the matter of yarn, fabric structure, and the knitting process and found that tensile property of jacquard weft knitted fabrics is different in birds eye, striped jacquard, and twill jacquard knit structures.

As reviewed in different research results, the tensile property of knitted fabrics has been investigated by different scholars in relation to yarn types, yarn structure, and knit structures. Concerning the raw materials, the scholars did not yet investigate the comparative effect of Lycra yarn on tensile strength and elongation of single jersey and 1×1 rib knitted fabrics. This research is designed to study the tensile properties of single jersey and 1×1 rib knitted fabrics made from jute and cotton and cotton, Lycra blend with jute by conducting scientific tests and analysis.

Jute, jute/cotton blended yarn and lycra yarn is procured from local mill and local market for the sample fabric production of the project. Knitting machine (circular and flat bed) is used from in-house and out source also.

The grey fabric is woolenized with 15-25% caustic soda solution (55-65⁰ tw) at a temperature of 20⁰-30⁰c then scouring and bleaching is performed with hydrogen peroxide, caustic soda and other required chemicals at 90⁰c -100⁰c for one hour.

Jute (98%) lycra (2%) fabric is heat setted with remind temperature (180-185⁰c) for 30 seconds to 1 minute, in tube heat-set machine. Then pretreatment, dyeing and finishing is carried out with necessary chemicals and dyes as requirement.

Jute/cotton blended (58/40) yarn and lycra more or less 2% fabric is also head-settled with the aforesaid parameters by the same machine. The subsequent wet processing - pretreatment, dyeing and finishing is also done with chemicals, dyes, time and temperature by following standard procedure, is completed in pilot plant processing division, BJRI.

All finished fabrics were assessed for desired quality in respect of wash fastness, abrasion resistance, bursting strength, shrinkage testing by mechanical and chemical methods.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:** Innovation of dyed jute knitted fabric in textile technical sectors
2. **Implementing organization:** Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207
3. **Name and full address with phone, cell and e-mail of PI/Co-PI (s):**

PI:- Dr. Nazmina Chowdhury, Chief Scientific Officer (RW),
Pilot Plant and Processing Division, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207.

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Bangladesh Jute Research Institute, Manik Mia Avenue,
Dhaka-1207. Mob.01714891542, E-mail. asibbjri@gmail.com

4. **Sub-project budget (Tk):**

4.1 Total: 42,15,530/- (Forty two lac fifteen thousand five hundred thirty taka only).

4.2 Revised (if any): N/A

5. **Duration of the sub-project:**

5.1 Start date (based on LoA signed): 7th November, 2017

5.2 End date: 30th September, 2018

6. **Justification of undertaken the sub-project:**

The production of various types of industrial fabrics for industrial application is almost as old as the mechanical knitting operation itself, and these end uses are important today. What are new and extremely attractive to the manufacturer are the growth in industrial textiles and its application in the sectors such as agriculture, construction, geotextiles, automotive, protective apparel, electronics textile etc. This rapid increase in market potential has led these high profile manufacturers to develop specialized fabric for knitting and serving the end purpose efficiently. In this paper focused various knitted fabrics used for manufacturing of industrial textiles have been reviewed. More/less, it is concerned to all educated people that the world is becoming day by day unsafe and unhealthy for different types of problems. Using of synthetic fiber (polyester, acrylic etc) for different purpose in textile sectors is one of them. This project will contribute to implement / the application of jute (natural fiber) uses in place of synthetic fiber as technical fabric in the textile sector for the world-wide. Since cotton is more costly and synthetic is not environment friendly, so after successful completion of this project activities jute will drive a positive sense for its innovation as jute knitted fabric. As technical

fabrics, this project will provide technical aspects and share the knowledge to the entrepreneurs for their interest/uses – locally and globally.

7. **Sub-project goal:** Production of value added dyed jute knitted products in textile technical sectors.

8. **Sub-project objective (s):**

- a) To produce innovative knitted technical value added jute fabric of plain and rib structure with desired aesthetic and performance characteristics.
- b) To produce different types of value added and attractive garments items such as ladies suit, cardigan, over coat etc by using those knitted fabrics.
- c) To create a new field of job which will contribute to partially eliminate the poverty and will upgrade the economy of the country also particularly in the jute sector.

9. **Implementing location (s):**

- i) Pilot Plant and Processing Division, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207, Bangladesh.
- ii) M B Knit Fashion, BSCIC, Narayangong, Bangladesh.
- iii) 4-S Park Ashulia, Savar, Bangladesh.

10. **Methodology in brief:**

- i) Collection of yarn: Jute cotton blended yarn, (Ring and Rotor) 18' and lycra yarn (20 & 40 D) was collected from local source as requirements.
- ii) Knitted Fabric Production (Grey): Circular knitting machine (30" dia, 24 gauge) and Flat-bed knitting (7 gauge) machine was used to make the fabrics. Single jersey fabric was made from Circular knitting machine by using mechanical device - needle, sinker and cam and material (yarn 18', lycra 20D) through the accurate feeding arrangement. Rib was made from Flat-bed machine by using mechanical device (full needle, cam) and material (yarn 18', lycra 40D). Knitted fabrics were also related to relaxation shrinkage. It had been found difficult experimentally to determine when a fabric has reached a totally relaxed state in which it was in a stable state. The fabric samples were subjected to the following relaxation treatments and the geometrical properties like wales per inch, course per inch were analyzed after each state of relaxation.

Dry Relaxed State (DRS):

The fabric was relaxed in grey state under standard test conditions at $65 \pm 2\%$ RH and $27 \pm 2^\circ\text{C}$ for 12 hrs.

Wet Relaxed State (WRS):

This was achieved by subjecting the fabric to static soak with 0.7% wetting agent and the fabric was allowed to relax after drying for 12 hrs under standard test conditions.

iii) Chemical Treatment for Coloration:**a) Heat Setting (HS):**

The lycra fabrics – jute lycra (98% & 2%) and jute cotton lycra (58%,40%& 2%) were stretched to the required level/width and set permanently by passing in stenter machine through the heating or curing chamber at 180-185 °C for 30 seconds to 1 minute.

b) Bleaching:

The fabrics were treated altogether in the jigger machine. At first joining is done to length wise by stitching with sewing machine before loaded in the machine and then twenty (20) times water was taken in the jigger machine based on sample fabric weight. Now, the fabrics were load in the machine and run for twenty (20) minutes at 45 °C by adding 2% detergent/wetting agent, 2% anticreasing agent and 1% sequestering agent in the water. And then the fabric was treated to get rid of the natural impurities with 3% caustic soda (NaOH), 10 % hydrogen peroxide (H₂O₂) and 1% peroxide stabilizer. Here all these chemicals were calculated based on the fabric weight and the machine was run for one hour at 95°C. After that the bath is drained, filled with fresh water and the fabrics were moved with 1% peroxide killer/remover at 50°C for ten minutes and at last was treated with 1% acetic acid at 40°C for neutralization at pH of 6.5 for five minutes.

c) Dyeing (DY):

Dyeing was executed with dyes and chemicals on the bleached sample fabric in the Jigger machine. Colors are applied - Remazol Red RR 0.90%, Novacron Blue FN-R 0.6% and Indofix Black B0.01% on the weight of the fabric. Chemicals were used - Salt 20 gpl, Soda ash 5gpl, Levelling agent 2gpl, Anticreasing agent 1gpl, Sequestering agent 1gpl and Wetting/penetrating agent 1gpl based on amount of water was taken for dyeing in the machine. Here, M:L ratio is maintained at 1:15 and the temperature was remained 65°C for 50/60 minutes. The salt was added to obtain the evenness of color throughout the fabric and soda ash was added to fix the color in the fabric. Then washed off at 80°C for 10/12 minutes with 1.5 gpl soaping agent (detergent), drained and rinsed with fresh water for ten minutes to remove the unfixed dyes and chemicals from the fabric. Then again washed off at 50°C for 10/12 minutes with water only and at last treated with acetic acid with 1 gpl for neutralization at 40°C for 5/7 minutes. Then the fabric was unloaded from the jigger machine and sent to squeezing to remove the water for drying and finishing.

d) Squeezing:

Squeezing was done with mechanical device (hydro-extractor) to release the excess water and make the fabric ready for dryer.

e) **Finishing:**

Finishing was performed with the Stenter machine as the desired quality/width of the fabric. Here finishing chemical- softner 30 gpl (to make the fabric soft and fluffy) and acetic acid 1gpl (to maintain the P^H 5-6) and temperature 120-150°C was also applied on the fabric.

f) **Compacting (COM):**

It was done to get the hand-feel and to stabilize the fabric with steaming at 100 -110°C for 15/20 seconds. The fabric was subjected to compressive shrinkage in the length and width direction by mechanical processing.

iv) Determination of physio-mechanical, chemical and aesthetic properties:

a) **Bursting Strength Test:**

Bursting strength is a method of breaking force in which the knit fabric is stressed in all directions at the same time. Here an increasing fluid force or pressure is vertically applied on the fabric to the underside of the diagram as the prescribed test method in table 1. The pressure in the fluid increases at such a rate that the specimen bursts within 20 ± 3 sec. The strength was measured at break in lbs/sq. inch. The sample fabrics were conditioned under standard testing atmosphere i.e. $65 \pm 2\%$ RH and $27 \pm 2^\circ\text{C}$ for 24 hrs before conduct the test.

b) **Abrasion Test:**

The abrasion resistance of knit fabric was the most important property in wear to maintain the fabric's original appearance and structure. This abrasion consists of friction or rubbing between the fabric and some other material. Here, the sample fabrics were conditioned at first under standard testing atmosphere. After that the circular specimens are taken randomly using the related device from each sample fabric. Then the specimens were stretched over the face of the circular holders and rubbed against the flat abrasive surface placed to the lower plates. Machine was run until the hole(s) appeared. A total weight of 395.35 gm is applied to the specimens with a motion that was continually changing direction and the counter was counted the number of revolutions/strokes required for end point and recorded to the table. The worst cloth was used as standard abradant.

c) **Pilling Test:**

A major test to perform this project work and assess mechanical characteristics of fabric. It was formed on fabric surface during wear and washing by the entanglement of loose fibers. Samples were assessed following the aforesaid method (in table1) by pilling photograph of Gray rating.

d) Shrinkage Test:

Shrinkage was a parameter of fabric to measure changes in length and width after washing (laundry). The level (%) of fabric shrinkage rate was one of the criteria to measure product quality. Here, mechanical shrinkage method was applied to complete the test under prescribed international standard atmosphere. Specimens with required dimension (50x50 cm) were washed in water at 40°C for 30 minutes. Then measure the changes in the length and width direction after drying and evaluate shrinkage as below-
$$\text{Shrinkage} = \left[\frac{\text{the length before wash} - \text{the length after wash}}{\text{the length before wash}} \right] \times 100\%$$

Spirality is the dimensional distortion of the fabric after washing according to seam length and evaluate as below –

$$\text{spirality} = \left(\frac{\text{side seam actual length before wash}}{\text{side seam displacement length after wash}} \right) \times 100\%$$

e) Wash fastness test:

Wash fastness is the ability of fabrics to retain the dyes used to color them. A specimen of each dyed sample fabric was tested with the adjacent cotton fabric under specified conditions. In the test, change in color of the sample and also staining of color on the adjacent fabric were assessed and the rating was expressed in fastness numbers as prescribed method in table 1. A 10 x 4 cm swatch of the colored fabric was taken and was sandwiched between two adjacent cotton fabrics and stitched. The sample and the adjacent fabric were washed together with soap 5 gpl and soda 2gpl solution at 50°C for 30 minutes. The liquor material ratio was 50:1. After soaping treatment, remove the specimen, rinse twice in cold water and then in running cold water under a tap. Squeeze it and air dry at a temperature not exceeding 60°C. At last, the change in color and staining was evaluated with the help of grey scales.

f) **Production of knitted garments:**

From finished fabric ladies overcoat, cardigan and children wear of innovative design were produced.

Working Activities



Flat bed knitting machine 7G

Fig: 1



Flat bed knitting machine 5G

Fig: 2

Fabric Linking Activities



Fig: 3

Garments Sewing Activities



Fig: 4

11. Results and discussion: All test results are recorded in below tables from the related fabric according to the prescribed required methods as table 1.

11.1 different parameter of loop length

Structural parameters	Mean value	Standard deviation	Maximum value	Minimum value
Thickness (m)	0.001	0.000	0.0016	0.00044
Interlock loop length (cm)	1.317	0.278	2.72	0.95
Jersey loop length (cm)	0.310	0.080	0.74	0.25
1×1 rib loop length (cm)	0.599	0.068	0.92	0.32
2×2 rib loop length (cm)	0.622	0.079	0.87	0.58

Standard deviation of Jersey loop length is higher rib loop length

11.2 Comparison between Ring and Rotor yarn [10 Ne]

Parameters	Ring yarn	Rotor yarn
Tenacity (cN/ Tex)	17.5	15.1
CSP	2550	1830
Elongation %	3.75	4.35
TPI	14.23	18.31
Uster U %	9.774	9.41
CVm % [1cm]	12.412	11.872
CVm % [3m]	2.882	2.91
Thin [- 40%]/ km	20.687	36.56
Thick [+35%]	446.25	178.75
Thick [+50%]	48.125	5
Neps [+200%]	60.3125	26.25
Hairiness Index [H]	7.21	4.65

The properties of Ring yarn is better than Rotor yarn

11.3 GSM Test

Test Results of GSM against Loop length

Name of Sample Fabric	Yarn Count		Loop Length mm	Weight GSM
	Jute Cotton Blended Ne	LycraD		
Single Jersey Plain			3.4	180
	18	20	3.3	175
			3.2	172
Rib 1/1			4.7	210
	18	40	4.5	203
			4.2	200

GSM of Rib fabric is higher than single jersey fabric

11.4 Fabric Density: WPI & CPI

Test Results of Wale/inch (WPI)&Course/inch (CPI)

Name of Sample Fabric	Yarn Count		Wale Density WPI	Course Density CPI
	Jute cotton blended Ne	Lycra D		
Single Jersey Plain	18	20	21	21
Rib 1/1	18	40	23	21

WPI & CPI of Rib fabric is higher than single jersey fabric

11.5 Stitch Density

Calculation of Stich Density as WPI & CPI

Name of Sample Fabric	WPI	CPI	Stitch Density (S) = WPI x CPI
Single Jersey Plain	21	20	21 x 20 = 420
Rib 1/1	23	22	23 x 22 = 506

Stitch density of Rib fabric is higher than single jersey fabric

11.6 Dimensional Stability (Shrinkage) Test

Shrinkage & Spirality Test Result

Name of Sample Fabric	Loop Length mm	GSM	Shrinkage %		Spirality %
			Length	Width	
Single Jersey Plain	3.3	175	- 4.2	- 2.1	3.5
Rib 1/1	4.5	203	-3.8	- 1.9	2.7

Shrinkage of Rib fabric is higher than single jersey fabric

11.7 Bursting Strength Test

Test results of Bursting Strength

Name of Sample fabric	Bursting Strength (lbs/in ²)
Single Jersey Plain	1223.36
Rib 1/1	4838.51

Bursting Strength of Rib fabric is higher than single jersey fabric

11.8 Abrasion Resistance and Pilling Test

Test results of Abrasion Resistance& Pilling

Name of Sample fabric	Abrasion Resistance no. of cycle	Pilling pills/area
Single Jersey Plain	5233	4
Rib 1/1	6838	4

Abrasion Resistance of Rib fabric is higher than single jersey fabric

Discussion:

The weight of both fabric - single jersey and rib fabric is fully related to loop length (table 2) and stitch density is also governed by WPI & CPI (table 3) as acceptable technical norm of any development fabric.

It is found from table 4 that the shrinkage and spirality of both fabric is better as compare to international standard acceptable parameter ($\pm 5\%$ for single jersey and $\pm 6\%$ for rib, 5%) where the rib fabric is more better than the single jersey.

In table 6, the strength (bursting) is remarkably high than the performance level pressure of 116.03 lbs/in^2 for both tested fabric.

The abrasion performance is very high (table 7) than the desired numbers of movements (acceptable standard movements 3500) and pilling (table 7) is also very good as compared to standard norms. The wash fastness (change and staining) of dyed both sample is good as grey scale assessment.

Conclusion:

In this work, the major quality parameters of knit fabric – weight, fabric density, dimensional stability, spirality, bursting strength, abrasion resistance and pilling, wash fastness are tested and assessed the performance of jute in replace of synthetic or cotton for apparel concern. All results are better and acceptable as compare to ISO norms. So, jute will be easily used as replace of project demand.

Knitted Products from our Project



Fig: 5 Knitted items



Fig: 6 Knitted items

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

- Ladies Gown
- Sweater

The term "sweater" is a catch-all for a variety of knit garments. Although the term often refers to a pullover, it can also refer to a cardigan, a garment that opens and fastens down the front. Within either group, there is a great variety of design.

- Cardigan

A cardigan is a type of knitted garment that has an open front

Commonly cardigans have buttons: a garment that is tied is instead considered a robe. A more modern version of the garment has no buttons and hangs open by design. By contrast, a pullover (or sweater) does not open in front but must be "pulled over" the head to be worn. It may be machine- or hand-knitted. Traditionally, cardigans were made of wool but can now be made of cotton, synthetic fibers, or any combination thereof.

- Ladies suit

A suit is a set of men's wear comprising a lounge jacket and trousers. When of identical textile, and worn with a collared dress shirt, necktie, and dress shoes, it is traditionally considered informal wear in Western dress codes. The lounge suit originated as 19th-century casual sports and country wear in Britain, still reflected in the sport coat and blazer worn as smart casual. After replacing the black frock coat in the early 20th century, a darker suit also became known as a *business suit* for professional occasions, when sober in style

- Children wear

Children's clothing or kids' clothing is clothing for children who have not yet grown to full height. Grandma bait is a retail industry term for expensive children's clothing.

Children's clothing is often more casual than adult clothing, fit for play and rest. Hosiery is commonly used. More recently, however, a lot of childrenswear is heavily influenced by trends in adult fashion. Due to the rise of social media platforms such as Instagram, celebrities and fashion bloggers have been using their accounts to post pictures of their children wearing luxury "street style" clothing, thus inspiring parents to dress their children as they would dress themselves

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	-	-	-	-	Office equipment has included in other capital items
(b) Lab & field equipment	-	8,00,000/-	-	8,00,000/-	Jute, Cotton, Lycra ,Chemicals, dyes and apparatus has procured
(c) Other capital items	17	9,00,000	17	5,25,700	-

2. Establishment/renovation facilities:

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	
Repair, renovation and maintenance	-	-	-	-	Knitting machine has repaired by using 2,00,000/-

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

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training	26	06	32	3 (three) days	-
(b) Workshop	-	-	-	-	-



Figure- 7 : Picture of Certificate distribution of Training programme



Figure 8 : Published in Textile focus Training on “Jute Knitting Technology” held in BJRI

WTUAAB reconciliation event held in Dhaka

Wuhan Textile University Alumni Association of Bangladesh (WTUAAB) organized a reconciliation event in Dhaka. Bangladeshi graduates from Wuhan Textile University (WTU) in China has started a formal organization to strengthen cooperation and networking between them. A large number of alumni from WTU who are successfully working in different leading companies globally, doctoral degree in world leading universities & others professionals joined at the event. With the aim to promote strong cooperation among former and new students, to strengthen collaboration between WTU and Bangladesh and to expand their activity globally WTUAAB members pledged strong support in this endeavor. The alumni shared their experience working in different positions. WTUAAB members are committed to work unitedly for the betterment of their members and the textile industry as well. WTUAAB members are advising the Bangladeshi students who are going WTU for their



study. Already Bangladeshi students has created a prestigious image at WTU by their merit and performance. WTUAAB members expressed their pleasure joining at the event. Senior members mentioned that such initiative will strengthen the spirit of brotherhood and encourage the young members to be motivated to move forward.

Training on “Jute Knitting Technology” held in BJRI

Three days short term training program entitled “Jute Knitting Technology” was held at the Planning Training & Communication Division (BJRI) during 27-29 September, 2018 under PIU-BARC, National Agricultural Technology Program(NATP) Phase II & implemented by Bangladesh Jute Research Institute (BJRI). Dr. Md. Monjurul Alam, Director General, (BJRI) inaugurated the training program as chief guest, Dr. Md Abul Kalam Azad, Director (JTPDC), Dr. Md. Mujibur Rahman, Director (Agriculture), Dr. S.M. Mahbub Ali, Director (Administration & Finance), Dr. Nazmina Chowdhury, CSO (In-charge) & Project PI(BJRI), Dr. Md. Shahidullah, CSO, Dr. Md. Osman Gani Miazi, CSO were present as special guest, Md. Asib Iqbal, SO & Project Co-PI, Senior Officers, Staff and various Jute knitted Entrepreneur participated in the training program.

The training program started with the recitation of the holy Quran. Director General Dr. Md. Monjurul Alam gave the welcome address and thanked to the special guest, BJRI staff and participants. Dr. Md. Monjurul Alam in his speech mentioned that jute is our pride. He urged for need based research and development of diversified jute goods. Jute diversified products industry of Bangladesh is an informal, unstructured and niche market compared



Picture: Participants with guest in the training program on Jute Knitting Technology

to the competitive countries like India. Having the second position among jute production countries, the country's GDP industry is under privileged. The sector contributes about 5% to total foreign exchange earnings and 4% to country's GDP.

Dr. Md. Mujibur Rahman, Dr. SM Mahbub Ali, Dr. Md. Shahidullah & Dr. Md. Osman Gani Miazi delivered their valuable speech on Jute Knitting Technology. Dr. Nazmina Chowdhury thanked everyone for their participation in this training program.

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/unspent	Physical progresses (%)	Reasons for deviation
A. Contractual staff salary	1,55,530/-	153222/-	125622	27600	81.98	i) Delay starting ii) Operating period is very short of industry
B. Field research/lab expenses and supplies	20,50,000/-	20,50,000/-	2049700	300	99.98	
C. Operating expenses	3,70,000/-	3,70,000/-	369960	40	99.99	
D. Vehicle hire and fuel, oil & maintenance	2,85,000/-	2,85,000/-	285000	0	100.00	
E. Training/workshop/seminar etc.	2,20,000/-	2,20,000/-	218100	1900	99.14	
F. Publications and printing	1,60,000/-	1,60,000/-	60000	100000	37.50	
G. Miscellaneous	75,000/-	75,000/-	75000	0	100.00	
H. Capital expenses	9,00,000/-	9,00,000/-	550700	349300	61.19	
Grand Total	42,15,530/-	42,13,222/-	3734082/-	4,79,140/-	88.63/-	

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(s hort term effect of the research)
<p>a)To produce innovative knitted technical value added jute fabric of plain and rib structure with desired aesthetic and performance characteristics.</p> <p>b)To produce different types of value added and attractive garments items</p>	<p>Heat Setting (HS): The lycra fabrics – jute lycra (98% & 2%) and jute cotton lycra (58%,40%& 2%) were stretched to the required level/width and set permanently by passing in stenter machine through the heating or curing chamber at 180-185^{°C} for 30 seconds to 1 minute.</p> <p>Bleaching: The fabrics were treated altogether in the jigger machine. At first joiningis done to length wise by stitching with sewing machine before loaded in the machine and then twenty (20) times water was taken in the jigger machine based on sample fabric weight. Now, the fabrics were load din the machine and run for twenty (20) minutes at 45^{°C} by adding 2% detergent/wetting agent, 2% antcreasing agent and 1% sequestering agentin the water. And then</p>	<ul style="list-style-type: none"> • Ladies Gown • Sweater • Cardigan • Ladies suit • Children wear 	<ul style="list-style-type: none"> • jute knitting technology

<p>such as ladies suit, cardigan, over coat etc by using those knitted fabrics.</p> <p>c)To create a new field of job which will contribute to partially eliminate the poverty and will upgrade the economy of the country also particularly in the jute sector.</p>	<p>the fabric was treated to get rid of the natural impurities with 3% caustic soda (NaOH), 10 % hydrogen peroxide (H₂O₂) and 1% peroxide stabilizer. Here all these chemicals were calculated based on the fabric weight and the machine was run for one hour at 95°C. After that the bath is drained, filled with fresh water and the fabrics were moved with 1% peroxide killer/remover at 50°C for ten minutes and at last was treated with 1% acetic acid at 40°C for neutralization at pH of 6.5 for five minutes.</p> <p>Dyeing (DY): Dyeing was executed with dyes and chemicals on the bleached sample fabric in the Jigger machine. Colors are applied -Remazol Red RR 0.90%, Novacron Blue FN-R 0.6% and Indofix Black B0.01% on the weight of the fabric. Chemicals were used - Salt 20 gpl, Soda ash 5gpl, Levelling agent 2gpl, Anticreasing agent 1gpl, Sequestering agent 1gpl and Wetting/penetrating agent 1gpl based on amount of water was taken for dyeing in the machine. Here, M:L ratio is maintained at 1:15 and the temperature was remained 65°C for 50/60 minutes. The salt was added to obtain the evenness of color throughout the fabric and soda ash was added to fix the color in the fabric. Then washed off at 80°C for 10/12 minutes with 1.5 gpl soaping agent (detergent), drained and rinsed with fresh water for ten minutes to remove the unfixed dyes and chemicals from the fabric. Then again washed off at 50°C for 10/12 minutes with water only and at last treated with acetic acid with 1 gpl for neutralization at 40°C for 5/7 minutes. Then the fabric was unloaded from the jigger machine and sent to squeezing to remove the water for drying and finishing.</p> <p>Squeezing: Squeezing was done with mechanical device (hydro-extractor) to release the excess water and make the fabric ready for dryer.</p> <p>Finishing: Finishing was performed with the Stenter machine as the desired quality/width of the fabric. Here finishing chemical- softner 30 gpl (to make the</p>		
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fabric soft and fluffy) and acetic acid 1gpl (to maintain the P^H 5-6) and temperature 120-150°C was also applied on the fabric.

Compacting (COM):

It was done to get the hand-feel and to stabilize the fabric with steaming at 100 -110°C for 15/20 seconds. The fabric was subjected to compressive shrinkage in the length and width direction by mechanical processing.

Determination of physio-mechanical, chemical and aesthetic properties:

Bursting Strength Test:

Bursting strength is a method of breaking force in which the knit fabric is stressed in all directions at the same time. Here an increasing fluid force or pressure is vertically applied on the fabric to the underside of the diagram as the prescribed test method in table 1. The pressure in the fluid increases at such a rate that the specimen bursts within 20 ± 3 sec. The strength was measured at break in lbs/sq. inch. The sample fabrics were conditioned under standard testing atmosphere i.e. $65 \pm 2\%$ RH and $27 \pm 2^\circ\text{C}$ for 24 hrs before conduct the test.

Abrasion Test:

The abrasion resistance of knit fabric was the most important property in wear to maintain the fabric's original appearance and structure. This abrasion consists of friction or rubbing between the fabric and some other material. Here, the sample fabrics were conditioned at first under standard testing atmosphere. After that the circular specimens are taken randomly using the related device from each sample fabric. Then the specimens were stretched over the face of the circular holders and rubbed against the flat abrasive surface placed to the lower plates. Machine was run until the hole(s) appeared. A total weight of 395.35 gm is applied to the specimens with a motion that was continually

	<p>changing direction and the counter was counted the number of revolutions/strokes required for end point and recorded to the table. The worst cloth was used as standard abradant.</p> <p>Pilling Test: A major test to perform this project work and assess mechanical characteristics of fabric. It was formed on fabric surface during wear and washing by the entanglement of loose fibers. Samples were assessed following the aforesaid method (in table 1) by pilling photograph of Gray rating.</p> <p>Shrinkage Test:</p> <p>Shrinkage was a parameter of fabric to measure changes in length and width after washing (laundry). The level (%) of fabric shrinkage rate was one of the criteria to measure product quality. Here, mechanical shrinkage method was applied to complete the test under prescribed international standard atmosphere. Specimens with required dimension (50x50 cm) were washed in water at 40°C for 30 minutes. Then measure the changes in the length and width direction after drying and evaluate shrinkage as below- $\text{Shrinkage} = \left[\frac{\text{the length before wash} - \text{the length after wash}}{\text{the length before wash}} \right] \times 100\%$</p> <p>Spirality is the dimensional distortion of the fabric after washing according to seam length and evaluate as below – $\text{spirality} = \left(\frac{\text{side seam actual length before wash}}{\text{side seam displacement length after wash}} \right) \times 100\%$</p> <p>Wash fastness test: Wash fastness is the ability of fabrics to retain the dyes used to color them. A specimen of each dyed sample fabric was tested with the adjacent cotton fabric under specified conditions. In the test, change in color of the sample and also staining of color on the adjacent fabric were assessed and the rating was expressed in fastness numbers as prescribed method in table 1. A 10 x 4 cm swatch of the colored fabric was taken and was sandwiched between two adjacent cotton fabrics</p>		
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	<p>and stitched. The sample and the adjacent fabric were washed together with soap 5 gpl and soda 2gpl solution at 50°C for 30 minutes. The liquor material ratio was 50:1. After soaping treatment, remove the specimen, rinse twice in cold water and then in running cold water under a tap. Squeeze it and air dry at a temperature not exceeding 60°C. At last, the change in color and staining was evaluated with the help of grey scales.</p> <p>Production of knitted garments: From finished fabric ladies overcoat, cardigan and children wear of innovative design were produced.</p>		
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E. Materials Development/Publication made under the Sub-project:

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.	-	-	-
Journal publication	Under preparation	-	-
Information development	-	-	-
Other publications, if any	-	-	-

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

i. Generation of technology (Commodity & Non-commodity)

Jute yarn is used in knitting m/c.

Knitting Technology is generated to produce the project related product – jute cotton lycra technical textiles. In this technology jute is used in place of synthetic yarn as replacement/ alternate to make the product commodity if jute is only used then it will be not marketed or accepted by the consumers due to body touch feelings is as not as wear comfort.

Over-all employment generation, alleviation of poverty high-lighting the creation of income generating activities for the target groups, specially for women.

Jute scoter provides employment of about 10% of our labour force. The project will create more opportunities for employment, particularly in the knit sector. New knit Industries for production of various kinds of improved jute cotton lycra based knitted products like garment and other diversified commodities will generate significant employment opportunities for men and women.

The benefits of the Project will not directly be accruable to BJRI. The jute sector, including the jute growers and users will be benefited. Bangladesh, as a nation will find ways and means to evade the aspects of jute crisis.

In the industrial sector the Project will endeavor to secure a stronger position for jute and jute goods in the face of serious competition from synthetics. The quality and cost effectiveness of the conventional jute goods will be significantly improved and new diversified products from jute in blends with others textile fibres will be manufactured. Implementation of the objectives of this Project is expected to increase the demand and price of jute and different jute based products at home and abroad. Improved process reliability and produce consistently high- and reliable-quality knits, which is very sustainable.

ii. Generation of new knowledge that help in developing more technology in future

New technology (knitting) to use jute in knit fabric as commercial purpose will contribute a positive role in textile sectors. This technology has applied to use jute in loop formation as technical fabric. Following this technology in future more technology will invent to produce different types of knitting fabrics.

Fabric structures and fabric sensors will become the 'norm' for the future. To innovate in knitting design, designers and technicians union is required to create a dialogue and extend the boundaries to the development of new products in fashion and design.

iii. Technology transferred that help increased agricultural productivity and farmers' income

Raw jute consumption will be increased as product diversification through technology transferred to the industry for the bulk production. This raw jute will imposed a positive demand to get it from local agricultural cultivation for the availability. So, ultimately jute agricultural productivity will be increased and farmers will be delighted from the income for their cultivation.

iv. Policy Support

Fabric structures and appearance of jute as replace of synthetic or cotton will become the 'norm' for the future. To innovate in knitting design, designers and technicians has to train for knowledge sharing and extend the boundaries to the development of new products in fashion and design. The quality and cost effectiveness, these goods of jute will be significantly improved and new diversified products from jute in blends with others textile fibers will be manufactured. Implementation of the objectives of this Project is expected to increase the demand and price of jute and different jute based products at home and abroad. Improved process reliability and produce consistently high and reliable-quality knits, which is very sustainable.

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring [description & output of consultation meeting, monitoring workshops/seminars etc.):

Different level of consultants from different sectors have paid a visit to the activities of the project and commented that it will be very viable to the environment and will create a field to absorb/consume natural fibers in place of synthetic fibers as well as shared their valuable advice for the success.

ii) Field Monitoring (Time& No. of visit, Team visit and output):

Monitor team has visited at BJRI premises with their respective member on 11th February, 2018.

They also observed the project situation and discussed with Director General of BJRI, PI, Co PI & other scientists related to this project.

Monitoring team	Date(s) of visit	Total visit till date (No.)	Remarks
Technical Division/ Unit, BARC	11-02-2018	01	All members recommend that this project will be viable, if project continue in future.
PIU-BARC, NATP-2	-	-	
Internal Monitoring Dr. Md. Abul Kalam Azad, Director, JTPDC	30-08-2018	01	
Others Visitors Dr. M A Hamid Mia EX- Director General, BJRI	13-09-2018	01	
Md. Morsed Alam Assistant Professor, Butex	10-09-2018	01	

H. Lesson Learned/Challenges

Lesson Learned

- i) Product selection (jute yarn) to produce the required material/sample has changed time to time to maintain the quality and machine operation.
- ii) Machine set-up experience –needles (latch and compound) cam, sinker, yarn creeling, lycra yarn feeding arrangement, take up roller etc is also a vital point before m/c operation to run smoothly.
- iii) Heat-set parameters (temperature, time and speed) is also learned to execute the process of the desired product.

I. Challenges

- i) Replacement of synthetic/cotton yarn to use the jute yarn in knitted fabric is not an easy expectation. Since production related people are not experienced with this material.
- ii) The experimental machine is fully engaged with commercial production. So, it was not easy to get that machine as the requirement by maintaining with all settings and parameters.

Signature of the Principal Investigator
Date
Seal

Counter signature of the Head of the
organization/authorized representative
Date
Seal