
An Approach to Design a Sustainable Supply Chain: Future Non-government Investment in Jute Industry in Bangladesh

A. M. Almas Shahriyar Azad, Sajib Ahmed,
Zarin Tasnim Oishi & Sarkar Sudipta Shekhar Supta

Department of Industrial & Production Engineering
Rajshahi University of Engineering & Technology (RUET)

1. Abstract

This research focuses on designing a robust supply chain for the jute sector of Bangladesh, so that all the existing issues get mitigated as well as private investors get attracted to this sector. Besides, the paper tends to rank the issues according to their intensity. From Bangladesh Jute Research Institute (BJRI) reports, records of Bangladesh Jute Mills Association (BJMA), and Bangladesh Jute Mills Corporation (BJMC), several national and international journal data were collected and after analyzing data were ranked with the Analytic hierarchy process (AHP) calculator. Bangladesh being an agricultural country, development is impossible by ignoring the agricultural sector; industrialization is also necessary to keep abreast of modernization. Ensuring balance among all the essential departments of the jute supply chain and creating a bridge between agriculture and industrialization, this paper shows a bright future for the jute sector in consideration of non-government investment.

Key Words: Agriculture, Bangladesh, jute, industrialization, supply chain.

2. Introduction

2.1 Rationale of the study

The jute sector is one of the oldest traditional, agricultural, and industrial sectors of Bangladesh. Once upon a time jute was called the ‘Golden Fiber’ of the country as there was a huge contribution of the jute sector to Bangladesh's economy. Gradually, the jute industry has lost its glory because of some fizzles. The jute industry emerged during East Pakistan's age in the early 1950s. In the next 2 decades, a big share of national income, foreign exchange, and source of employment came from this sector. After getting Bangladesh independent, the government established Bangladesh Jute Mills Corporation (BJMC) to operate the jute sector of the country. After some years, the government planned to denationalize jute mills and return them to private ownership due to losses. To implement it, Bangladesh Jute Mills Association (BJMA) was founded in 1982 which was an association of Jute Mill owners in Bangladesh.

Bangladesh is known as the second leading country to export jute products. Once Bangladesh used to hold a monopoly position in producing and exporting jute. But now such a monopoly position no longer exists due to competition from India, Uzbekistan, China, and other Asian nations. At present, Bangladesh produces 55-60 lakh bales of raw jute every year of which about 32 lakh bales are used in the existing jute mills. The country yearly exports 24 lakh bales of jute. It provides a livelihood for so many farmers and industrial workers in the country. About 1,60,000 employees of the country are directly employed in the jute mills (Mohammad, Hossain & Hoque, 2014). The welfare of many rural people also depends on the production and trade of jute; but as the sector is facing fluctuations, the economy of the country is getting affected. As people are becoming more environment-conscious in the present day, they are rejecting synthetic materials and focusing on using ecofriendly materials like jute. So, the sector already has good potential to expand marketing all over the country and also earn foreign currencies.

The supply chain is the process that starts from collecting raw materials, converting them into finish goods, transferring them to the right place, and distributing those goods to the customers. The jute industry has to go through a number of supply chain activities. Every player of the jute supply chain has its individual role to add value in these stages. The flow of the jute supply chain stages is-

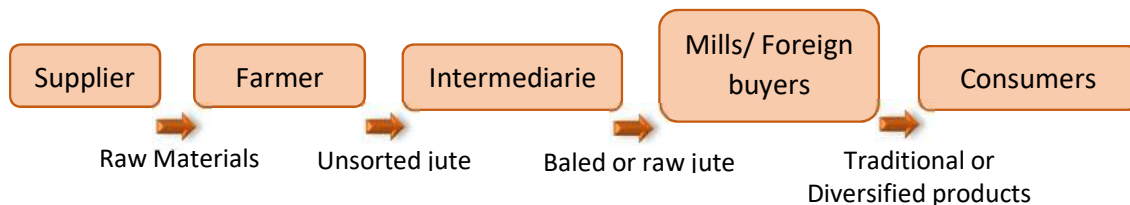


Figure 1: Jute supply chain

This research attempts to identify a sustainable supply chain model of the Bangladesh jute industry. The paper has also discussed some previous studies related to the market functions of each and every step of the supply chain to find out the problems of those stages. Lastly, some recommendations have been mentioned for the betterment of the jute industry. A model has been suggested to operate all the activities under the private sector. This system will help to minimize corruption and increase transparency. Previous researches have been done on a particular operation of the jute supply chain. But this research represents a complete model of

the jute supply chain from the farming stage to the mills and exporting stage. So, this study can give a better and clearer concept about how to conduct the whole supply chain of jute from.

2.2 Scopes and limitations of the research

In the research, it was not possible to conduct field works because of the COVID-19 situation. Thus, professionals in the jute industry could not be contacted directly. So, its reliability had to be analyzed on the basis of secondary data alone which was not easy to test. If the fieldwork was done properly, there was a huge chance of better results. Again, due to the lack of recent data in the jute sector of Bangladesh, non-recent data had to be followed. If the recent data could be gathered from the professionals, mills, or different companies by direct contact, then there was a scope of getting more information and updating the recommendations. Moreover, this research will be handy for private sectors and entrepreneurs, who are interested to invest in the jute sector.

2.3 Research objectives

- Depict how effectively the different segments of the jute supply chain; e.g. procurement, logistics, manufacturing, warehousing, intermediaries, and marketing are interacting with each other.
- To find out the problems and opportunities of each and every step of the existing jute supply chain.
- Designing a conceptual model of the jute supply chain that can be efficient for entrepreneurs, private sectors, and who are interested to invest in the respective sector.
- Recommending the best feasible ways for the supply chain to be more effective in addition to betterment in the marketing and management sector.
- By using AHP rank the existing problems, so that the entrepreneurs and investors get a clear scenario about the existing problems.

3. Literature review

Jute has played a vital role in the economy even before the birth of Bangladesh. During the British reign in the Indian subcontinent, Bangladesh only cultivated jute and during the Pakistan regime, the first jute mill was erected in Bangladesh. After independence, all those jute mills were owned by the newly formed government and the jute sector started to lose its glory (Islam D. M., 2019). The jute sector and the farmers are connected intensively. Sheheli stated that overall 61% of jute farmers have earned overall livelihood from jute cultivation during the years of 2011-2014 (Sheheli & Roy, 2015). She also added that 15% of farmers use self-seed and only 2.5% of farmers used state seed (BADC seed) and 82.5% used local marketable seed. However, it is noteworthy that the quality of government seeds was higher than jute seeds purchased from the market or self-grown. Ali's research shows that about 4 million farmers in Bangladesh are engaged in the cultivation of jute (IJSG, 2009) and most of them use the conventional method of retting in ponds/canals and time-consuming approaches (Ali et al., 2015). The conventional approach hampers jute fiber consistency and pollutes the atmosphere by decomposing biomass. Khan's research presented that 40 insect and mite species are attacking jute in Bangladesh. The insects, mites, and nematodes feeding on jute belong to 70 different species of pests, which appeared at different growth stages of jute over two consecutive years of observation (Khan, 2018).

Currently, in addition to farming in the jute sector, there are numerous problems. Failing to modernize the technology, corruption, unskilled laborers have been considered liable for not having satisfactory outcomes from the jute sector in the past years (Moazzem, Rahman, & Sobhan, 2009). The paper “Present Condition of Jute Sector in Bangladesh” demonstrates some problems in the jute industry including lack of effective managerial policies, mismanagement in the procurement of raw jute, imbalance in the supply chain, increasing need for subsidies, and many more. Huge manpower is employed in the jute sector and the losses affect them greatly. Revamping the capital structure and closely monitoring the performance can solve these problems to some extent (Hoque, Hossain, & Uddin, 2014). The disorderly situation of Aleem Jute Mill is focused on the paper titled “IMPLEMENTATION OF 5S IN JUTE MILL: A CASE STUDY” the authors found an untidy situation, broken machinery, mismanagement, lack of waste management, and not efficient workers. “5S” has been suggested as the solution for the existing problems (Amin, Roy, Rahman, & Shikdar, 2019). “Economic Importance of Jute in Bangladesh: Production, Research Achievements and Diversification” titled paper demonstrates the reasons for the unsatisfactory performance of the jute sector. Improper cultivation of jute, outdated manufacturing facilities, improper government policies has been emphasized as the failure of the jute sector. Based on multiple fields visits the author suggested some ideas such as pest control techniques, modernization of mills for better outcomes (Islam & Bjri, 2017). The activities in the upstream supply chain of the jute industry are represented in the paper “A Conceptual Model of Upstream Jute and Jute Diversified Products’ Supply Chain Management”. It includes the role of suppliers, farmers, intermediaries, and exporters and also shows their flaws. The unavailability of quality seeds, higher interest rates, higher labor costs, irregular credit systems, insufficient storage facilities, and high transportation costs are mentioned as the main challenges for the jute industry. The author gave some necessary suggestions to monitor the market, enable proper communications among stages, and increase coordination among the competitors (Rifath, 2018). Deficiency of efficient workers can be noticed in the downstream of the jute supply chain; as the paper titled “A CONCEPTUAL MODEL OF DOWNSTREAM SUPPLY CHAIN AND THE IMPORTANCE OF IT IN BANGLADESH JUTE INDUSTRY ” claims that the efficiency of jute workers is almost half compared to the workers China. Moreover, some conceptual models have been depicted based on outsourcing by the author (Ashif, 2018). The paper named “Marketing of Raw Jute in Bangladesh: A Review” highlights the entire marketing process of jute with the explanation of the chain and different channels of the intermediaries. The author mentioned transportation, storage facilities, financing, marketing cost, and market information flow as the important jute marketing factors. The paper claims a lack of marketing facilities and storage facilities, a lack of technical knowledge, and insufficient information flow as the major problems in the jute industry. It also reveals the farmers as self-financed (Islam M. M., 2017). The marketing channels of jute and the quantity of the product flow in these channels are focused on the paper “Study on Marketing Channel of Jute in Bangladesh”. The credit system is mainly followed by the balers and the mills, other intermediaries also use it along with the cash transaction system. Lack of innovation, storage problems, and archaic marketing systems are mentioned as obstacles to make the industry revived (Rab, 2018). The paper “Raw jute marketing system in Bangladesh: An economic overview” shows the important data and records related to jute marketing. According to the paper, transportation, bank interests, warehousing rent, and processing cost add a large part to the cost of intermediaries. It represents the seasonal price variation and demand fluctuation of Tossa jute by mentioning it as a challenge of the jute industry. The author discussed the marketing margins of different intermediaries of the jute industry separately which shows that the exporters get more profit than others (Moniruzzaman, Sabur, Islam, Salam, & Alamgir, 2008).

In spite of some unexpected incidents still, the jute sector can turn around and can be a potential sector contributing to the growth of the economy of Bangladesh. Proper policies should be initiated soon for the rapid expansion of the jute sector in the national and global markets (Rahman, Kazal, Begum, & Alam, 2017). The opportunities and challenges of jute diversified products have been discussed in the paper “A CASE STUDY VALUE CHAIN ANALYSIS OF DIVERSIFIED PRODUCTS OF JUTE”. Lack of knowledge of product development techniques, unavailability of skilled labor, a limited variation of JDP products, lack of dedicated designer for jute products is the challenges to promote jute diversified products. The introduction of new technology, prioritizing fashion designing degree, ensuring the flow of information on design and product development are suggested to tackle this situation (Bhuiyan, 2016). Since the '90s Bangladesh is using jute geo-bags to prevent river erosion. This measure is cheap, reliable, sustainable, and environment friendly. Geo-bags can also serve the purpose of road construction. Entrepreneurship based on geotextile can be optimized for both businessmen and the national economy (Oberhagemann & Hossain, 2011). Neither jute fibers' biodegradability nor economic benefit can be overlooked, that's why the demand for jute is increasing day by day. From the perspective of Bangladesh cultivation of jute, jute bags, use of jute as vegetables, consumption of CO₂ by jute plants can be a greater benefit for a green sustainable environment (Islam & Ahmed, 2012). Environmental awareness has already crossed the boundary of the countries and expanded across the globe. But if the market demand is compared with the production of diversified products in Bangladesh, the country has a lot to do. After depicting these facts, Rahima Akter researched the potential of jute products at the Australian market, which is a great opportunity for the Bangladeshi jute sector (Akter, 2015). In addition to Australia, grabbing the European market can be considered as a golden opportunity for Bangladesh as European countries are also interested in using jute products in lieu of other synthetic products. More research on diversifying jute products, scientific cultivation methods, and proper market analysis can really be fruitful for the promising jute sector (Vries, 2007).

So to say, numerous research works have been initiated about failures, cultivation processes, diversification of jute products in addition to national and international market analysis of the jute sector. But there is a lacking of research works pertaining to the problems of the supply chain of jute, challenges for designing conceptual supply chain model from the aspect of future non-government investments in this respective sector, on which this paper tends to focus.

4. Methodology

Methodology in this research, the data are gathered from the secondary sources based on the primary studies done previously. A qualitative method has been followed in this study. Both analytical and descriptive techniques are used here. The target population in this research are the farmers, middlemen, employees, laborers, entrepreneurs, professionals, exporters who are directly engaged with the jute industry of Bangladesh, and also the customers of the jute and jute diversified products. The secondary data are collected from different BJRI reports, records of BJMA, BJSA, and BJMC, several national and international journals, conference papers and research papers, articles on national and international newspapers, and websites on the related topics. After the data being collected, the data was analyzed, and based on this analysis inconsistency between different stages of the supply chain was determined. A conceptual supply chain model was suggested for sorting out repugnancies in the existing supply chain. The conceptual model will mainly involve the intermediaries and jute mills. For other phases, necessary recommendations will be added. At last, an AHP calculation was initiated to rank the problems within the supply chain.

5. Current scenario of the jute supply chain

The jute supply chain involves various phases. Each phase is unique, has own role and importance. Moreover, due to problems each stage needs some minor modifications or major changes. For better understanding and research purposes we will divide the supply chain in several portions, which will start from farming and farmers, flow through intermediaries and mills at last will be followed by marketing strategies.

5.1 Jute farming and farmers

Jute is one of Bangladesh's primary cash crops. Jute occupies 2.86% of the total area under cultivation. With the production of 0.912 million tons of fiber, Bangladesh covers 0.461 million hectares of land (Mohammad, 2002). 80,000 hectares of agricultural land are lost each year due to road development and river erosion in Bangladesh. Thus, the main crops such as rice, wheat, maize, potatoes, etc. are cultivated on the same land each year, and this mono-cultivation limits the diversification of crops and decreases the productivity of the soil. Around 85% of the farmers' total cultivated land was brought under deshi jute cultivation on average. According to data from the survey, 25% of farmers started growing jute between 2007 and 2009, 50% in or after 2010, 18% between 2004 and 2006, and just 7% of farmers between 2003 and 2000. Of the jute farmers, 30% grew their jute on their own land and 70% grew on leased land. A common expectation of jute farmers (89%) is that it would produce more benefit than rice or other crop farming (Sheheli & Roy, 2015).

After the growth in 2018, the Bangladesh government had taken some steps to mitigate the credit problem for the jute farmers.

- In 2018, jute growers, traders, entrepreneurs, and jute and jute commodity exporters were eligible for loans from the fund at a 5% interest rate, according to the draft policy. The government has set up a Tk10,000-crore Jute Sector Development Fund (JSDF) as part of its initiatives. A draft policy for low-cost loans from the Special Fund was finalized by the Ministry of Textiles and Jute (*Dhaka Tribune*, 2018).

The revolving fund will be in effect for 20 years, according to the draft policy, and the entire management will remain under the central bank. Recently in the COVID pandemic situation, our government has also taken a very good step for the jute grower.

- To alleviate the crisis triggered by the novel coronavirus, farmers will obtain agricultural loans at a 4% concessional interest rate in the crop market. For the next 15 months, starting from 1 April this year to 30 June 2021, the Bangladesh Bank released a circular making agricultural loans cheaper. At present, banks disburse farm loans at 9% interest. Banks will provide farm loans at concessional interest during this 15-month period, and they will return to charging normal interest after June 30 next year, the circular reads. The remaining 5% interest would be paid by the central bank as a subsidy to the bank (*The Business Standard*, 2020).

But the problem is that most of the farmers are not aware of these projects. Necessary steps should be taken by the policymakers and local administration to spread the credit facility projects among the rural people.

5.1.1 Problems associated with farming and farmers

Lack of experience in technical assistance and training: 40% of farmers acquired experience from their friends and neighbors in jute farming, where 33% obtained formal training from various government organizations (GOs) such as DAE, BJRI and non-government organizations (NGOs), and 27% have no experience in jute farming. Data shows that they joined jute farming through their self-experience and are still continuing it now. It is critical that 60% of farmers expect to be trained in jute farming. Just 2% of farmers receive professional training from Bangladesh Agricultural Research Institute (BARI) in a survey conducted in some villages in Mymensingh and Kishoreganj. That is why it is difficult for our jute farmers to guarantee the highest quality jute yield (Sheheli & Roy, 2015).

Jute seed problem: The problem with jute seeds is also acute in our region. Currently, Bangladesh Agricultural Development Corporation (BADC), our country's largest public sector, produces and distributes jute and Allied Fibers (JAF) seeds to the grower. But, sadly, both deshi and Tossa generate only 700-800 tons of seeds, which is only 8-10 percent of the total JAF seed requirements. For jute growers, this restriction often causes problems. Our government has to import seeds from neighboring countries for this use, and they cannot ensure the quality of the seed. Besides, for our growers, the seed is also expensive. Along with fiber crops, the farmers cultivated jute seeds, a portion of which is held at the corner of the field for planting. None of the farmers tested their seeds in the field prior to sowing. The local market was mainly the source of jute seeds. Data showed that 15% of farmers used self-seed and only 2.5% of farmers used state seed (BADC seed) and 82.5% used local marketable seed. However, it is noteworthy that the quality of government seeds was higher than jute seeds purchased from the market or self-grown (Sheheli & Roy, 2015).

Labor problem: In the fiber extraction process (20 percent) and weeding procedure (20 percent), maximum production costs were incurred. In the rainy season, weeds are very rigid jute rivals, causing up to 70 percent crop loss. A timely weeding is very important in the development of jute. Continuous rains at the weeding stage often cause problems and unforeseen high costs in the weeding process are incurred by the removal of dense weed populations. One hundred percent of farmers said in the study region that weeding and fiber extraction activities require a large amount of human labor (Sheheli & Roy, 2015). But in recent years the number of labors has decreased and even labor is so costly.

Jute retting: There has always been the problem of retting the jute in the proper way in our region. It is difficult to ensure the highest quality fiber in the conventional jute retting process (stem retting). Although, about 4 million farmers in Bangladesh are engaged in the cultivation of jute (International Jute Study Group, 2009) and most of them use the conventional method (stem retting) of retting in ponds/canals and time-consuming approaches. The conventional approach hampers jute fiber consistency and pollutes the atmosphere by decomposing biomass. There is also an issue with the lack of enough water for retting. 1:20 should be the minimum ratio of plant content to water in stagnant water. Nowadays, due to climate change, the pattern of dryness of rivers and ponds/canals during short harvesting time makes it difficult for farmers to ret-jute (Ali et al., 2015).

Lacking of prior knowledge on fertilizer: It was observed that fertilizers were applied only during the fiber crop production and no additional fertilizers were applied for a seed crop. Most of the farmers' jute growing villages doesn't not apply irrigation or plant protection measures. The farmer used traditional practices of user inputs. This was mainly due to a lack of available

technology of jute at the farmer level and also farmers had a problem of managing cash money for purchasing inputs like seeds, fertilizers, etc.

House level storage problem: Data revealed that just after harvesting, most farmers (57 percent) sell their commodities. Furthermore, 35 percent of farmers sell their commodity to middlemen before harvesting in order to pay for their subsistence. Over a long period of time, just 8% of farmers store jute and sell it. They have storage facilities for several months to store large quantities of raw jute (Sheheli & Roy, 2015).

Different mutant against insects and mite pests: During the summer season, jute is grown, infesting a variety of insect pests across the crop cycle. Insect pests, jute hairy caterpillar, jute semi looper, leaf-eating caterpillar, red pumpkin beetle, ants, etc. have been discovered to infest various jute mutants. The jute-hairy caterpillar was powerful and destructive among them. In addition to these, the leaves of jute mutants were affected by the jute yellow mite. In general, 40 insect and mite species are attacking jute in Bangladesh. The insects, mites, and nematodes feeding on jute belong to 70 different species of pests, which appeared at different growth stages of jute over two consecutive years of observation (Khan, 2018).

Table 1

Main issues with keynotes

Number	Main issue	Keynotes
1	Jute cultivation and cultivated area	• 85% of the total cultivated land of the farmers are under deshi jute cultivation. • More than 50% of percent farmer started their jute cultivation after 2010. • 30% grew their jute on own land and 70% grew on leased land (enough land problems).
2	Experience in technical assistance and training	• Almost 40% of the farmers acquire jute farming experience from their friends and neighbors. • where 33% received formal training from different GOs (such as DAE, BJRI) and NGOs. • The rest 27% have no knowledge about jute cultivation. • formal training is not frequent in the survey areas. It is important that 60% of farmers were expecting training regarding jute farming. • only 2% of farmers take a professional training from our BARI. • 40% jute grower cultivating jute from their neighbors.
3	Jute seed problem	• BADC only produces 700-800 tons of seed both of deshi and Tossa which is only 8-10% of the total JAF seed requirements. • Our government has to import seeds from neighboring countries and they can't assure the seed quality, the seed is also costly for our farmers. • The farmers grew jute seeds along with fiber crop, a part of which is kept for seed at the corner of the

		field. None of the farmers tested their seeds before sowing in the field. • 15% of farmers used self-seed and only 2.5% farmer used government seed (BADC seed) and rest 82.5% used local marketable seed.
4	Labor problem	• Maximum production fibre extraction process (20%) weeding operation (20%). • Sometimes continual rains at the weeding stage create the problem. • Removal of dense weed population incurred unexpected high costs in weeding operation. • weeding and fiber extraction operations require a huge amount of human labor which is costly.
5	Jute retting	• In the traditional jute retting process (stem retting) it is hard to ensure the best quality fiber. • But the majority of them use the traditional method. • The problem of scarcity of enough retting water. The minimum ratio should be 1:20.
6	Lacking prior knowledge of fertilizer	• Fertilizers were applied only during fiber crop production. • No additional fertilizers were applied for seed crop • Most of the farmers' jute growing villages does not apply irrigation or plant protection measures. • Farmers had the problem of managing cash money for purchasing inputs like seeds, fertilizers, etc.
7	House level storage problem	• Majority of the farmers (57%) sell their product just after the harvesting. • Only 8% of the farmers stock jute and sell it over a long period of time. • Storage problems.
8	INSECT AND MITE PESTS	• 70 different species of pests belong to insects, mites, and nematodes feeding on jute which appeared at different growth stages of jute in two consecutive years of observations. • 40 species of insects and mites attack jute in Bangladesh.

5.2 Intermediaries

The principal functionaries involved in the marketing and supply chain of raw jute from producer to consumer are identified as the intermediaries of the jute industry. These market intermediaries include faria, bepari, katcha balers, pucca baler, exporters and millers. Intermediaries play a vital role in different stages of upstream supply chain of jute.

5.2.1 Types of intermediaries in the supply chain

Farias are the small traders of unsorted jute. They keep their jute at their own dwellings or at the farmers' house for a short period. Beparis are divided into two categories- small beparis and big beparis. They use common storehouse or the dwellings of farmers or farias for a short duration of time. The katcha balers go through the process called katcha baling. Katcha balers

have adequate storage facilities. Pucca balers assert the raw jute according to the commercial or the export grades. But the mills don't want to buy pucca bales because it is a hard task to use the pucca bales for further processing. Private Mills have these agents who operate between the jute producers and the mills and get a commission for it named as brokerage. Aratdars often provide storage facilities and loans to other intermediaries. There are many government purchasing centers across the country for the farmers and small traders to sell their jute directly and get profitable prices. Then these raw jutes are taken to the mills or the exporters. But the number of these centers is not enough in our country.

5.2.2 Distribution Channels of Raw Jute

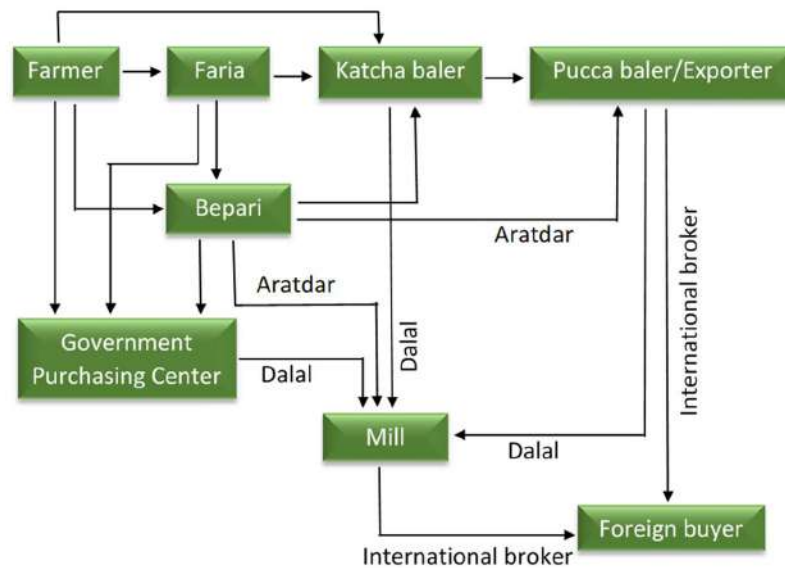
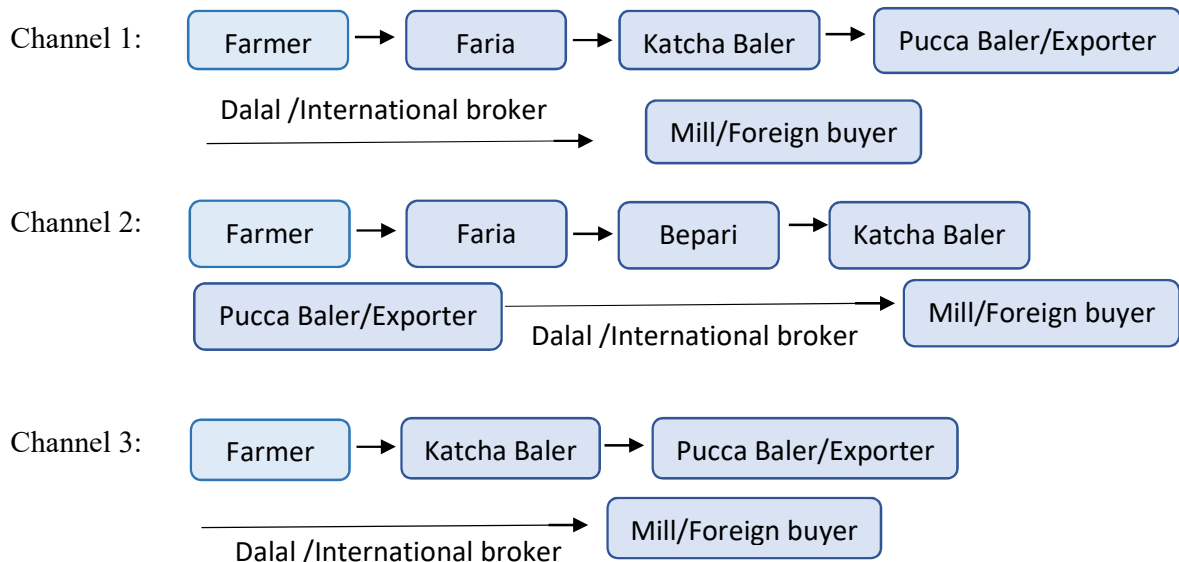
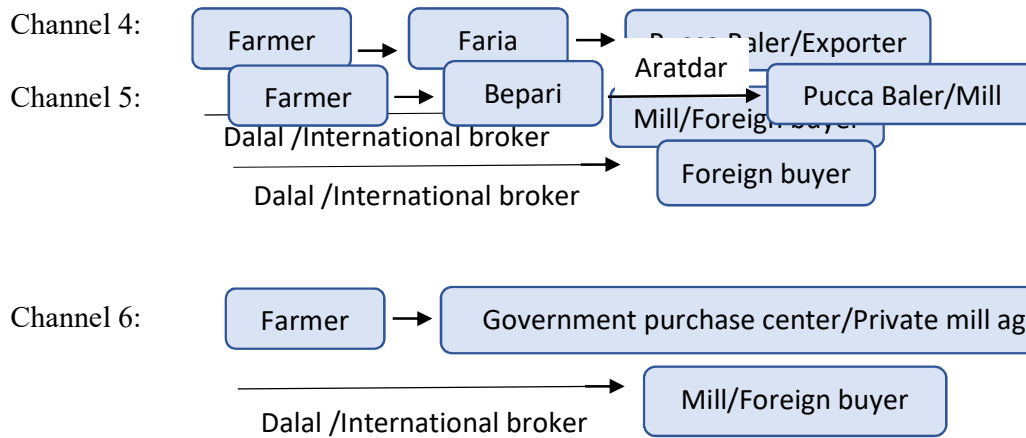


Figure 2: Distribution Channels of Raw Jute

How jute circulates from farmers to mills through intermediaries is demonstrated with the help of following infographics:





5.2.3 Marketing of the intermediaries

The entire jute marketing process is consisting of various functions including transportation, grading, storage, financing, market information, and pricing. Some specialized business activities are operated to accomplish this marketing process.

Source of Financing: Here are the sources of financing of jute intermediaries shown in the table.

Table 2

Sources of finance of jute producers and traders

Farmers and Traders	Sources			
	Own (%)	Friends and Relatives	Banks (%)	Aratdars (%)
Farmers	94.72	5.28	-	-
Farias	81.27	7.3	3.55	7.88
Beparis	62.94	11.65	15.37	10.04
Kutchha balers	45	3.82	51.18	-
Pucca balers/Exporters	16.71	-	83.29	-

Note: Collected from Moniruzzaman, 2014

Generally, the small traders are self-financed. The small traders usually don't have access to institutional credit. But these credits are available to the big traders.

Marketing cost: The cost items for the jute intermediaries are transportation, loading-unloading, storage, commission, tolls, subscription, shortage, assortment, weighing, packaging, telephone bill, electricity bill, processing cost, bank interest, and personal expenses.

Table 3

Total marketing cost of jute incurred by market participants

Market Participants	Cost (Tk./quintal)	Percentage of total cost
Farmers	27.91	3.21
Farias	117.37	13.51

Beparis	143.43	16.51
Kutcha balers	155.79	17.94
Pucca balers	201.2	23.17
Exporters	222.85	25.66
Total	868.55	100

Note: Data was taken from Moniruzzaman, 2014

For the farmers, farias, and beparis the major cost items are transportation and storage. For balers and exporters, bank interest, insurance premium, processing cost are the highest cost items.

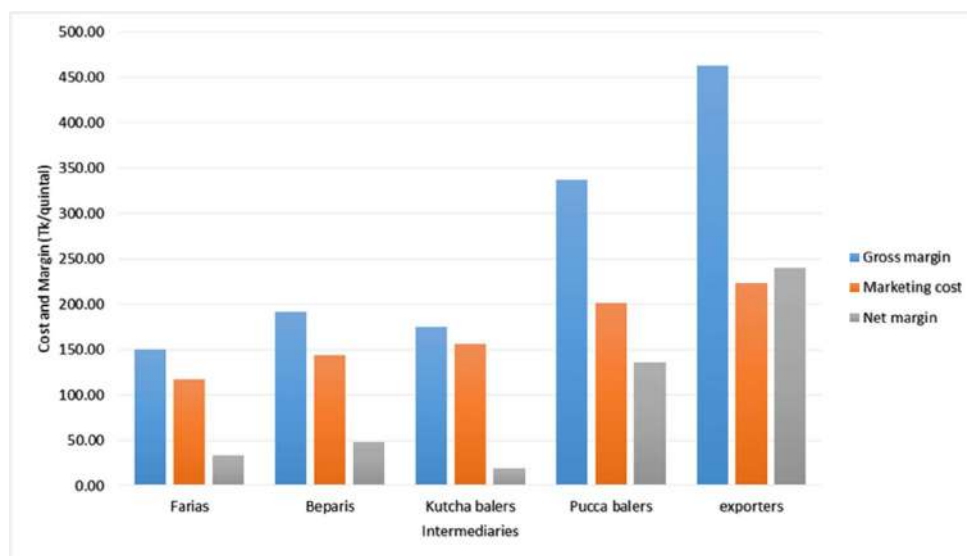
Marketing margin: Marketing margin measures the profitability of the traders. The marketing margin should provide a reasonable return to the marketing activities to make the industry stable.

Table 4

Marketing margins of all intermediaries (Tk./Quintal)

Intermediaries	Purchase price	Sale price	Gross margin	Marketing cost	Net margin	Return over total investment
Farmers	2000.00	2150.00	150.00	117.37	32.63	1.54
Beparis	2055.00	2247.50	192.00	143.43	48.57	2.21
Kutcha balers	2237.50	2412.50	175.00	155.79	19.21	0.80
Pucca balers	2412.50	2750.00	337.50	201.20	136.30	5.21
Exporters	2412.50	2875.00	462.50	222.85	239.65	9.09
Total			1317.00	868.55	476.36	

Note: Each intermediary's report is based on Bangladeshi jute market conditions.



(Source: Md. Mahbulul Islam, 2017)

Figure 3: Marketing cost, Gross margin and Net margin of different intermediaries
The data shows that the exporters make a good profit with a higher net margin comparing to other traders.

Transportation: Adequate and efficient transportation enables the movement of products between different places and ensures the availability of goods at the right time and place. As jute is a perishable product and there is a lack of storage facilities, it has to be moved very quickly.

Table 5

Modes of transportation used by farmers and jute traders

Mode of Transportation	Farmers and Traders				
	Farmers (%)	Farias (%)	Beparis (%)	Kutcha belar (%)	Pucca balers (%)
Head load	85.72	-	-	-	-
Carts/Push carts	35.71	20	40	20	-
Richshaw/Van	28.57	70	40	-	10
Boats/Mechanical boats	42.86	90	80	100	100
Truck	-	20	40	30	30
Rail	-	-	10	30	40
Vessel	-	-	-	-	20

Note: Data is taken from Moniruzzaman, 2014

It can be seen from the table that small traders use traditional transportation methods, while katcha balers and pucca balers use some mechanical transports like mechanical boats, truck, and rail.

5.2.4 Problem of the intermediaries

Irregular and steady payment of credits: Mills and exporters purchase jute from the beparis or balers on credit and pay for it irregularly. Often it takes several months or almost a year for the beparis and the balers to get their full payment of an order.

Inadequate storage facilities: The supply chain of jute is so weak that the traders don't have sufficient storage facilities. Storing the jute in a rented warehouse increases the cost. Again, keeping this perishable product on the farmer and faria's own dwellings without any precautions causes a hamper of the quality of jute.

Dishonesty of the middlemen: Farias and other small traders sometimes mix poor quality jute with the good one to increase the volume and get higher prices. Moreover, some traders mix water with the jute to increase the weight and get more profit. All these adulterations badly affect the quality of the raw jute.

Market fluctuations: For the variation of production and supply in different seasons, price and demand fluctuations are affecting jute marketing directly. As a result, there is a good chance of loss for the intermediaries every season due to the uncertainty of the price and demand.

Expensive transportation system: Jute is mainly produced and cultivated in rural areas where the condition of roads and transportation are not satisfactory. So, the traders have to pay high transportation costs to move the raw jute from farmers to other intermediaries, mills, or customers.

Lack of direct contact of farmers with mills and big traders: Mills do not want to buy from the farmers because mills purchase several metric tons at a time, but each of the farmers produces only a few mounds of jute. On the other hand, farmers do not want to sell products to the mills because mills buy on credits, farmers are more interested to sell the raw jute to the intermediaries at a lower profit but on cash.

Lack of government purchase center: The purchasing center helps the farmer and some small traders to sell their product and get the standard price. But we don't have sufficient government purchase center near the jute producing areas in Bangladesh.

Insufficient market information: The farmers and small traders rarely have access to the accurate and up to date information about jute marketing. They can't get the proper information from BJA and BJEa. So, it hampers to operate their role effectively.

Lack of financial support: Farmers, farias, and beparis don't get the availability of credit from institutional sources. So, they can't afford the necessary equipment, seeds, and storage facilities, and the whole marketing system is affected.

Lack of technical knowledge of grading: The small traders of jute can't grade their products. Grading of jute is usually done by the balers. But they have a lack of knowledge about grading in an expert and effective way. For the absence of grading at a specific standard, the jute is not much suitable to export.

5.3 Mills

In Bangladesh, there are 32 mills operated by the government. Moreover, 38 government mills are being run by private companies, which is a clear indication of the dominance of the private sector over the government in running jute mills (Wikipedia, 2020). After jute being collected from intermediaries, jute reaches to jute mills. Comparing to the traditional supply chain, jute mills can be considered as manufacturing facilities. In jute mills, various operations are performed in order to process jute fiber and turn it into finished products with different types of machinery.

5.3.1 Operations carried out at jute mills

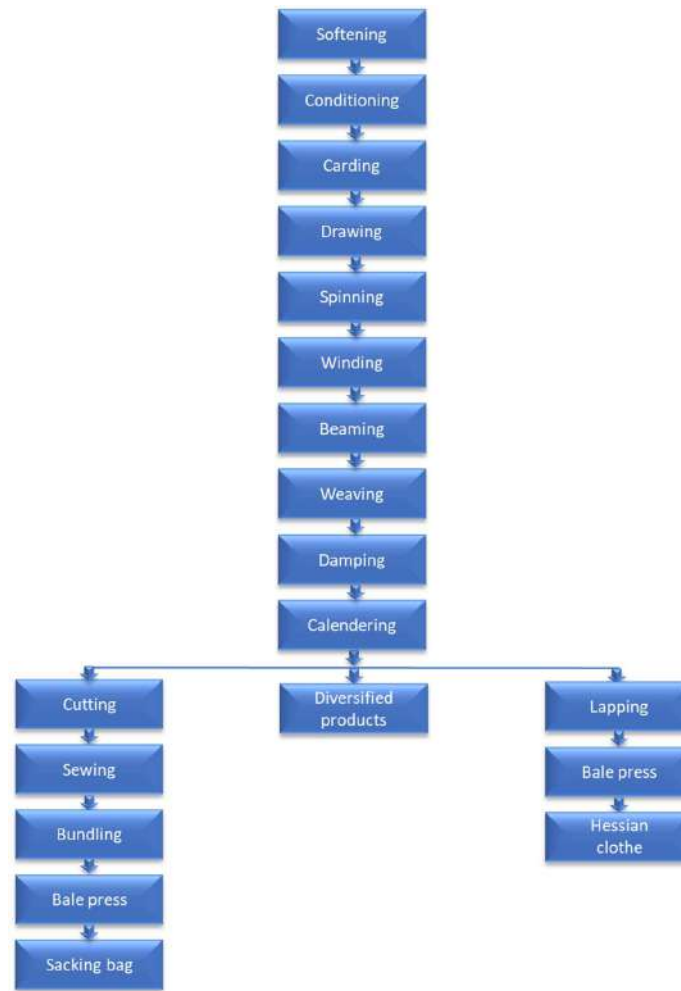


Figure 4: Flow of operations performed at traditional jute mills

In Bangladesh, almost a similar category of functionalities is carried out for processing jute. Normally the machines for this regard are not automated. The mills hire workers for maintaining these activities. Mostly the workers are not well trained nor have technical knowledge about handling these machines. Softening, conditioning, various cardings, framings, spinning, winding, beaming, weaving, dumping, calendering, lapping, cutting, hemming, sewing, bailing are the basic activities that are implemented on jute fiber for processing them into finished products. The processes are showed in figure 5 for a better understanding of the role of mills in the supply chain.

5.3.2 Problems at the jute mills

Technological limitation: Lack of technology can be considered as one of the prominent reasons for consistent failures in the jute sector. Most of the mills use obsolete technologies, which are outdated. These old machineries consume too much fuel, pollutes the environment, creates too much noise, and produce less. Besides, maintenance cost is high as often these machines are to be repaired to keep the plants running. Consequently, the technology used in mills causes less productivity and efficiency.

Unskilled workforce: The scarcity of skilled and well-trained workforce is seen in every sector at jute mills. Even on the eve of the twenty-first century, there were not sufficient engineers for handling the machinery. Recently, because of BUTEX and other textile colleges, this problem is getting solved. But poor management in the jute mills is a regular scenario. Besides, most of the workers don't have any prior knowledge or experience about jute production, so the workers also fail to perform their best.

Unfamiliarity with Industry 4.0: Industry 4.0 brought a paradigm shift in the aspect of the business. In industry 4.0 IoT (Internet of Things) has been introduced to the manufacturing and production sector. But in Bangladesh, the jute sector is far away from industry 4.0 and IoT is totally unknown. As a result, the sector is failing completely to stay updated with world business.

Poor management: The management sector of jute mills has been failing continuously. So, the mills are running not in an optimized state and the departments of the mills are failing to interact with each other effectively.

Lack of demand forecasting: Forecasting the market at different times of the year is essential to understand the demand. But most of the mills do not even have any department for forecasting. Even often the unsold products are dumped in storehouses. Consequently, by holding proper inventory, maximizing the profit has become almost impossible for the jute mills. Moreover, it also results in untimed sourcing in some cases (Tithi, 2019).

5.4 Marketing

The demand for jute products increasing day by day because of its various uses & biodegradability. According to the Jute Diversification Promotion Center (JDPC), about 281 types of products are made by jute. Day by day, this number increases. Jute diversified products are non-traditional jute goods and have a good scope for business. A Sweden company named 'Juteborg' produces many high-tech and cost-effective products from jute including cable protection pipe. The reason behind the present popularity of jute diversified products is the awareness to save the environment by maintaining the ecological balance and also can be turned into various attractive products by using technical and artistic knowledge.

5.4.1 Service functions of JDP

The entrepreneurs of Bangladesh get several services from different actors. These value chain functions and actors make the market dynamic according to their capacity and quality. JDP value chain functions have three major parts: input supply, manufacturing, and trading or marketing. The basic input components of JDP enterprises include fiber or yarn, fabric, machinery, designs, and accessories. The production and manufacturing of traditional and diversified jute products are the two parts of this function. Among the jute diversified products, 70% of them are targeted to sell them in foreign markets, rest 30% are supposed to sell in the institutions and other customers.

5.4.2 Value chain actors of JDP

Input suppliers: The composite and spinning mills act as the primary input suppliers of JDP industry. These mills transform the raw jute into fiber, yarn and fabric and supply these to the next stages. Local accessories wholesalers and retailers perform as the secondary level input

suppliers by supplying drawstring, zipper, button etc. There are also some companies and enterprises that supply machineries and tools for sewing and cutting.

JDP enterprises: The whole processing tasks are operated by JDP enterprise owners. They produce jute diversified products by adding value to the raw materials. Designing, cutting, sewing, packaging, delivering, and other activities are done by them, MSME (Micro, Small & Medium Enterprises) sector is a vital part of it.

Buyers: There are three major types of buyers in the JDP market- domestic individual customer, different institutional buyers, and international buyers. The institutions are the major source of domestic earning of JDP. People from different countries including Japan, Europe, Turkey, and Iran are the buyers of our jute diversified products.

Here is the value chain of JDP industry in Bangladesh-

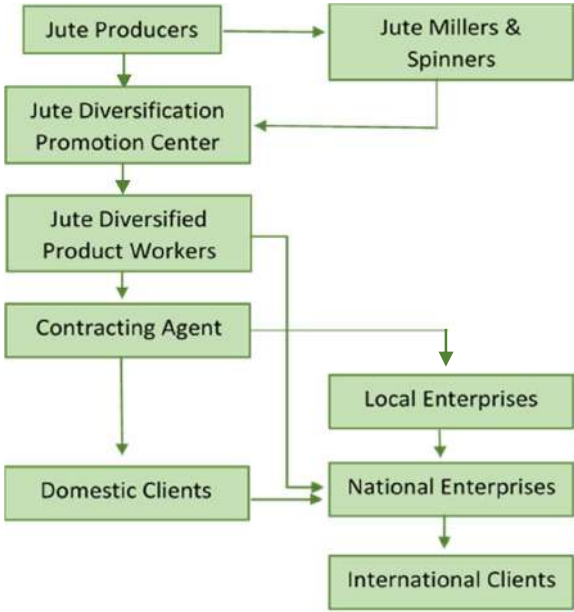


Figure 5: Value Chain of Jute Diversified Product

5.4.3 JDP industry in Bangladesh

Though Bangladesh takes the second position in the world in producing jute, there is a lack of advancement in producing diversified products from jute. It is known as a small and ordinary market in Bangladesh till now. But It is a matter of hope that the JDP industry in our country is improving gradually. There is a demand for jute diversified products both in the foreign and domestic markets. India and many other countries are earning foreign exchanges by exporting jute diversified products. As people all over the world are showing interest to use environment-friendly products, it can be a good opportunity for our JDP industry. If the necessary steps are taken with a proper plan, Bangladesh can easily ensure a bright future of the JDP industry comparing to other competitive countries. In this case, the help of different private organizations and agencies can play a vital role.

Table 6

Market size and growth rate of JDP industry Bangladesh (2009-2015)

Year	The market size of JDP in crore (BDT)	Growth rate per annum (in percentage)
2015	300	30.43
2014	230	19.17
2013	193	33.1
2012	145	42.16
2011	102	39.73
2010	73	14.06
2009	64	-

Note: Data was taken from Bhuiyan, 2016

The above table shows the ups and downs of the growth rate of the market size during 2009-2015 for Bangladesh. The average growth rate found from the table is 25.52%. There are many domestic buyers of JDP in Bangladesh. Along with individual customers, many companies and institutions use jute diversified products such as Pharmaceuticals, financial institutions, educational institutions and training service providers, supermarkets and retail stores, etc. Bangladesh exports jute diversified products throughout the world over 85 countries including Europe, Australia, Middle East & United States. According to the Jute Diversification Promotion Centre (JDPC) report, the domestic and export trade of JDPs roughly accounts for BDT 300crores.

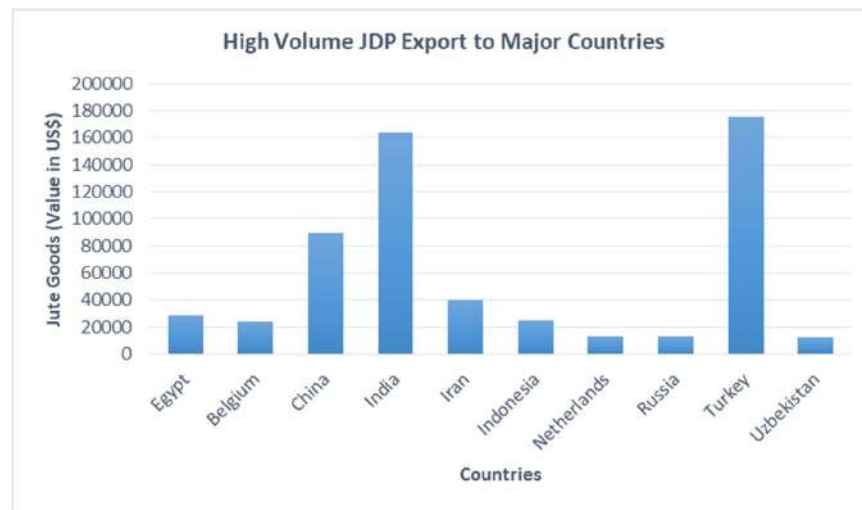


Figure 6: Major Jute Diversified Products Export Countries (2015-2016)

The graph focuses on the major countries where Bangladesh exported jute diversified products from July 2015 to June 2016. From the graph, we can see that Turkey, India, China, Iran, Egypt, and Indonesia are the main markets for Bangladesh to earn foreign exchange from JDP.

5.4.4 Scopes of traditional products

Chances of eliminating plastic products and bags; the government of Bangladesh started to enforce the ‘Mandatory Jute Packaging Act 2010’ in January 2014. According to this law, seventeen types of commodities must be packaged with jute bags (Siddique, 2017) including Paddy, Rice, Wheat, Maze, Sugar, Fertilizer, etc. But because of lacking monitoring

systems, awareness, and law enforcement, this law is not implemented properly. A report of Dhaka Tribune supports the fact that even after imposing the law 312 tons of plastic is produced monthly in Bangladesh (Amin, 2018). So, if the law is enforced properly a huge demand for jute bags will raise, which will boost up the sector greatly.

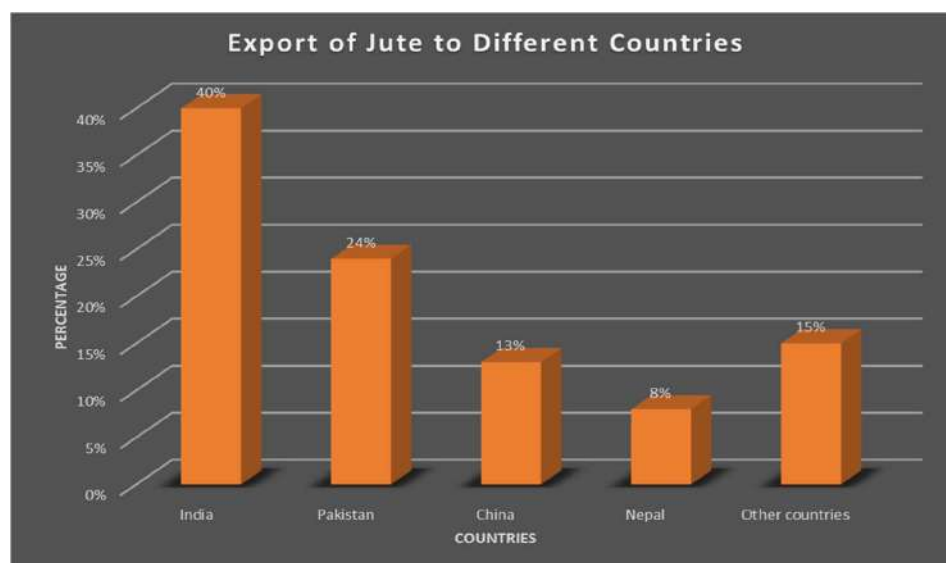
5.4.5 Scopes of not selling raw jute

From figure 7, it is clear that India is the largest importer of jute from Bangladesh. So, it would seem like India is mainly a jute importing country. But importing raw jute is actually a business policy for the Indian sector, which at present is dominating over the world jute market. The business policy can be understood from the following statistics.

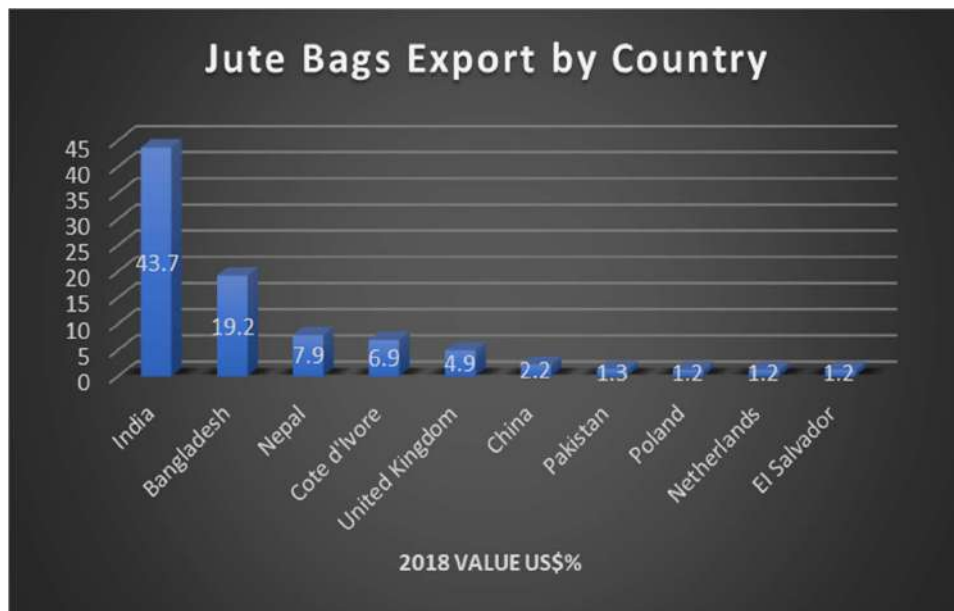
(Source: Export promotion Bureau, 2020)

Figure 7: Export of raw jute to different countries on the 2019-20 month of July-May

But from figure 8, it is visible that India is the largest jute bag exporter in the world. Moreover, the world market of finished jute products is mostly captured by India though Bangladesh



exports raw jute at a cheap rate to India (Chowdhury, 2019).



(Source: Export genius blog)

Figure 8: Jute bags export by country.

Bangladeshi private sectors and entrepreneurs should emphasize on this golden opportunity. Instead of exporting raw jute, finished traditional and diversified jute goods can capture a large market around the world at a better price; which will be an epoch-making change for the jute sector as well as the economy of the country.

5.4.6 Major problems of marketing

Market research: In every business, market research is a big factor. Every company invests a lot in this department just to survive in their industry. Jute is one of the biggest industries in Bangladesh. Many Government & Non-government institutions research a lot about this industry to make it sustainable. Still now, it is not enough and also, authorities cannot implement all the recommendations. As it is going to be a big sector, every year a new market is creating in different countries. But we don't have enough arrangements for it.

Entrepreneurs: A business basically comes with the hands of entrepreneurs. It is already assumed that jute is one of the market-driven products. Already Europe, the USA, Australia, and so many countries try to create a big marketplace of jute products. After a lot of possibilities, there is not a satisfied number of entrepreneurs who catch this opportunity though It must say that the initial rate increases.

Skilled manpower on JDP industry: The cottage industry has a reputation in this country since ancient times. Their works also export in a foreign market at a high rate. Jute is also a raw material to run this industry. Some youth entrepreneur tries to organize them and help to export their product, but all of these skilled people are not organized. Also, the number is not so big who knows this art.

Innovation: After a lot of possibilities, Bangladesh just grabs the highest position of export raw jute and make sacks and ropes. Though some private industry works with some innovative product ideation, most of them are busy with that ancient system. This is not enough

arrangements to grab the large jute diversified products (JDPs) market. There is also a lack of promotional agencies in this sector.

Automation: To increase productivity, an installed automation system is a must. But in Bangladesh, it cannot ensure in all jute companies. Scarcity of automation system, the delivery process is not fast and reliable. It also very hard to calculate growth and other parameters of a company. This is also one of the biggest issues for grabbing the large market of jute products.

6. Proposed conceptual supply chain model

Analyzing the current situation and existing problems we have designed a conceptual model that deals with problems associated with jute mills and intermediaries of the supply chain. Further suggestions about the model and other supply chain parts will be recommended in the following sections.

6.1 Conceptual model for the intermediaries

Shortening the chain of intermediaries: The existing chain of middlemen is so long that there is much probability of hampering the quality of the fiber due to long lead time. Moreover, the farmers don't get the fair price of jute. So, it is suggested that there will be only two steps of local intermediaries-these middlemen will complete the task of buying jute from the farmers directly and then selling it in the jute purchasing center.

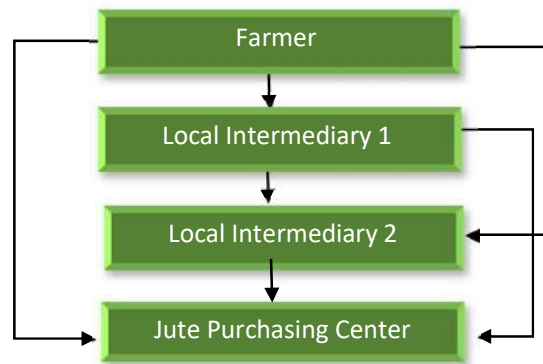


Figure 9: Suggested chain for intermediaries

The advantages of this system are-

- The credit transaction system will not affect the small traders.
- Transportation costs will be reduced for the local traders to some extent.
- Their profit margin will increase.
- Jute requires 65% humidity

Increasing the number of purchasing center: Purchasing center is the proper way for the farmers and local intermediaries to sell the jute at a standard price. The number of the purchasing center has to be increased in the private sector so that the jute can be sold with a good profit for the farmers and the local middlemen.

Adequate storage facilities in the purchasing center: In the purchasing center, the jute has to be kept for several days. But in most cases, there is a lack of storage facilities and the required

precautions. Lacking of storage facilities in the whole intermediaries' channels can damage the quality of jute. So, every purchasing centers should have adequate storage facilities. There are some factors of storing perishable products showing below in table 7. These factors should be strongly maintained while storing the jute. Steps to protect the product from insects should be taken.

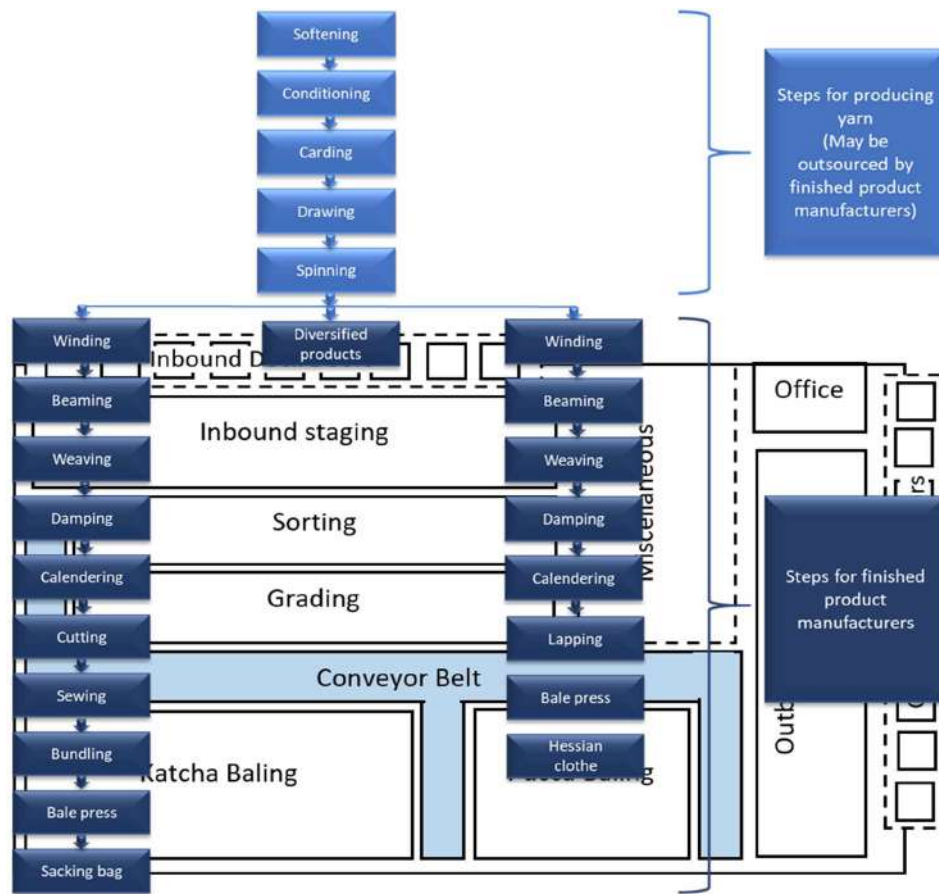
Table 7

The required environment of the storing jute

Physical Factors	Requirements
Temperature	The temperature should be lower than 25°C. Very high or low temperatures can cause damage.
Humidity	Moisture should be controlled as they easily absorb moisture and get rotten. The relative humidity should be 65%
Ventilation	The air exchange rate should be 10 changes/hour (airing). Jute absorbs oxygen very quickly. An oxygen shortage may therefore arise in the room. So, it must be ventilated
Heat	It should be kept away from heat or solar radiation
Condition of the room	The room should be clean as jute is sensitive to contamination by dust, coal, metal filings, fertilizers, dirt, fats, and oils. The room should be protected from rainwater.
Protection from the insects	Jute can be easily attacked by molds and get rotten. That's why the room must be cool and dry.

Transportation: The farmers or local jute traders should use the local transports like rickshaw, van, or cart as usual to reach the purchasing center. Again, the mill agents should use the vehicles according to distance from the purchasing centers to the warehouses or the mills. As they are generally at long distances, transports like boat, rail or truck can be used. Rainwater damages its quality, so the product should be protected from rain during transportation. The temperature should be 18 – 30°C in the transport. It should be clean and dry.

Warehousing: In Bangladesh, the role of grading, sorting, batching, and other processes are done by the balers. But they are not well trained and cannot do all these activities in a proper way. Scarcity of warehouse is one of the major concerns. That's why the jute industry badly needs a well-functioning warehouse. In there, the jute will be ready both for taking to the mill or exporting to the foreign buyers. The role of mill agents is important here to transfer the jute. The raw jute will enter the warehouse by the inbound dock doors. Then the jute will be placed at the inbound staging area. After sorting and grading the jute properly, it will be taken to katcha baling. Then some of the katcha bales will go for pucca baling, rest katcha bales will reach the outbound staging. Pucca bales will also reach the outbound staging area. Both of



these bales will be ready for mills and exporting and they will be taken outside by the outbound dock doors.

Figure 10: Suggested warehouse design for Jute

6.2 Conceptual model for the mills

Previously it has been shown that the processing of finished products from raw jute fiber involves a lot of steps with the combination of several types of machinery. Installation and maintenance of such a huge, intricate plant can be expensive, and managing the whole factory efficiently also becomes a challenge. The installation cost of a well-facilitated jute mill having only spinning capacity, 17 metric tons per day, maybe approximately 855 lakhs BDT let alone the other operations (Niir Project Consultancy Services (NPCS), 2003-2020). So, installing a whole facility of jute processing involves a pretty big investment in a developing country like Bangladesh. Outsourcing can be a better solution to decrease the production cost and to optimize the business. Yarn producing less complicated, cheaper, and easier compared to the whole jute processing system. For entrepreneurs, this is a convenient opportunity, as they can enter the foreign and national market of the jute sector just by producing more yarn. Also, new investors may concentrate on finished products. By outsourcing the jute yarn, the management issue at the mills will be lesser, the costs of setting up the manufacturing facility will also be mitigated. Again, the new entrants will be able to focus on diversified jute products. Finally, if one part of the investors focus on quality yarn production and the other part invests in manufacturing quality traditional and diversified jute products with quality yarn; the chances to be successful increase for both of the investors as well as the rapid development of the jute sector. The idea is demonstrated in figure 11.

Figure 11: Conceptual model of outsourcing for jute mills

Combining both the models together, the entire jute supply chain process can be more efficient and it would create an effective relationship between all the phases.

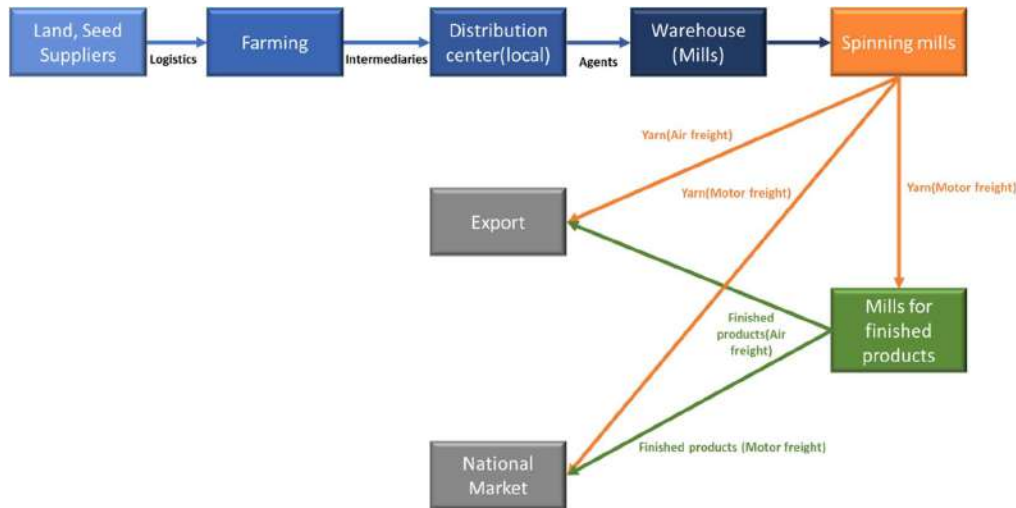


Figure 12: Conceptual model of entire jute supply chain

Finally, the suggested compressed model of a jute industry is shown below-

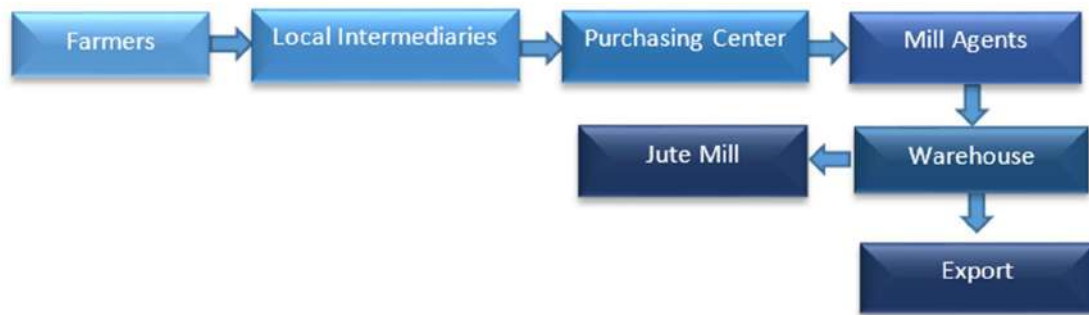


Figure 13: Suggested model for jute industry from intermediary to jute mill

7. Recommendations

7.1 Recommendations for farming and farmers

As stated, farmers are the most oppressed phase of the jute supply chain. For the development of the supply chain, the farmers must be ensured of getting their rights and better payments. Assuring modern technology engagement with the farming process is also essential for getting better jute fiber. Some initiatives are shown in the following sections regarding this topic.

7.1.1 Proposed solutions for seed problem

In 2017, at Hill Agricultural Research Station, Khagrachari (representing hilly areas), Agricultural Research Station, Satkhira and Jute Research Station, Patuakhali (representing saline areas), experiments were conducted with seven varieties of jute and one variety of kenaf

to determine the potential for seed production in non-traditional areas. All varieties were sown from 2009 to 2011 from late July to mid-August (Al-Mamun et al., 2017).

Hill area: White jute varieties (BJRI Deshi Pat-6, CVL-1, and BJRI Deshi Pat 5) performed better at seed production in the hilly station than Tossa jute and kenaf varieties (Al-Mamun et al., 2017).

Saline area: Kenaf variety HC-95 performed better than the white and Tossa jute varieties (O-9897, OM-1, BJRI Tossa Pat-4, and BJRI Tossa Pat-5) for seed yield at the saline station (both Satkhira and Patuakhali). The highest yield was given by the kenaf variety (HC-95) in saline areas. Around 30 percent of the shore belts are part of the net cultivable region in Bangladesh. Around 0.83 million hectares of land are affected by varying degrees of soil salinity (36531). Via increased demand for food and other crops, Jute and kenaf were pushed into marginal lands. On the other hand, jute and kenaf seeds are cultivated in the Kharif-2 and rabi seasons, and therefore there is no likelihood of shifting Aman rice and many high-value rabi crops for the cultivation of jute and kenaf seeds. The development of jute and kenaf seeds may be the right choice in this situation, as it has the potential for tolerance and can provide minimum yield in an environment of stress (Al-Mamun et al., 2017).

Plane area: BJRI Deshi Pat-5 produced the highest yield (0.66 ton/ha) among the white jute varieties, and BJRI Tossa Pat-5 produced the highest seed yield (0.70 ton/ha) in the case of Tossa jute varieties. That's why, BJRI Deshi Pat-5 white jute, BJRI Tossa Pat-5, and HC-95 kenaf are considered to be the best suitable varieties for seed production in the hilly and saline (Al-Mamun et al., 2017).

7.1.2 Proposed solutions for jute retting

Ribbon retting is a specific retting system based on the mechanical pretreatment of plant stalks, which has allowed the water requirement, the period of the retting time, and the number of environmental emissions to be reduced to almost one-fourth compared to other processes used by the entire plant. In the 2012-2013 production year, approximately 7.5 percent of the ribbon retting process was used, while only 1 percent was used in the 2008-2009 production year (Ali et al., 2015).

Ribbon retting process:



Figure 14: Ribbon retting process



Figure 15: Final low-quality jute using traditional stem retting



Figure 16: Final high-quality golden jute fiber using ribbon retting process

In ribbon retting, it is also clear that part of hemicellulose was extracted though ribbon retting did not affect lignin. These findings suggest that retting is basically a serpentinization process with partial soluble hemicellulose elimination. However, in the event of over retting causing a decrease in the strength of jute fiber that has not taken place during the present analysis, fiber cellulose is stated to be decomposed. In order to get jute fiber of commercial value, however, it is important to extract fiber at the critical endpoint of retting (Banik et al., 2003).

Table 8

Comparison between two retting processes at the study area in different production years

Retting	Yield in different retting processes (bale)			
Processes	2009-10	2010-11	2011-12	2012-13
Stem retting	8807.87	8368.19	8323.5	8983.6
Ribbon retting	134.13	258.81	438.0	728.4
Total yield	8942.00	8627.00	8761.5	9712.0

Note: (Ali et al., 2015)

Table 8 shows the consistency of the ribbon retted fibers, which is higher than that of the conventional system and the consistency can be easily observed from Figure 15 and 16 in both

methods. This table provides a contrast between the two retting processes in the different output years in the study region.

7.1.3 Technological advancement

Technology is the basis for sustainable agricultural growth. Seed, fertilizer, and irrigation technologies are known as “Green Revolution Technologies” have long played major roles in the growth of agriculture production in Bangladesh. National Agricultural Research System (NARS), with a strong linkage with public and private extension systems, has been trying hard to develop the appropriate technologies or innovations to satisfy the crying needs of the population. New variety development, appropriate agronomic practices, mechanization, ICT/GIS-based services, area or soil-based crop modeling, etc are some of the fields of innovations where the emphasis is being given (Sultana et al., 2009).

Table 9

Existing training facility projects in 2009

SL No.	Name of the project	Name of technology
1	Farmers Training at Upazila level for Transfer of Technology	Dissemination of innovations
2	Agricultural Support for Small Holder in the South Western Region of Bangladesh	Dissemination of innovations
3	Enhancement of Crop Production through Farm Mechanization	Popularization of innovative mechanical devices
4	Safe Crop Production Project through Integrated Pest Management (IPM) Approach	Pest management innovations
5	Production, Storage & Distribution of Quality Seeds of Rice, Wheat & Jute at Farmer's Level	Seed production and storage innovative practices.
6	Environment-Friendly Safe Crop Production Through Good Agricultural Practices (GAP) for Food Security Program	Environmental protection innovations

Note: (Sultana et al., 2009)

7.1.4 Increasing training facilities & institutional policy arrangement

To create and introduce new agricultural technologies, significant farming policies and strategies have been developed. By the Bangladesh Government (Sultana et al., 2009).

- The National 2018 Agricultural Strategy (NAP)
- The 2018 National Seed Policy
- Integrated Strategy for Minor Irrigation-2017
- The National Strategy of Organic Agriculture 2016
- The 2015 National Framework of Agricultural Extension

These policies have been taken by our government. But unfortunately, it was not successful to recover our jute industry. There might be some problems with infrastructure or project

planning. That is why the private sector must keep their eyes on these projects too and find out the best way to implement these projects with success.

7.1.5 The high rate of disease infestation

Agriculture and mobile app: The Farmer's Window are a database of crop diseases, pests, insects, and fertilizers centered on photos. The farmer or any consumer can recognize any crop problem by looking at the picture and can get solutions to that problem by clicking on the problem in the database. On notebooks, desktops, and smartphones, it can easily be used. Through this, from the Union Digital Center (UDC), Farmers Information and Advice Center (FIAC), and Agriculture Information and Communication Center (AICC) next to his house, the farmer can get the answer to any crop problem. Using a cell phone window, an experienced farmer can also get a solution to the crop problem. It can be used and introduced to our jute farmers on a large scale so that they can use this method to identify the threats of their jute and can have better treatment advice (Sultana et al., 2009).

Recent treatment methods:

- Eco-friendly treatments suggested the treatment was 50 percent N: P: K + Azotobacter seed treatment and PSB @ 5g / Kg + T seed treatment. Among the disease control treatments, Viride (bean treatment @ 5g / Kg of bean and soil application @ 2Kg / ha at 21DAS) + P. fluorescent spray @ 0.2% at 45DAS was found to be superior. The percent occurrence of stem rot and root rot disease was 3.46 and 1.43 percent, respectively, while 13.17 and 4.96 percent, respectively, were in control (Meena et al., 2014).
- FYM @ 5t / ha + seed treatment with Azotobacter and PSB @ 5g / Kg + T was the second-best treatment. Viride (seed treatment @ 5 g / Kg of seed and soil application @ 2Kg / ha at 21DAS) + P. fluorescence spray @ 0.2% at 45DAS showed an incidence of 3.61 and 2.0 percent respectively of stem rot and root rot diseases. At 45DAS, treatment with N: P: K @ 60:30:30 and seed treatment with carbendazim 50WP @ 2g / Kg resulted in an incidence of 4.56 and 2.10 percent. Application of potash @ 50-100 kg K₂O / ha as a baseline dose will substantially regulate the disease. The incidence of stem rot disease decreased with micronutrient application (Zn, Fe, Bo) along with N: P: K (Meena et al., 2014).

7.2 Recommendations for mills and intermediaries

Monitor the intermediary stage: The jute mills should send a team of officials to supervise the activities and arrangements in the purchasing centers before buying crops from those centers. It will help them to procure raw jute of good quality. It will also ensure the transparency of the intermediaries and will help to stop the dishonest activities of middlemen including adulteration or watering the raw jute.

Financial support for the small traders: The private sector can provide short term loans to farmers and small traders. It may help them to buy seeds, raw jute, and other materials of good quality and adequate quantity. It will also ensure the mills to get more supplies.

Introducing IoT and Industry 4.0 to the mills: In the current century, it is almost impossible to maximize profits and ensure the highest production without digitalization and the advancement of technology. All these will help to keep the mills updated about procurement

and market demand. As a result, an optimized result can be obtained by passing and receiving data throughout the entire supply chain.

Demand forecasting: Demand forecasting is essential because it helps to get an insight into the current and future situation of the market. The insight about the market helps to set the production target and helps to manage inventory efficiently. Each jute mill in Bangladesh should have a demand forecasting section to maximize the profits of the business. Comprehensive demand data of national and foreign markets have to be collected for effective forecasting. Considering both trend and ratio seasonality for forecasting may be beneficial for the jute sector. We would like to demonstrate some mathematical formulas that can be beneficial for entrepreneurs and existing jute companies.

For data having a linear trend,

$$\text{Level of current data, } S_t = \alpha \left(\frac{D_t}{I_{t-L}} \right) + (1 - \alpha) \times (S_{t-1} + T_{t-1})$$

Here,

α = Smoothing factor

D_t = Demand of current period

S_{t-1} = Level of previous period

T_{t-1} = Trend value of previous period

L = number of cycles in a period

$$I_t = \text{Seasonality index for current period} = \frac{D_t}{\text{Average demand}}$$

$$\text{Trend value for current period, } T_t = \beta (S_t - S_{t-1}) + (1 - \beta) \times (T_{t-1})$$

Here,

β = Smoothing factor

S_t = Level of current period

S_{t-1} = Level of previous period

T_{t-1} = Trend value of previous period

$$\text{Forecasting for next period, } F_{t+1} = (S_t + T_t) \times (I_{t-L+1})$$

For data having ratio trend,

$$\text{Level of current data, } S_t = \alpha \left(\frac{D_t}{I_{t-L}} \right) + (1 - \alpha) \times \left(\frac{S_{t-1}}{T_{t-1}} \right)$$

Here,

α = Smoothing factor

D_t = Demand of current period

S_{t-1} = Level of previous period

T_{t-1} = Trend value of previous period

L = number of cycles in a period

$$I_t = \text{Seasonality index for current period} = \frac{D_t}{\text{Average demand}}$$

$$\text{Trend value for current period, } T_t = \beta \left(\frac{S_t}{S_{t-1}} \right) + (1 - \beta) \times (T_{t-1})$$

Here,

β = Smoothing factor

S_t = Level of current period

S_{t-1} = Level of previous period

T_{t-1} = Trend value of previous period

Forecasting for next period, $F_{t+1} = (S_t \times T_t) \times (I_{t-L+1})$

Forecasting is just an assumption of demand data by depending on previous demand data, so it is rare that forecasting and actual demand will be the same. There are some well-known methods such as mean absolute deviation (MAD), mean squared error (MSE), mean absolute percentage (MAPE) for finding out the forecasting error. After determining the forecasting error, it is important to dig up the reasons for the errors. Forecasting error may be biased to under or over forecasting. The biasing can be determined with tracking signal.

$$\text{Tracking signal} = \frac{\text{Running signal forecasting error}}{\text{Mean absolute standard deviation}}$$

Thus, demand forecasting helps to deal with the fluctuations in demand of the market; while forecasting error and tracking signal helps to make the process more accurate which may be a great factor for maximizing profitability in the jute sector.

7.3 Recommendations for marketing

Table 10

Production, Export and Import information of jute, 2018

Production			
Area	Quantity (Tons)	Value (\$)	Average
Worldwide	3.9M	2.7B	
India	2.1M	}93% of Global Production	
Bangladesh	1.6M		
Export			
Worldwide	291K	213M	
Bangladesh	229K	158M	
India	14K	-	Average export price \$734/Ton
Tanzania	12.7K	18M	
Belgium	10.5K	-	
Kenya	8.8K	-	
Malaysia	4.6K	-	
Import			
Worldwide	295K	197M	
Pakistan	91K	49M	
India	64K	40M	
Nepal	41K	23M	
China	31K	-	Average import price \$669/Ton
Germany	8.1K	-	
UK	6.1K	-	
Cote d'Ivoire	5.8K	-	
Brazil	5.5K	-	
South Korea	4.5K	-	

Note: Taken from IndexBox AI Platform

This chart represents an overview of overall jute production in 2018. India is a big player of this industry. They are the highest producer of the jute. Despite being in the highest position, they are importing more than exporting raw jute. This is the big market strategy of them. They just convert cheap raw jute to expensive jute diversified product. As this strategy, they get a huge amount of interest from this sector. If we see the condition of Bangladesh, still now we control a huge part of the export market of raw jute. On the other side, there are not enough diversified product industry. For that, Jute exporters are one kind of forced to export most of the raw jute. According to The Financial Express, *‘As many as 28 countries of the European Union (EU) as well as New Zealand and Canada have taken an initiative recently to ban single-use polythene bags in their territories. Some countries like Luxemburg and Denmark have already imposed taxes on these bags. There is a demand for non-plastic bags worth Tk 47.5 billion in the EU alone. When these bans come into force, jute bags can replace plastic bags in these countries as a cheap and environment-friendly alternative. According to the international think-tank ‘Research and Marketing’, the global market for jute bags till 2018 was US\$ 1.80 billion, which is expected to rise to US\$ 3.10 billion by 2024’*. So, it is easily assumed that the demand is increased so high in the near future. It is the high time to plan effectively and also take steps to make a long-term sustainable sector like RMG sector. For that, there are some recommendation-

1. Need a big motivation from the government to make entrepreneurs. Also, search for investors who leads the economy. Their investment can create a huge chance to make a lot of employment and lead this sector. It will also help to make the local market eco-friendly and create an opportunity to earn a lot from the foreign market.
2. Automation is a must to cope up with the growing economy. Set the production rate and increase it every year by improving the ability of production and machinery. Innovative product idea for jute diversified program is also welcomed for this sector. It will help most to grab the local and foreign marketplace.
3. Skilled manpower is mostly needed to meet up the production target. Also, create a lot of promotional center for marketing. Make sure the proper leadership that can only progress this sector.
4. Increase the uses of JDP at every level. Mostly ensure some vital sectors like packaging, tourism, airport, etc. that can engage a lot of environmentally aware people.

8. Prioritizing all the key issues

Analyzing all the secondary data we found that some key issues must have to be taken under consideration at the very beginning. To find out the most important problem an AHP based MCDM analysis has been conducted on the 5 topmost variables like farming, intermediaries, mill management, outdated machinery, and marketing strategies.

According to the AHP analysis, the key issues are ranked with their priorities. The Marketing strategy is the most effecting issue in the jute industry. There is a lot to improve in this field. Then it comes to the internal mill management problems. Especially our mills are not well organized and they cannot provide the best possible output for some of the organizational problems in jute mills. Then the intermediaries, outdated machinery, and farming problems come accordingly (Table 12).

9. Conclusion

Jute, the golden fiber of Bangladesh, has always played a vital role in the economy of the country. Though after independence the jute sector has faced some fluctuations and at present time the sector is not performing up to mark, investment of private sectors can revamp the entire supply chain. The supply chain of jute starts with the farming process of jute and

Table 12

These are the resulting weights based for the criteria based on pairwise comparison

Category		Priority	Rank
1	Farming	4.4%	5
2	Intermediaries	10.4%	3
3	Mill management	22.5%	2
4	Outdated machinery	6.6%	4
5	Marketing strategies	56.1%	1

Note: Consistency Ratio, CR= 3.7%, number of comparisons= 10

undoubtedly farmers are the ones who are the most deprived entities in the whole supply chain. From the cultivation of jute to selling it the farmers face challenges and do not get satisfactory profit, in spite of Bangladesh being an agricultural country. This has to be fixed and the farmers should be provided with better payment policies. The intermediaries are a prominent factor in the jute supply chain. But as the intermediaries are not well-coordinated, they are just adding values to the supply chain. Proper coordination between the farmers and the intermediaries is a must. The jute mills, the manufacturing facilities, needs numerous changes. The whole management system has to be revamped, modern technology should be introduced and the mill owners must have to ensure better working conditions, policy, and payment for the workers. Outsourcing of mills can really be helpful in this respect. There is a large demand for jute in the national and international markets. With diversified products and the marketing strategies demonstrated in this paper, it is highly expected that a large share of the market can be grabbed.

Table 11

These are the resulting weights based on the principal eigenvector of the decision matrix (AHP analysis)

	Farmin g	Intermediarie s	Mill management	Outdated machiner y	Marketing strategies
Farming	1	0.333333	0.2	0.5	0.125
Intermediarie s	3	1	0.333333	2	0.166667
Mill management	5	3	1	4	0.25
Outdated machineries	2	0.5	0.25	1	0.142857
Marketing strategies	8	6	4	7	1

Note: Principal eigen value = 5.166, eigenvector solutions = 4 iterations, delta = 6.7E-8

By connecting all the departments of jute supply chain this paper encourages further comprehensive researches in the respective sector.

To sum up, it is time for the private sector and entrepreneurs to come forward, invest in the jute sector, help the farmers, modernize the manufacturing facilities and create a strong bond

between agriculture and industrialization in order to dominate the market with a well-planned robust jute supply chain, as depicted in this paper.

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