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Competitive Research Grant

Sub-Project Completion Report

on

Value Chain Analysis of Rice and its Byproducts in Bangladesh

Project Duration

May 2017 to September 2018

Agricultural Economics Division
Bangladesh Rice Research Institute
Gazipur-1701, Bangladesh

Submitted to
Project Implementation Unit-BARC, NATP
Bangladesh Agricultural Research Council
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Acronyms

BBS	=	Bangladesh Bureau of Statistics
BCR	=	Benefit Cost Ratio
BRKB	=	Bangladesh Rice Knowledge Bank
BRRI	=	Bangladesh Rice Research Institute
BTC	=	Bangladesh Tariff Commission
DAM	=	Department of Agricultural Marketing
DoRB	=	De-oiled Rice Bran
FC	=	Fixed Cost
FAO	=	Food and Agricultural Organization
FFA	=	Free Fatty Acid
FPMU	=	Food Planning and Monitoring Unit
GDP	=	Gross Domestic Product
GM	=	Gross Margin
GNI	=	Gross National Income
MC	=	Marketing Cost
MMT	=	Million Metric Tonne
MoA	=	Ministry of Agriculture
MoF	=	Ministry of Finance
MoFDM	=	Ministry of Food and Disaster Management
NI	=	National Income
NM	=	Net Margin
Qt	=	Quintal
RBO	=	Rice Bran Oil
Tk.	=	Taka
UN	=	United Nations
VA	=	Value Addition
VC	=	Variable Cost
TC	=	Total Cost

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Executive Summary

The present study was conducted to identify value chains for rice and its by-products (broken rice, dead rice, rice bran, rice husk, rice bran oil and de-oiled rice bran), dominant supply chain, costs and margins and value addition of the different actors. The research project was carried out in ten districts namely; Dinajpur, Naogaon, Kushtia, Bogra, Mymensingh, Jamalpur, Pabna, Rangpur and Jessore in which autometic and semi-autometic rice mills were selected from Dinajpur, Naogaon, Kushtia district and ten rice bran oil mills were selected from remaining seven district where rice bran oil mills are situated intensively. A total of 650 samples (90 farmers, 30 paddy traders, 75 automatic rice millers, 105 rice traders, 45 dead rice traders, 45 Broken rice traders, 45 rice bran traders, 45 rice husk party, 15 rice bran oil millers, 40 rice bran oil dealers, 75 rice bran oil retailers, 24 de-oiled rice bran oil dealers and 40 de-oiled rice bran oil retailers) were purposively chosen from selected district for collecting primary data. Besides, secondary data were collected from FAO, BBS and other secondary sources. Among the rice byproducts, dead rice, broken rice, rice bran and rice husk were found 4.42%, 7.44%, 8.56% and 20% respectively. The average recovery ratio for head rice, dead rice, broken rice, rice bran and husk were 61.00%, 3.51%, 6.49%,8.50% and 20.50% respectively from the automatic rice millers. Bangladesh has produced 52.50 million-tons of paddy, which earned 30.98 million-tons head rice. Other than the head rice, the byproducts are dead rice, broken rice, husk and rice bran which were 2.31, 3.89, 10.50 and 4.46 million-tons, respectively. In the domestic market, about 45% aromatic rice (unpacked) were supplied by millers with the help of aratder, wholesaler and retailer. On the other hand, different companies of Bangladesh (like: Pran, ACI, Pusti and Chashi) collected about 55% of aromatic rice from selected mills. After that these companies processed, packaged and leveled it and sold by their own brand name. Then they marketed about 30% aromatic rice in the domestic market and remaining 25% were exported to the foreign countries. Automatic rice millers supplied 55% of broken rice in the feed industry with the help of the broken rice party. About 90% rice bran were supplied by the millers with the help of bran party. After that bran party, about 65% best quality rice bran were supplied to the rice bran oil mills to produce the bran oil. On the other hand, 55% rice husk were purchased by the husk party from the mill and sold it in the briquettes factories to produce the briquettes. Total production capacity of fourteen surveyed rice bran oil mills was 258000 ton/year where as these mills utilized 67% of the capacity which produced 168,540 ton of rice bran oil. The manufacturing cost of rice bran oil was Tk.176, 206/ton; including value of byproducts (Tk. 89,187). After deducting the returns from by products; actual cost of rice bran oil was Tk. 87019/ton. Two dominant supply chains of rice bran oil (RBO) were:i) Miller > Dealer > Retailer> Consumer and ii) Rice Bran Oil Miller > Company (Pran, Pusti, ACI, Aristocrat > Dealer > Retailer > Consumer. During the period of 2017, fourteen rice bran oil mills produced 168,540-ton rice bran oil in our country where 64.04 % (107940 ton) were supplied in the domestic market and 35.96% (60600.00 ton) were exported to the international markets (specially India, China and Japan). The key problems of RBO were unavailability of adequate rice bran and lack of promotional activities at consumer level. During the period of 2017, fourteen rice bran oil mills produced 674160-ton de-oiled rice bran where 65.21 % (439620 ton) were supplied in the domestic market and 34.79% (234540 ton) were exported to the foreign countries (specially India, China and Thailand).

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project: Value Chain Analysis of Rice and its Byproducts in Bangladesh**
2. **Implementing organization:** Bangladesh Rice Research Institute BRRI Gazipur
3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s):**

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4. Sub-project budget (Tk):
   - 4.1 Total: Tk. **25,00000** (**Twenty-five lac Taka Only**)
   - 4.2 Revised (if any):
5. Duration of the sub-project:
   - 5.1 Start date (based on LoA signed): 15 May 2017
   - 5.2 End date: 30 September 2018
6. **Justification of undertaking the sub-project:**

Value chain analysis is the key framework for understanding how a product moves from the producer to the ultimate users. It describes the full range of activities required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers and final disposal after use (Kaplinsky and Morris 2000). Value chain perspective provides an important means to understand the business-business relationships, mechanisms for increasing efficiency, and ways to enable business to increase productivity and value addition.

Rice is the dominant dietary and staple food in Bangladesh. More than 95% of the population consume rice, which alone provides about 62% calorie and 46% protein of average daily intake (HIES, 2010). About 80 percent of the total arable land is devoted to rice production and it alone occupies 77% of total cropped area in Bangladesh. Present population of the country is about 152.51 million and will swell progressively to 190 million by the year 2030, which will require 42 million tons of food grain with per capita demand of 146 kg/year (BBS, 2016). In fact, rice is the driving force of the economy of Bangladesh. It also ensures political stability for the country and provides a sense of food security to the people. Besides, rural income, employment, nutrition and the market for the industrial output in the domestic economy as well as government's capacity and effectiveness of mobilizing domestic resources and savings are inextricably linked with rice.

Bangladesh has made remarkable progress in rice production through escalating productivity using better genotypes and expanding agrarian capacity which increased total production substantially from 9.77 million metric tons in 19971/72 to 34.35 million metric tons by 2013/14 (BBS, 2014), in spite of the declining trend of arable land.

Paddy, on an average, consists of about 72% of clean rice, 5-8% of bran and 20-22% of husk (Prasad et al., 2000). Most of the paddy varieties produced in Bangladesh contains 60-67% whole rice, 22% husk, 5-8% bran and 1-2.5% broken rice (BRRI, 2009). Bangladesh produced about 51.36 million tons of paddy during 2013-14 from where approximately 34.41 million tons of head rice,3.60 million tons of bran and 12.32 million tons of husk as by-products are being produced (Quayum et al 2015). Rice and food are synonym in Bangladesh and there are multiple uses and applications of its main and byproducts. There are various uses and applications of the by-products of rice. Rice bran oil (RBO) is produced from rice bran which is very useful and beneficial for human health. Rice husk ash which is prepared after burning of husk is being used as a replacement/supplement of cement materials (Rashid, 2015).
Bangladesh is self-sufficient in main cereal-rice production but still huge deficit in edible oil production. It imported 13.44 lakh metric tons edible oil during 2013/14, which was about 85% of total national demand (BBS 2014). Bangladesh has commenced to produce rice bran oil besides oilseeds oil in order to increase edible oil supply of the country. There were 15 rice bran oil mills in operation in the country from where about 0.898 lakh ton of bran oil produced, which was only 35% of total potentiality of the mills due to lack of supply of rice bran (Quayum et al 2015). Total demand for edible oil in Bangladesh is about 14 million tons of which 2-2.5% is coming from rice bran oil (BBS, 2013).

Rice husk is another byproduct of rice which consists of the outermost covering of the rice kernels that is separated from the rice grains during the milling process. In majority of rice producing countries, major portion of rice husk is either burnt for heat or dumped as a waste. In Bangladesh, most of the husk from the rice milling industry is being burnt or dumped as waste in open fields and a small amount is used as fuel for boilers, electricity generation, etc. (RHA market study, 2003). But the usage of rice husk in different sectors; such as power plant, cement and concrete industry, brick production, waste water treatment plant, agricultural industry, cellulosic ethanol production is increasing (www.rmir.edu.au).It is estimated that every ton of paddy produces about 0.20 tons of husk and every ton of husk produces about 0.18 to 0.20 tons of ash, depending on the variety, climatic conditions and geographical location (Prasad et al., 2000 and Bouzoubaa and Fournier, 2001). By-product of rice bran oil (**de oiled rice bran oil-DRBO**) is used as fish, poultry and cattle feed. The use of aquaculture feeds in Bangladesh has grown substantially in recent past, and now over 1 million tons of commercial pelleted feed are being formulated for use by aquaculture farmers. Rapid growth in use of formulated feeds has helped many aquaculture farmers intensify production and gaining financial benefit. Currently, there are 100 commercial feed mills in operation and another 20 are in pipeline. In addition, about 600 small-scale noncommercial and on-farm feed manufacturers producing feed for their own consumption (Ali, 2012) that uses rice bran and de oiled rice bran as component with other ingredients.

From this study we will find out the proportion of head rice, broken rice, husk, rice bran etc. from paddy under automatic rice mills, semi-automatic rice mills and other kinds of milling process. The proportion of different milling process of total paddy production on country context. It will help us to find out the production and marketing scenario of rice bran oil and de-oiled rice bran in our country. A large number of stakeholders are involved with the value and supply chains of rice and rice byproducts in Bangladesh. If the actors are known about the benefit of value chain; they would be able to harvest the gain from improved value creation. Thus, a detailed analysis with the efficient utilization of these value chains would have a potential contribution to the farmers, millers, traders, consumers as well as in the economy of

Bangladesh. However, the findings of this study would be very useful for the researchers and policy makers as well.

7. Sub-project goal:

Document the opportunities and constraints of value chains of rice and its byproducts to explore the consumers demand visualize the existing disposal scenario of rice its byproducts and to promote the economy as well.

8. Sub-project objective (s):

i. To identify major value chains for rice and rice by-products (rice bran and bran oil, rice husk, feeds) in Bangladesh.
ii. To map the different activities of the actors and value addition processes of the respective chains focusing distributional issues as well as costs and margins of the actors involved in the chains.
iii. Sketch the feasibilities and future prospects of value chains of rice byproducts as a new dimension for the economy of Bangladesh.

9. Implementing location (s):

Agricultural Economics Division, Bangladesh Rice Research Institute, Gazipur

10. Methodology in brief:

10.1 Study areas:

The research project was conducted in three districts namely; Dinajpur, Naogaon, Kushtia, where autometic and semi-autometic rice mills are intensively situated compared to other parts of Bangladesh. Ten rice bran oil mills were seleted from seven districts (Bogra,Mymensingh,Jamalpur,Pabna,Naogaon Rangpur and Jessore) where rice bran oil industry are situated intensively.

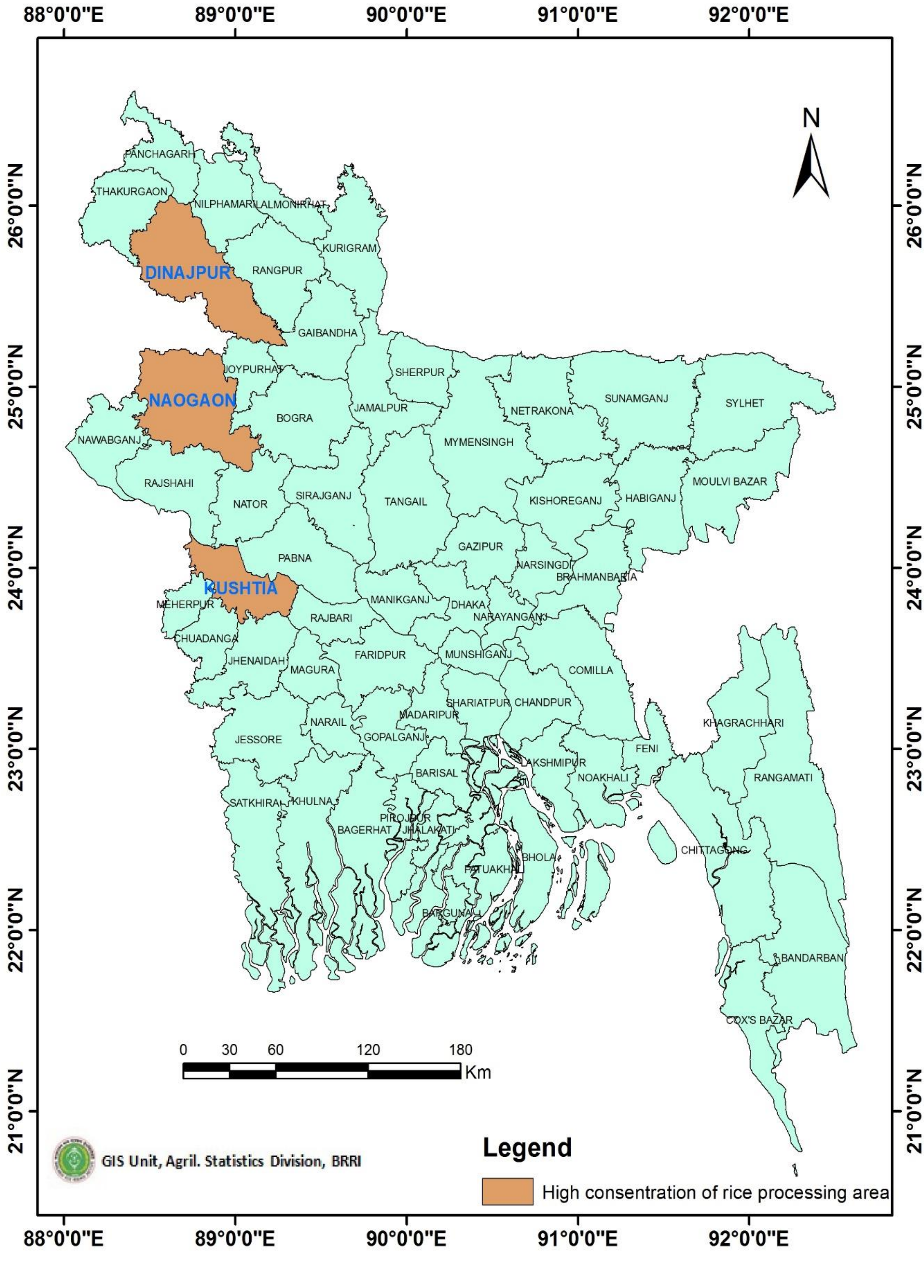

Fig No: 10.1. Map of Bangladesh showing high concentration of rice processing area

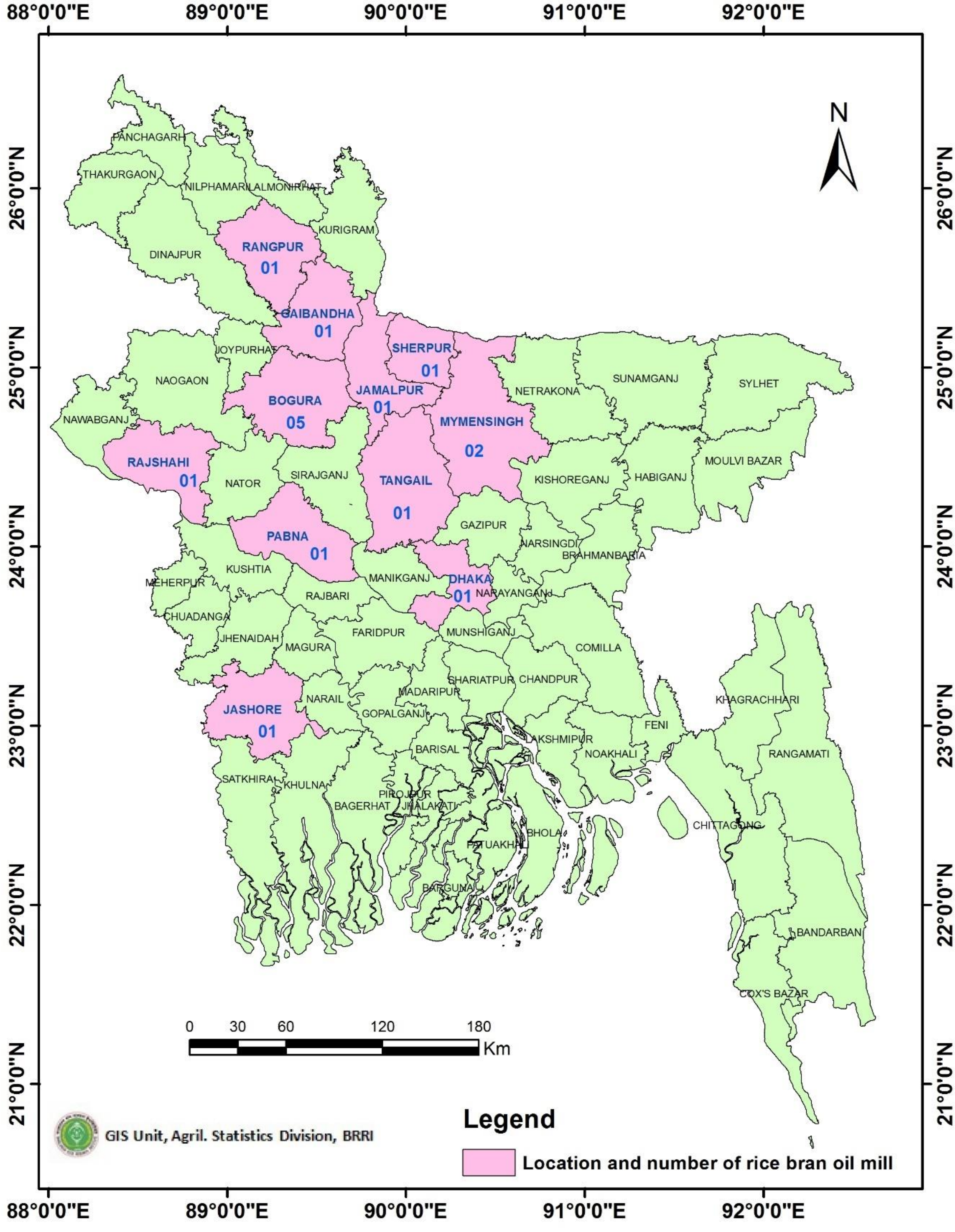

Fig No: 10.2. Map of Bangladesh showing location and number of Rice Bran Oil Mill

10.2 Product items:

Head rice, husk, bran and broken rice information were collected from autometic and semi autometic rice mills.Information on rice bran oil and de-oiled rice bran were collected from rice bran oil industry.

10.3 Head rice and by products of rice: (465 sample)

For this study,90 paddy growers and 30 paddy traders were selected from the selected three districts where 20 paddy growers and 10 paddy traders were selected from each districst.Besides,for head rice and by products of rice (husk, bran, broken rice and dead rice) were selected 75 autometic and sami autometic rice mill from three district where twenty autometic rice mills and five sami autometic rice mills were selected from each district. On the other hand, 105 traders were selected from three districts for head rice where 5 arathder, 10 wholesaler and 20 retailer from each districts proportionately.Besides,160 traders were selected to four by products of rice such as husk, rice bran,broken rice and dead rice where 45 traders were selected from three districts.Similarly, 45 traders for broken rice 45 traders of dead rice and 45 traders for rice bran were selected from three districts.From each district 15 traders were selected for husk, rice bran, broken rice and dead rice.

10.4 Rice bran oil and de-oiled rice bran: (192 sample)

Rice bran oil (RBO) and de-oiled rice bran (DoRB) information were collected from 15 rice bran oil mills from ten districts. For rice bran oil, 112 traders were selected from ten districts where 1 exporter, 5 dealer/wholesaler, 10 retailer were selected from each district {(1+5+10)*7=112}.On the other hand, 80 de-oiled rice bran traders were selected from ten districts where 3 dealer and 5 retailer were selected from each districts {(3+5)*10=80}.

Total sample =Paddy growers (90 sample)+ Paddy traders (30 sample)+ Head rice and rice by products (330 sample) + Rice bran oil and de-oiled rice bran (192 sample)

Total sample =**657**

10.5 Sampling technique:

Both purposive and simple random sampling technique were adopted in selecting the study samples for this research project. For selecting farmers, traders, automatic/semi-automatic rice mill and rice bran oil mill purposive sampling technique was followed. For selecting different types of trader’s simple random sampling technique was applied.

10.6 Value chain analysis:

Kaplinsky and Morris (2001) mentioned that there is no “correct” way or specific methodology to conduct a value-chain analysis; rather, the approaches depend on fundamentally the issue is being explored. The approaches which are generally followed in a value chain analysis are; (a) systematically mapping the actors of value chain, (b) identifying the distribution of benefits of actors in the chain, (c) examine the role of upgrading within the chain and (d) highlighting the role of governance (M4P, 2008). Although, there are several approaches to conduct value chain study; does not mean that all of the tools should be used at all times. The choice of tools to be used (**general, qualitative and/or quantitative**) depend largely on the scope and objective of the analysis itself. However, in the present study mainly survey method were employed to collect data from different stakeholders of the value chains

Table 10.1. Sampling design for the proposed project

Items	Farmers	Paddy Traders	Autometic mill	Semi-autometic mill	Arathder	Wholesaler	Retailer	Bran party	Husk party	Broken rice party	Exporter	Districts	Total Traders	Total miller & farmer	Total Sample
A. Head rice					5	10	20						150		
B. Rice Bran	30	15	10	15	-	-	-	15	-	-		3	45	**75(M) & 90 (F)**	
C. Rice husk									15				45		
D. Broken rice										15			45		
Head rice and rice by products													285	165	450
A. Rice Bran oil			10			5	10				1	7	112	10	
B. De-oiled rice bran						3	5						56		
Rice Bran oil and de-oiled rice bran													168	10	178
Total sample															**628**

Note: M = Millers & F = Farmers.

10.7 Data and Information

Both primary and secondary data were used in this study. Primary data related to producer and traders were gathered from field level through sample survey from the aforesaid locations. The data were collected on production cost, profits, supply chain, marketing cost, marketing margins, marketing constraints, etc from the millers and traders. Secondary data relating to different aspects of production, market development, marketing constraints and other relevant data were gathered from various published sources (e.g. BBS, FAOStat, journal, research reports, thesis, etc.) through in-depth literature review. In addition, focus group discussion (FGD) following in-depth interview system were adopted to collect information from the farmers. Individual key informant interview (KII) system were followed to collect information from other stakeholders along with the value chains of rice with pre-tested, structured questionnaires for specific stakeholders (Farmers, Rice millers, Rice bran oil millers, arathder, wholesaler, retailer, exporter, husk party, bran party, broken rice party dead rice party). Relevant secondary information from various sources were collected as per requirement.

10.8 Analytical tools:

- Conventional profit model was used to evaluate the profitability of rice and rice by products
- Cost and return analysis at millers' level
- Net marketing margin at traders' level

- 'Instantaneous' costs margin method was followed to calculate marketing costs and margins and price spread, etc.

10.8.1 Cost and return analysis

The following profit equation was employed to assess the profitability of paddy and head rice production.

$$\Pi = P_F . Q_F - (TVC + TFC)$$

Where, Π = Profit of producer per unit

P_F = Per unit price of paddy or head rice

Q_F = Quantity of paddy or head rice

TVC = Total variable cost of paddy or head rice

TFC = Total fixed cost of paddy or head rice producer

10.8.2 Marketing performance

Marketing performance was evaluated using different measures of marketing efficiency as described by Shepherd (1972), and Acharya and Agarwal (2004). In the present study, the efficiency of marketing was investigated by examining price spread, Producer's share, Acharya's methods for estimating efficiency. The methods for studying these estimates are given in the following.

$$I. Price\ spread\ =\ Price\ paid\ by\ consumers -\ Price\ received\ by\ the\ Producer$$

$$II. Producers\ share\ (\%) = \frac{\text{Price received by the Producer}}{\text{Price paid by the consumer}} \text{X } 100$$

10.8.3 Value addition by traders

$$Value\ Addition\ =\ Gross\ margin - Marketing\ cost$$

$$Gross\ Margin\ = Sale\ price -\ Purchase\ price$$

$$RP =\ Price\ paid\ by\ the\ consumers$$

The farmer's or producer's share may be defined as the farm value of food expressed as a percentage of its retail price and the ratio of gross marketing margin to retail price gives the share of the middlemen including marketing costs in the consumers price.

$$\boldsymbol{iv})\quad \boldsymbol{Gross\ marketing\ margin}\ (M)\ =\ Retail\ price -\ Farm\ harvest\ price$$

$$(M) =\ P_R\ -\ P_F$$

$$\textbf{Share of the middlemen in consumer's price } (Ms) = \frac{P_R - P_F}{P_F}$$

We know, share of the producer in the consumer's price (Ps) + Share of the middlemen in the consumer's price (Ms) = 1

So, the share of the producers in the consumer's price

$$(Ps) = (1 - Ms)$$

Where,

$Ps = Producer's\ share$

$Ms = Middlemen's\ share$

Producer's share of rice, which is the ratio of net average price received by the producer to the weighted average price of clean rice, bran and husk, was derived using the following formula:

Percentage of producer's share = $\frac{P_{pw}}{P_{rw}}$ x 100

Where, P_{pw} = Producer's price (farm gate price)

P_{rw} = Weighted average retail price of clean rice, bran and husk.

10.8.4 Cost and return analysis

The following profit equation was employed to assess the profitability of aromatic rice production of producers.

$$\Pi = TR - TC$$

Where,

∏= Net return (Tk/ha)

TR= Total return (Tk/ha)

TC= Total costs (Tk/ha)

$$\Pi = \sum Q_y . P_y + \sum Q_b . P_b - \sum_{i=1}^{n} (X_i . P_{xi}) - TFC$$

Where, ∏= Net returns (Tk/ha);

Q_y = Total quantity of (paddy) output (kg/ha);

P_y = Per unit price of (paddy) output (Tk/kg);

Q_b = Total quantity of the concerned byproduct (kg/ha);

P_b = Per unit price of the relevant byproduct (Tk/kg);

X_i = Quantity of the concerned ith input;

P_{xi} = Per unit price of the relevant ith input;

TFC = Total fixed cost involved in production process;

$i = 1,2,3,\ldots,n$ (Number of inputs)

Value addition by traders

$$Value\ Addition\ =\ Gross\ margin - Marketing\ cost$$

$$Gross\ Margin\ = Sale\ price -\ Purchase\ price$$

$$RP =\ Retail\ price$$

10.8.5 Determination of costs and margins of rice bran oil (RBO)

Total costs of rice bran oil processing consist of fixed costs and variable costs, $TC\ =\ FC +\ VC$.

Where,

$TC\ =\ Total\ costs$

$FC\ =\ Fixed\ costs$

$VC\ =\ Variable\ costs$

$$\begin{aligned}\boldsymbol{Fixed\ cost}\ =\ & Opportunity\ cost\ of\ land\ +\ Staff\ salary/administrative\ (management) cost \\ & +\ Depreciation\ of\ machinery\ +\ Depreciation\ cost\ of\ building \\ & +\ Interest\ on\ investment\ of\ building\ costs \\ & +\ Cost\ of\ interest\ on\ operating\ capital\end{aligned}$$

$$\begin{aligned}&\boldsymbol{Variable\ Costs} \\ &\quad =\ Costs\ of\ bran\ + Chemical\ costs\ +\ Labor\ cost +\ Repair\ and\ maintenance\ cost \\ &\quad +\ Electricity\ cost +\ Tax +\ Cost\ of\ lubricants\end{aligned}$$

During the rice bran oil production, it produces some other byproducts; like de-oiled rice bran, wax, free fatty acid and gum, etc. Some revenues are generated from these byproducts. So, to determine the final cost of production, theses revenues should be deducted from the total costs of RBO.

$$\textbf{Net}\ \boldsymbol{cost\ of\ rice\ bran\ oil\ (RBO)}\ =\ (Fixed\ cost\ +\ Variable\ Cost) - Total\ revenue\ of\ by\ products$$

After production of RBO, it requires some marketing costs. So, these costs also should be included into the total costs of rice bran oil.

$$\boldsymbol{Total\ production\ and\ marketing\ costs}\ =\ Production\ Cost\ +\ Marketing\ Cost$$

10.8.6 Capacity utilization of rice bran oil mill

$$\%\ \boldsymbol{of}\ \textbf{Capacity utilization}\ = \frac{(\text{Actual production of rice bran oil mill})}{\text{Total production capacity of rice bran oil mill}} \times 100$$

11 Results and discussion:

11.1.1 The Present Scenario of the Rice Processing Industry of Bangladesh

The rice milling or processing sector in Bangladesh is undergoing a revolution. Due to rise in the income levels, people now prefer processed rice, which is less costly, looks glossy, takes less time to cook, is free from stones and dead rice, and has longer shelf life. To match with the demand of the people, new automatic rice mills are being set up at a mounting rate, increasing competition for thousands of small and medium husking mills. Automatic rice mills may have an impact on the performance of the rice selling system. On the other hand, many husking mills are withdrawing which is decreasing the market share for the small millers. Over the previous decade, hundreds of automatic and semiautomatic rice mills have been established in different rice producing regions of Bangladesh. Naogaon, Chapainawabganj, Dinajpur, Kushtia and Jessore are some districts that have involved investment in establishing large automatic rice mills. More investments are coming up for placing new auto rice mills (The Daily Star, 2011). In 2005, around 500 automatic and semi-automatic rice mills together with 17000 husking mills had been in operations which were also involved in parboiling, drying and crushing paddy bought from farmers. Of these mills, more than 350 operators had their own brand rice in the market. Bangladesh Auto, Semi-auto and Husking Mills Association has around 17,000 members. These mills process and market at least 60 percent or three crore tons of the five crore tons of paddy produced a year in the country. The farmers keep the rest of the production for their own consumption. On average the cost of milling and processing of rice stands at around Taka 50,000 crore in a year (The Daily Star, 2015). According to the provisional data by the Bangladesh Bureau of Statistics (BBS), it has been reported that in FY2015, the production of milled rice reached a record high of around 34.708 million tons, a little up from approximately 34.41 million tons in FY2014 (Rice Outlook, 2015).

11.1.2 Scenario of rice processing by automatic rice mill in Kushtia, Dinajpur and Naogaon Districts

It was evident from table 11.1.1 that, 75 auto rice mills processed 1960.00-thousand-ton paddy in Kushtia, Dinajpur and Naogaon districts where millers found head rice 1174.55 thousand-ton, dead rice 83.74 thousand-ton, broken rice 146.62 thousand-ton, rice bran 166.62 thousand-ton and husk 392.04 thousand-ton. On an average conversion ratio of head rice and rice byproducts were found 59.56% and 40.44%, respectively. Among the byproducts, dead rice, broken rice, rice bran and rice husk were found 4.42%, 7.44%, 8.56% and 20%, respectively.

Table 11.1.1 Rice processing scenario of automatic rice mill in the study area in 2017

(000 ton/year)

Districts	Types of Paddy	Paddy	Head rice	Dead Rice	Broken rice	Bran	Husk
Kushtia (25 mill)	Parboiled	533.81	325.62	20.82	37.37	45.37	106.76
	Aromatic	72.79	37.85	5.10	8.01	6.19	14.56
	Sub total	**606.60**	**363.47**	**25.91**	**45.37**	**51.56**	**121.32**
Dinajpur (25 mill)	Parboiled	562.85	343.34	21.95	39.40	47.84	11.26
	Aromatic	76.75	39.91	5.37	8.44	6.52	15.35
	Sub total	**639.60**	**383.25**	**27.32**	**47.84**	**54.37**	**127.92**
Naogaon (25 mill)	Parboiled	628.32	383.28	24.50	43.98	53.41	125.66
	Aromatic	85.68	44.55	6.00	9.42	7.28	17.14
	Sub total	**714.00**	**427.83**	**30.50**	**53.41**	**60.69**	**142.80**
3 Districts (75 mill)	**Total**	**1960.20**	**1174.55**	**83.74**	**146.62**	**166.62**	**392.04**
% share	**-**	**100%**	**59.56%**	**4.42%**	**7.44%**	**8.56%**	**20%**

Source: Authors' calculation. Rice mills survey 2017-18

11.1.3 Availability of rice and its by-products in Bangladesh

The availability of rice and its byproduct has been measured according to the estimated percentage share of paddy found in the survey results of the study area. The percentage shares of head rice and rice byproducts are in the bottom row of the table 11.1.1. This study used this share to the rice statistics of the Food and Agriculture Organization (FAO) to find out the available amount of head rice and rice byproduct in Bangladesh.

Data in table 11.1.2 reveal that during 2016-17 period, Bangladesh has produced 52.50 million-tons paddy, which earned 30.98 million-tons head rice. Other than the head rice, the byproducts are dead rice, broken rice, husk and rice bran that produced 2.31, 3.89, 10.50 and 4.46 million-tons, respectively. The rice bran has been used to produce crude rice bran oil. Here, 4.46 million-tons rice bran can produce 0.98 million-ton crude rice bran oil, from which about 0.92 million-ton refined rice bran oil could be obtained.

Table 11.1.2: Availability of rice and its byproducts in Bangladesh

Items	% of share	Year 2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Paddy	100	49.86	50.06	50.58	50.50	51.28	51.64	52.00	52.50
Rice	**59.56**	**29.42**	**29.54**	**29.84**	**29.80**	**30.26**	**30.47**	**30.68**	**30.98**
Dead rice	4.42	2.19	2.20	2.23	2.22	2.26	2.27	2.29	2.31
Broken Rice	7.44	3.69	3.70	3.74	3.74	3.79	3.82	3.85	3.89
Husk	20	9.97	10.01	10.12	10.10	10.26	10.33	10.40	10.50
Rice Bran (RB)	8.56	4.24	4.26	4.30	4.29	4.36	4.39	4.42	4.46
Crude rice bran Oil (CRBO)	22 of RB	0.93	0.94	0.95	0.94	0.96	0.97	0.97	0.98
Rice Bran Oil	**94 of CRBO**	**0.88**	**0.88**	**0.89**	**0.89**	**0.90**	**0.91**	**0.91**	**0.92**

Data source: FAOSTAT, Authors' calculation. Note: all figures are in million-ton unit.

11.1.4 Conversion ratio of rice and its byproducts under different types of rice in selected areas

Although the conversion ratio of paddy in to head rice and rice byproduct are estimated in table 11.1.1, a question has been raised about the conversion ratio according to the grain type. There is no doubt that the conversion ratio in table 11.1.1 is enough to represent the national scenario. However, this study has shown the conversion ratio according to the grain type in table 11.1.3 in addition. It was evident from table 11.1.3 that, in Kushtia district conversion ratio of course rice to head rice, dead rice, broken rice, rice bran and rice husk were 62%, 3.50%, 6.50%, 8.5% and 19.50%, respectively. conversion ratio of fine rice to head rice, dead rice, broken rice, rice bran and rice husk were 60.5%, 3.50%, 7.50%, 8.5% and 20.50%, respectively and that of aromatic rice were 53.0%, 4.50%, 12.50%, 8.5% and 20.50%, respectively. On the other hand, on an average same result was found in the Dinajpur and Naogaon districts. Broken kernels reduce milling yield. Broken produced during milling are generally the result of immature, chalky, or fissured kernels, all of which are weak and typically break during milling due to the substantial forces imparted to kernels in order to remove bran.

11.1.3 Conversion ratio of rice and its byproducts different types of rice in selected areas

Districts	Types of rice	Percentage				
		Head rice	Dead rice	Broken rice	**Bran**	Husk
Kushtia	Course rice	62	3.5	6.5	8.5	19.5
	Fine rice	60.5	3.5	7.5	8.5	20.5
	Aromatic rice	53.0	4.5	12.5	8.5	21
Dinajpur	Course rice	62	3.5	6.5	8.5	19.5
	Fine rice	59.5	4	7.5	8.5	20.5
	Aromatic rice	53.5	4.5	12.5	8.5	21
Naogaon	Course rice	62.5	3.5	6.0	8.5	19.5
	Fine rice	58.5	4	7.5	8.5	20.5
	Aromatic rice	54.5	4.5	12.5	8.5	21

Source: Rice mills survey 2017

11.1.4 Using pattern of Rice and rice byproducts in Bangladesh

The commonly use of rice and its byproducts in Bangladesh are explained in this section. However, rice and its byproducts are being used for different important purposes. The using pattern of rice and its byproducts is mentioned briefly in the figure 11.1.1

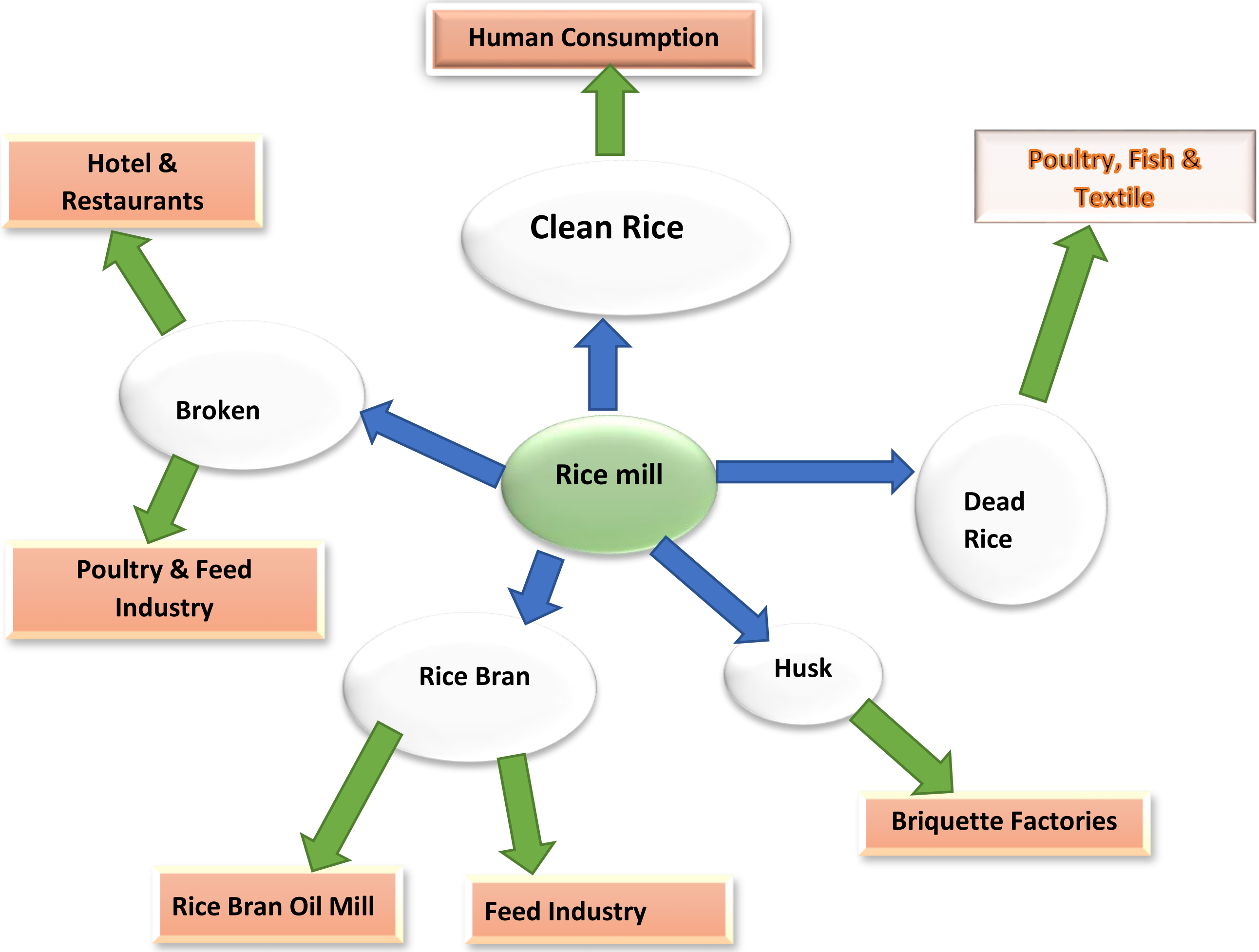

Fig: 11.1.1 Using pattern of rice and its byproducts

11.2 Value Chain Analysis of Rice in Bangladesh

11.2.1 Introduction

Bangladesh is one of the world's top rice-consuming countries. The per capita rice consumption stood at 196.6 kilograms in 2016 and 196.3 kilograms in 2017 (The University of Arkansas, 2017). Rice is the most important cereal and staple food which provide more than 70 percent of the total calorie intake in Bangladesh (Zaman, Mishima, Hisano, & Gergely, 2001). In Bangladesh there are three seasons of rice production namely Aus (summer), Aman (winter) and Boro (spring). The aggregated production of Aus (2.6 million MT), Aman (13.2 million MT) and Boro (18.7 million MT) paddies has been estimated to be 34.5 million metric tons (MT) in FY2016 by using a total of 11.77 million hectares of land (Lagos & Hossain, 2016) which is more than 75 percent of total cropped land (BARC, 2011). However, after harvesting paddy from the crops field, it needs to be processed for consumption. The value chain of rice is the sequence of events from its production to processing, then down to its marketing and consumption. The rice input suppliers, rice producers, and the marketing channels usually compose the basic value chain processes for a rice subsector. The variety of seed is the most important input of the rice industry. Rice is supplied mainly to retail markets, groceries, and to public markets to make available to the consumers. The industry's value chain uses wide-ranging labor. Upon paddy production, a pre-requisite to a good and efficient marketing system is the ability of the producers to decide on the best way to store and move their products down to their market destinations. Rice value chain concentrates on the linkages between each of the actors (rice miller, Faria, Bepari, wholesaler, retailer, and consumer) along with the value chain, from input supplies up to the ultimate consumers including actors associated with marketing and processing. It also concentrates on a detailed breakdown of the costs, profits and margins, the key constraints and linkages at each level of the chain. A long value chain and huge costs and margins derived by the actors are the main causes for its price instability. The value chain analysis would help making appropriate marketing strategy and pricing policy of rice in the country.

11.2.2 Inputs use pattern for rice cultivation

Farmers mainly use hired labor on contractual basis for the three major labor-intensive intercultural operations such as transplanting, harvesting and carrying. They also hired labor on daily wage basis for other intercultural operations such as land preparation, weeding, and post-harvest processing. Besides, most farmers rely on power thresher for threshing rice on custom hired basis. The highest number of human labor (121 man-days/ha) was used for Boro cultivation followed by T. Aman (103 man-days/ha) and Aus (101 man-days/ha). The seed rates for Aus, T. Aman and Boro rice were 35, 36 and 40 kg/ha, respectively. Farmers' rate of urea application was much higher than the BRRI recommendation in all seasons. Rate of TSP application in Aus season was much higher than BRRI recommendation, whereas, it was mostly accurate in Boro and Aman season. On the other hand, farmers' rate of MoP application was much lower than BRRI recommendation in all seasons (Table11.2.1).

Table11.2.1. Per hectare Input used for rice cultivation in different seasons in the study area, 2017-18

Input Items	Season		
	Aus	Aman	Boro
Human Labour (man-day/ha):	101	103	121
Hired	47	41	45
Family	16	17	18
Hired contract (transplanting and harvesting)	40	48	59
Seed (kg/ha)	35	36	40
Fertilizer (kg/ha):			
Urea	157 (135)	176 (170)	234 (202)
TSP	77 (52)	88 (60)	110 (90)
MoP	62 (82)	74 (97)	128 (165)
DAP	23	9	25
Gypsum	26	37	48
ZnSo4	5	8	8
Mg	0	3	6
Theovit	3	3	4

Note: Figures in parentheses indicate BRRI recommended doses. Source: Field survey, 2017-18

11.2.3 Costs of Cultivation

Per hectare cost of hired labor were Tk. 15,750; Tk. 16,800 and Tk. 18,200 for Aus, T. Aman and Boro rice cultivation, respectively. Fertilizer cost of Boro (Tk. 9,834/ha) was higher than that of Aus rice (Tk. 7,079/ha) and T. Aman (Tk. 7,138/ha). Irrigation cost was much higher (Tk. 17,240/ha) for Boro rice than that of Aus (Tk. 2200/ha) and T. Aman (Tk. 1,485/ha). Per hectare variable costs was Tk. 61,749, Tk. 59,367 and Tk. 90,324 for Aus, T. Aman and Boro rice cultivation, respectively (Table 11.2.2).

Table11.2.2. Per hectare cost of rice cultivation in different seasons in the study area, 2017-18

Input-wise cost (BDT/ha)	Cost in Tk./ha		
	Aus	Aman	Boro
Seedling development	2,458	2,354	2,682
Seed	1,672	1,845	2,000
Tillage	5,960	5,960	5,960
Human labour	43,392	42,325	49,437
Hired	15,750	16,800	18,200
Family	6,300	7,000	7,350
Hired contract (transplanting and harvesting)	21,342	18,525	23,887
Fertilizer cost	**7,079**	**7,138**	**11,034**
Irrigation	2,200	1,485	17,240
Herbicide	340	442	720
Pesticides	2,060	1,843	3,955
Power thresher	4,560	4,820	7,846
Total variable cost	**61,749**	**59,367**	**90,324**
Interest on operating capital	1,029	989	1,505
Rental charge	14,320	22,330	22,320
Total fixed cost	**21,649**	**30,319**	**31,175**
Total cost	**83,398**	**89,686**	**121,499**

Source: Authors' calculation

11.2.4 Profitability

The yield of Boro rice (5,883 kg/ha) was higher followed by T. Aman rice (4,621 kg/ha) and T. Aus rice (4,262 kg/ha). Despite of higher yield, gross margin of Boro rice (Tk. 21,391/ha) was lower than that of T. Aman rice (Tk. 47,704/ha) and T. Aus rice (Tk. 29,803/ha). It can be noted that the farmers obtained higher return from T. Aman and T. Aus rice due to low production cost and higher farm gate price of paddy. The benefit cost ratio (BCR) on cash cost basis of T. Aman was higher (1.8) followed by T. Aus (1.5) and Boro (1.2) (Table11.2.3).

Table11.2.3. Per hectare cost and return of rice cultivation in different seasons in study area, 2017-18

Items	Aus	Aman	Boro
Total costs (BDT/ha)	83,398	89,686	121,499
Total paid-out cost costs (BDT/ha)	61,749	59,367	90,324
Total imputed cost (BDT/ha)	21,649	30,319	31,175
Yield (kg/ha)	4,262	4,621	5,883
Market value of paddy (BDT/ha)	85,240	94,731	102,953
Market value of straw (BDT/ha)	6,312	12,340	8,762
Gross benefit (BDT/ha)	91,552	107,071	111,715
Gross margin (BDT/ha)	29,803	47,704	21,391
Net return (BDT/ha)	8,154	17,384	-9,785
Unit price of grain (BDT/kg)	20.0	20.5	19.5
Unit cost of production (BDT/kg)	19.6	19.4	20.7
BCR (cash cost basis) (Undiscounted)	1.5	1.8	1.2
BCR (full cost basis) (Undiscounted)	1.1	1.2	0.92

Source: Authors' calculation

11.2.5 Average selling price of paddy producer

In data table 11.2.4 show the variety and season wise price of paddy in Kushtia Dinajpur and Naogaon district, respectively, in different period (harvest season and off-season-two months later after harvest) at farmgate. It is understood that considering the prices by variety would be more useful in comprehending how paddy prices vary in Bangladesh depending on variety.

Table 11.2.4: Average farmgate price of paddy in different districts under the study: 2017

Districts		Boro		Aman		
		Coarse rice (Tk./ql)	Fine rice (Tk./ql)	Coarse rice (Tk./ql)	Fine rice (Tk./ql)	Aromatic rice (Tk./ql)
Kushtia	Harvest Season	2200	2570	2300	2625	3950
	Off-season	2450	2780	2530	2800	4160
Dinajpur	Harvest Season	2200	2570	2300	2625	3950
	Off-season	2450	2780	2530	2800	4160
Naogaon	Harvest Season	2200	2570	2300	2625	3950
	Off-season	2450	2780	2530	2800	4160

Source: Field Survey 2017-2018

As it was evident from the tables, in both seasons (*boro= dry season* and *aman= wet season*) there was a positive relationship between paddy prices and time of scale. This was true for all varieties. It was further evident from the tables that, the prices of all varieties were not same. Price differences were more prominent among varietal differences; such as course to medium or fine variety. Presumably, prices for the course were the lowest and the prices for the fine variety were the highest.

11.2.6 Intermediaries in the paddy/rice marketing and their characteristics

Chains of intermediaries are often active in the paddy/rice marketing in Bangladesh. The actors of the marketing chain are *faria, bepari* and paddy *aratdars,* rice millers, assembler, wholesalers and retailers. As enough information are not available on these intermediaries due to their reluctance to provide the necessary data, however, some major issues concerning them are discussed for the understanding of the role and importance of these intermediaries in the marketing channel. The following discussion is mainly based on the average data of Dinajpur, Naogaon and Dhaka city.

11.2.6.1 *Faria and bepari*

In Bangladesh/South Asian literature on food marketing, there is a slight distinction between *faria and bepari* which is based on their scale of operation (Baulch et al. 1997). In some studies, they are categorized as different kinds of agents, and in some studies, they are classified in the same category. There are no particular guidelines from the Department of Agricultural Marketing (DAM) on their function for us to follow. In Dinajpur district they use the term *bepari* and in Naogaon district both the term *bepari* and *faria* were used.

Faria/ beparis are the non-licensed small-scale paddy assemblers operating mainly in the village market. They do not have permanent business premises, travel from village to village and purchase paddy from the growers directly. Sometimes they also buy paddy from the village market. Some members of this group also work as agents for the paddy *aratdar*. They are mostly seasonal. Some of them had other occupations such as small size of farming, selling labors to others and similar activities. On average, they need Tk. 50,000 monthly to operate. Generally, they operate their business with their own capital. Normally they sell their purchased amount to the paddy *aratdar* at the same day of purchasing and sometimes they brought the paddy directly to the millers. They use *rickshaws* and vans for transporting paddy from the grower's house to their own house and from their own house to the market if necessary and store paddy from two to six days (up to next *hat* day) at their house. The monthly transactions of these paddy assemblers vary from 3-10 tonnes of paddy.

11.2.6.2 Paddy *aratdar*

Paddy *aratdars* are the commission agents who generally work for the millers. They have permanent business premises in the upazila market. Generally, they purchase paddy from the upazila market. Some of the *aratdars* buy paddy directly from the growers on the understanding that the growers can ask them for cash any time when desired.

In general, *aratdars* get capital from the millers. They supply paddy to the millers within 3 to 7 days of taking an order. Those *aratdars* who work for millers have little freedom in their purchasing and selling decisions. They follow the decisions of the millers. All time they stay connected with the millers to take decision whether they will purchase the paddy or not at the prevailing prices. They purchase about 25% of paddy from the farmers and the rest from the *bepari/paikar*.

On average, *aratdar*s get Tk. 1, 50,000 in advance from the millers for purchasing paddy and the rest, if any; they receive after delivering the full quantity of paddy. Millers bear all the expenses of buying paddy. They come to the *aratdars* premises for taking paddy for delivery and sometimes *aratdars* send the purchase volume through truck or other vehicles along with the buying receipt and after that the millers pays the rest amount of money. In return for the service, *aratdars* receive Tk.5 for each 40-kg of paddy as commission. The *aratdars* store paddy for a few days, if undelivered, at their business premise. The average period of storage varies from 3 to 7 days. They handle more than 2500 tonnes of paddy annually and their annual income ranges between Tk. 250000- Tk. 300000 after deducting their fixed costs and personal expenses.

11.2.6.3 *Dalal*

Dalals are the commission agents. They buy the paddy neither directly from the farmer nor from the other traders. Instead, they act like an intermediary between the buyer and seller. They always charge a fixed commission from both the parties (Tk. 2.0 – Tk. 3.0 per mound) for providing the services. Normally they act between medium farmers and millers and between large framers and millers. In Dinajpur district they were found but not in all the *hat* that were surveyed. Researcher found 9 dalals in two *hats* of that district.

11.2.6.4 Rural retailer

Rural retailers who are locally known as *kutials* in Naogaon district are the seasonal rice retailers. These small traders purchase paddy from the growers directly at the village market. Parboiled and dried at the home yard by family labor. The dried paddy is then taken to the small rice mills situated nearby close to the village market for milling. For milling the paddy, rice millers charged tk.20 per mound from the kutials. After milling, they sell the rice to the village consumers during the weekly (*hat*) and daily bazaar days. Their monthly transactions vary from 0.9 to 1 tonne of paddy. In general, marginal and landless growers, and rickshaw or van pullers are involved in this type of business. These rice retailers also work for the *aratdars* as daily laborers.

11.2.6.5 Marketing functions by rice millers

When the paddy is harvested from field, it needs to be processed for consumption. Parboiling, drying and milling are the different stages of rice processing. These are done both at home (small scale) and at the rice mills (large scale). Processing at home, the non-commercial sector of milling is perhaps the oldest and almost obsolete form of rice processing method in Bangladesh. Paddy is also processd by *dheki*[1] after it is parboiled and dried. Paddy processing and milling in Bangladesh is mostly performed at the rice mills. These mills are called commercial milling center. There are two kinds of commercial mills available in Bangladesh: one type is the rice miller those purchase paddy directly or through their agents from the local bazaar or *hat.* In these facilities, after parboiling, drying and milling the paddy, they usually supply the milled rice (finished products) to the wholesalers and assemblers of the big cities. On the other side, after parboiling and drying the paddy at home facility, the processed paddy is milled for finished rice in a small husking machine that situated in the nearby village bazaar. These huskers also husk paddy for the small itinerants traders of the village. Recently vendor huskers are also available in the villages.

Number of commercial rice millers is increasing over the years. These commercial- processing units have been playing a significant role in the rice marketing system. Three types of rice mills are available in Bangladesh. According to the Ministry of food (FPMU,1999), these are husky, major and automatic rice mills. For this study

1 A wooden made instrument, 2.5 meter long and 20-cm^2, balanced like a seesaw on a bamboo fulcrum. This is the *Dheki*, the tool the village women use to husk rice. During the husking, women push one end with her foot, so that the other end, fitted with a wooden peg, rises and falls on the rice grains in a hole scooped in the kitchen's earthen floor. The pounding breaks the outer husks, leading the inner kernels intact (Hartmann and Boyce 1990)

a total of 11 mills were randomly selected from Pulhat (Dinajpur) and Naogaon Sadar Upazila (Naogaon) amog them 7 were auto rice mill and the rest 4 were husky rice mill.

Data were collected on different aspects. It was difficult to receive data from the rice millers. Initially they were suspicious about the purpose, after repeated request and explaining the purpose clearly to them they agreed to talk with the researcher but in some cases the millers did not respond according to the need. To overcome some of these problems, the researcher had also accumulated some detailed information from a single auto rice miller. Though there might be some limitations in the analysis and the sample numbers might not symbolize the whole Bangladesh, this efforts will provide a good overview on the functions and characteristics of the commercial rice mills of the study area yet.

11.2.6.5.1 Rice millers as paddy purchaser

Rice millers in the study areas are the most significant members of the marketing system. In fact they play a vital role in paddy purchasing and selling operations. They buy paddy either directly or through the *aratdar*, a commission agent. These commission agents get capital (money) in advance from the millers for suppling paddy to the mills. The amount of money varies from mill to mill. *Aratdar* supplied paddy to the mill within 3-7 days of purchasing paddy. How much paddy would be purchased and at what prices was the decision of the millers and controlled by them. On average the rice millers need Tk. 10 crore annually to purchase paddy.

After receiving money, *aratdars* are to maintain liasion with the millers for necessary direction on paddy purchasing process. Milllers follow closely the information of nearby markets about the price and volume of paddy transacted at each market in the *hat* day. This information helps the millers to order their suppliers on further line of action. Based on the direction, *aratdars* supplied the desired quantity of paddy to the millers and receive a fixed commission (Tk. 5 per mound) from the millers. Generally, millers bear all the purchasing cost. No risk is involved for the *aratdars* for purchasing and delivering the paddy at the mill gate.

Aratdars are not only the suppliers of paddy to the millers but also the millers purchase paddy from growers and *bepari/faria* also. Data in table 11.2.5.1 show the sources of paddy supply to rice mills by area. The table suggests that, in all areas, commission agents mainly supply paddy to rice mills. A detailed discussion on the millers' pattern of paddy purchasing is discussed below and the following discussion will provide some ideas about the role of rice millers in the paddy/rice marketing system.

Table 11.2.5.1: Sources of supply of paddy to rice mills in the study areas (%)

	Share of paddy supplied to the millers by			
Locations	**Growers**	***Faria/Bepari***	***Aratdars*/Commission Agents**	**Total (%)**
Dinajpur	15.83	6.67	77.50	100
Naogaon	15.00	5.00	80.00	100
Kushtia	14.50	5.50	80.00	100
All	15.41	5.83	78.75	100

Source: Field Survey 2017-2018

The milling procedure of husky and automatic mills differs. These are explicated bellow:

Autonneatic rice mills use modern techniques for paddy processing. The paddy is pre-cleaned before soaking in water at high temperature and parbioled under pressure by steaming. Then the steamed paddy is dried in dryer and husked in a rubber roll huller or disc huller. The unhusked paddy is seperated from the brown rice by a paddy seperator and is recycled back to the huller. Brown rice polished by a cone type polisher, engleberg operated roller polisher. Milled rice is graded according to head rice, large broken, small broken rice and processed at least 2 tonnes per hour.

Husky rice mills do some polishing in addition to husking mostly by using two or more passes through hullers to grind off some of the bran after husking. These mills usually produce four types of products: milled rice, some broken rice, rice bran and husks. Major differences among these mills are presented in table 11.2.5.2.

Table 11.2.5.2: Major differences between automatic and husky rice mills

Types	Major components	Capacity	Power Requirement	Hulling/Polishing	Bran Separation and Grading
Automatic	Pre-cleaner, Soaking Tank Boiler, Steam, Pressure Parboiled Dryer, Rubber Roll Sheller, Paddy Separator Pollisher, Bran Separator etc.	2 tonne/hour	65-100HP	Separately by different devices	All activities mechanically
Husky	Soaking Tank, Steam Parboiled Drying Floor, Engleberg Huller.	0.6 to 1 tonne/hour	30-40HP	2 to 3 operations	Manually

Source: Rahman (1998); Baqui, Miah and Ahmed (1994)

11.2.6.5.2 Distribution of rice from the major mills in the study areas

The millers generally market the milled rice through private commercial channels. When a miller enters into the market, he sells the product directly to the assembler or wholesaler-cum- *aratdar* at the terminal market, or sells to the visiting traders from outside the local market (Rahman 1998). In case of this study, the researcher found that millers mainly sell rice to the wholesaler-cum- *aratdar* or to the rice assemblers of Dhaka, Chittagong, Feni, Munshigong, Narayangong, Noakhali and Faridpur. In case of Dinajpur, most of the milled rice was sold to Chittagong, Noakhali, Faridpur and Feni and in case of Naogaon district most of the rice was sold to Dhaka (70%), Chittagong, Narayangong, Faridpur and Munshigong. From Dinajpur district not a signicant amount of rice come to Dhaka. It is because, from Kustia, Naogaon, Mymensingh and Comilla a good amount of rice come to Dhaka. The average distance between the millers and these areas varies from 200 to 680 kilometers (km). Rice is transported by truck in those areas because of good road conditions. There are several reasons for selling rice in these areas, such as excellent transaction, opportunity to sell large volume at a time. Moreover, traders usually come to the mill site; consequently, the millers are safe from the risk of hijack at the road and other hazards.

Table: 11.2.5.3 Trading scenario of parboiled and aromatic rice in the study areas (in '000' tones)

Districts	Parboiled rice		Aromatic rice	
	Own District	Other Districts	Own District	Other Districts
Kushtia	55356 (15%)	443061 (85%)	5678 (13%)	32174 (87%)
Dinajpur	58367 (17%)	467164 (83%)	5987 (15%)	33924 (85%)
Naogaon	65157 (14%)	521506 (86%)	6683 (14%)	37871 (86%)

Source: Mills Survey 2017. Note: Figures in parentheses indicate share in the district.

11.2.6. Retailers

Retailers are the last intermediary of the rice marketing system through which rice flows to the consumers. In fact, retailers have permanent shops. Retailer in Dhaka city purchase rice from the Wholesalers-cum-*aratdar* and from the wholesaler and sell directly to the consumers. In the study area, retailers buy rice directly from the millers and sell to the consumers.

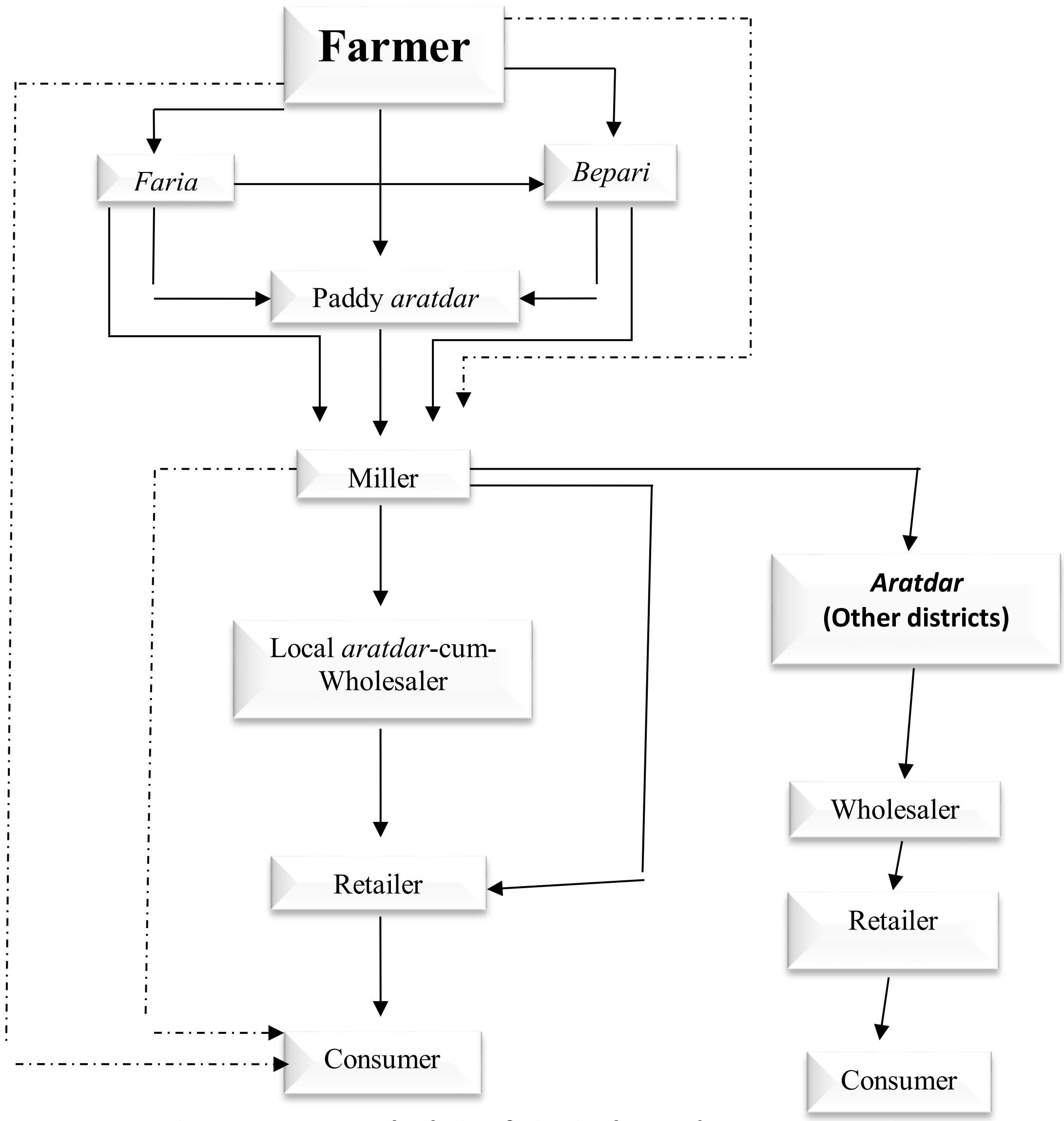

Figure 11.2.1: Supply chain of Rice in the Study Area

Note: ………….indicates less important channel.

11.2.7 Supply chain of course and fine rice

The Bangladesh rice marketing channel usually consist of two segments. First segment includes supplying paddy from the farm level to the millers/processors and the second segment includes supplying rice from the millers/processors to the ultimate consumers. The first segment in supplying paddy included *Farias*, *Beparies, Aratdar* and rice millers. On the other hand, actors included in the second segment are rice miller, *Aratdar, Bepari* or wholesaler and retailer. Various types of marketing channels are shown in Figure 11.2.1.
On the basis of the importance given by the respondents during their selling of paddy/rice in the study areas, the following supply chains were identified in case of course and fine rice marketing.

i: Farmer > Faria > Paddy arathder > Miller > Arathder (rice) > Wholesaler > Retailer > Consumer

ii: Farmer > Bepari > Paddy arathder > Miller > Arathder(rice) > Wholesaler > Retailer > Consumer

iii: Farmer > Paddy arathder > Miller > Arathder(rice) > Wholesaler > Retailer > Consumer

iv: Farmer > Miller > Arathder(rice) > Wholesaler > Retailer > Consumer

11.2.8 Conversion ratio of rice and its byproducts according to course and fine types of rice in selected areas

It was evident from table 11.2.7 that, in Kushtia district conversion ratio of course rice was found head rice, dead rice, broken rice, rice bran and rice husk 62%, 3.50%, 6.50%, 8.5% and 19.50% respectively. Conversion ratio of fine rice was found head rice, dead rice, broken rice, rice bran and rice husk 60.5%, 3.50%, 7.50%, 8.5% and 20.50% respectively. On the other hand, on an average same result was found in the Dinajpur and Naogaon district in table 11.2.7.

Table:11.2.7 Conversion ratio of rice to its byproducts for course and fine types of rice in selected areas

Districts	Types of rice	Head rice (%)	Dead rice (%)	Broken rice (%)	**Rice bran** (%)	Husk (%)
Kushtia	Course rice	62	3.5	6.5	8.5	19.5
	Fine rice	60.5	3.5	7.5	8.5	20.5
Dinajpur	Course rice	62	3.5	6.5	8.5	19.5
	Fine rice	59.5	4	7.5	8.5	20.5
Naogaon	Course rice	62.5	3.5	6.0	8.5	19.5
	Fine rice	58.5	4	7.5	8.5	20.5

Source: Field survey-2017

All the by-products that a mill produces have several possible applications. For example, bran and broken rice are useful feed for poultry, livestock and fish, while rice husks have been utilized as fuel for millers and the rural community.

11.2.8 Marketing cost of *bepari* and *aratder*

Data in table:11.2.8 reveals that marketing costs per quintal of *bepari* and a*ratdar in the study areas.* The marketing cost of *baperi* was a sum total of buying and selling cost. Total cost of *bepari* was Tk. 102.38 per quintal among them 67.40% was buying cost. The highest cost (36.64%) incurred by *Baperi* was for transportation followed by cost of bagging (29.30%).

Table:11.2.8 Marketing costs handled by the of *bepari* and *arathders*

Actors		Baperi		Arathder	
	Cost Items	Cost (Tk/ql)	% of Total Cost	Cost (Tk/ql)	% of Total Cost
A. Buying Cost	Transport cost	18.75	18.32	30	26.14
	Loading and unloading	7.50	7.33	7.5	6.54
	Market toll	3.75	3.66	5.625	4.9
	Sweepers	7.50	7.33	1.5	1.31
	Cost of bagging	30.00	29.3	30	26.14
	Personal expenses	1.50	1.47	1.5	1.31
	Sub-total	69.00	67.4	76.125	66.34
B. Selling Cost	Transportation	18.75	18.32	18.75	16.34
	Loading and unloading	7.50	7.33	7.5	6.54
	Personal expenses	1.50	1.47	1.5	1.31
	Weighing charges	3.75	3.66	0	0
	Electricity	0.00	0	0.75	0.65
	Market toll	0.00	0	5.625	4.9
	Others	1.88	1.83	4.5	3.92
	Sub-total	33.38	32.6	38.625	33.66
	Total cost	102.38	100	114.75	100

Source: Field Survey 2017-2018

The cost involved in performing these services includes transportation, loading and unloading, market tolls, cost of bagging etc. Total cost of *arathder* was Tk. 114.75 per quintal among them 66.34% was buying cost. The highest cost (36.64%) incurred by *arathder* was for transportation followed by cost of bagging (26.14%).

11.2.10 Processing and marketing cost of the rice miller in the study areas

Cost of processing included labor required for soaking, parboiling, drying and milling, electric bill, costs of bags for packing, storage etc. Total cost of miller was Tk. 842.60 per quintal among them 23% and 26.11% buying cost and selling cost. The total cost of processing was 51%of the total cost. Details of the cost of processing and selling are provided in table 11.2.9.

Table: 11.2.9 Stucture of processing and marketing cost of rice millers in the study areas;2017

	Cost Item	Tk/ql	% of cost
A. Buying Cost	Labour (Buying, weighing & loading)	44.00	5.22
	Market toll	8.25	0.98
	Cost of bags	55.00	6.53
	Rope (Sutli)	2.75	0.33
	Helping man (Koyal)	5.50	0.65
	Commission to Aratdar	27.50	3.26
	Transportation	55.00	5.22
	Unloading	5.50	0.65
	Sub-total	199.10	22.85
B. Processing Cost	Labour (Boiling, drying, milling &processing)	192.50	22.85
	Electricity cost	99.00	14.53
	Personal expenses	2.37	0.28
	Subscription for association	1.16	0.14
	Telephone charge	0.22	0.03
	Storage	11.00	1.31
	Bagging cost	94.60	9.79
	Others	22.00	2.61
	Sub-total	410.74	51.53
C. Selling Cost	Transportation cost for Dhaka	192.50	22.85
	Commission to rice Aratdar	27.50	3.26
	Sub-total	220.00	26.11
	Total	842.60	100

Source: Authors' calculation Source: Field Survey 2017-2018

11.2.11 Marketing cost of rice traders (*arathder,* wholesaler and retailer) in the study areas

Table 11.2.10 shows average costs per quintal of *Aratdar, wholesaler and retailer*. *Arathder* bear less cost because of that they are commission agents. They are not responsible for transportation and labor costs in this case. As commission agents', the main costs of traders are salary of permanent staffs (43.61%) and rent of the premise (18.69%). The transaction cost of a quintal of rice calculated for *aratdars* is Tk. 81.65.

The total marketing cost of wholesaler was Tk 108.60 per quintal. Of the total marketing cost, transportation cost was the highest (34.13%) which was followed by cost of bagging (29.86%).

Table: 11.2.10 Marketing cost of (rice traders) *arathder,* wholesaler and retailer

Actors	Arathder		Wholesaler		Retailer	
Cost Items	Cost (Tk/ql)	% of Total Cost	Cost (Tk/ql)	% of Total Cost	Cost (Tk/ql)	% of Total Cost
Unloading	12.50	15.58	15.00	12.80	15.00	16.53
Rent	15.00	18.69	2.50	2.13	1.00	1.10
Electricity charge	2.50	3.12	2.00	1.71	3.35	3.69
Labor charge-permanent	35.00	43.61	10.00	8.53	10.00	11.02
Transportation cost	0.00	-	40.00	34.13	35.00	38.57
Cost of bagging	35.00	29.86	35.00	29.86	15.00	16.53
Telephone charge	0.20	0.17	0.20	0.17	0.15	0.17
Market toll	0.40	0.49	7.50	6.40	7.50	8.26
Market search cost	0.25	0.31	0.00	-	0.00	-
Cost of lost in transportation & handling	0.75	0.92	0.00	-	0.50	0.98
Personal Expenses	0.75	0.92	0.00	-	1.00	0.82
0thers	5.00	6.23	5.00	4.27	3.75	4.13
Total	81.65	100.00	108.60	100.00	87.88	100.00

Source: Authors' calculation

Retailers have to incur costs like labor cost, loading and unloading charge, transportation cost etc. In Table 11.2.10 it was observed that the total cost of marketing incurred by retailers in the terminal market was Tk.87.88/quintal among them transportation cost was the highest (38.57% of the total marketing cost) followed by loading and unloading (16.53%) and cost of bagging (16.53%).

11.2.12 Marketing margin of different actors of coarse rice

Table 11.2.11 reveals that the miller shared highest cost (54.20 %) and captured highest percentage of total value addition (45.80%) amongst the traders. The second highest cost was incurred by *faria* (7.21%) and earned 7.37 % of the total value addition. The rice retailer captured 17.29 % of total value addition by incurring 5.70% of the total marketing cost.

Table 11.2.11: Stucture of marketing margin of different actors of coarse rice (Tk/ql)

Actors	Purchase Price	Sale Price	Gross Margin	% of GM	Cost of marketing	% of MC	Value addition/Net margin	% of NM/VA
Faria/Baperi	2150	2337.5	187.5	7.19	102.38	7.21	85.13	7.37
Arathder (paddy)	2337.5	2557.5	220	8.44	114.75	4.09	105.25	9.11
Miller	2557.5	4012.5	1455	55.8	842.60	54.2	612.40	45.8
Arathder	4012.5	4225	212.5	8.15	81.65	4.72	130.85	11.33
Wholesaler	4225	4470	245	9.4	108.60	6.58	136.40	11.81
Retailer	4470	4757.5	287.5	11.03	87.88	5.7	199.63	17.29

Source: Authors' calculation

The wholesaler earned 11.81 % of the net marketing margin by incurring 6.58 % of the total marketing cost. Share of value addition earned by the *bepari*, paddy *aratdar*, miller, *aratdar(rice)*, wholesaler and retailer were estimated at 7.37%, 9.11%, 45.80%, 11.33%, 12.00% and 17.30%, respectively.

11.2.13 Marketing margin of different actors of fine rice

Data in table 11.2.12 reveal that the miller shared highest cost (54.20 %) and captured highest percentage of total net profit (45.80%) amongst the traders. The second highest cost was incurred by *faria* (7.21%) and earned 7.37 % of the total net marketing margin. The rice retailer captured 17.29 % of total net marketing margin by incurring 5.70% of the total marketing cost.

Table 11.2.12: Stucture of marketing margin of different actors of fine rice (Tk/ql)

Actors	Purchase Price	Sale Price	Gross Margin	% of GM	Cost of marketing	% of MC	Value addition/net margin	% of VA/NM
Faria/Baperi	2800	2987.5	187.5	7.19	102.38	7.05	85.13	7.37
Arathder (paddy)	2987.5	3207.5	220	8.44	114.75	4.09	105.25	9.11
Miller	3207.5	4662.5	1455	55.8	842.60	54.2	612.40	45.8
Arathder	4662.5	4875	212.5	8.15	81.65	4.72	130.85	11.33
Wholesaler	4875	5120	245	9.4	108.60	6.58	136.40	11.81
Retailer	5120	5407.5	287.5	11.03	87.88	5.7	199.63	17.29

Source: Authors' calculation

The wholesaler earned 11.81 % of the value addition by incurring 6.58 % of the total marketing cost. Share of net profit earned by the *bepari*, paddy *aratdar*, miller, *aratdar(rice)*, wholesaler and retailer were estimated at 7.37%, 9.11%, 45.80%, 11.33%, 12.00% and 17.30%, respectively.

11.2.14 Producer share and farm-retail price spread of course and fine rice

Producer sharer in consumer's taka is the price received by the producer expressed as percentage of the retail price (price paid by the consumer). For the course and fine rice producer share and farm retail price spread were 45.19% and 51.71%, respectively. For the course and fine rice farm retail price spread was Tk. 2607 and Tk. 2807.50 per quintal, respectively (table 11.2.13). High producers share was taken as an evidence of increase the efficiency of the marketing system in favor of the farmer, while low producer share was taken as evidence of the fact that middlemen retained a large share.

Table:11.2.13 Producer share and farm retail price spread of course and fine rice (Tk/ql)

Item	**Course rice**	**Fine rice**
Producer price	2150.00	2800.00
Retail price	4757.50	5607.50
Producer share (%)	45.19	51.78
Farm retail price spread	2607.50	2807.50

Source: Authors' calculation

11.2.15 Marketing constraints of paddy/rice

In Bangladesh, agricultural production and marketing system is not free from problems. From production to selling all the channel members including growers are facing with different problems at different stages of marketing. The problems that described below are only the case of the study area but it was assumed that across the whole country, the problems faced by the farmers and the intermediaries of rice marketing channel were more or less same as paddy/rice is a homogeneous product. The logic behind the discussion of production and marketing constraints in this section was that, problems faced by the farmer and intermediaries may be determiner of marketing efficiency, meaning that the more the problems the less the efficiency.

11.2.15.1 Producers' constraints

The producers' in the study areas were asked to what sort of problems they were facing and they answered that they were facing a lot of problems and a summary of these problem has been shown in Table11.2.15.1 with a brief description of the major problems.

Lack of market: About 25% of the respondents said that there were market problems associated with maintenance of standards and grades. For Example, during husking, grains are broken in to pieces (farmer usually used traditional threshing i.e. by beating with stick and using ox) and this broken grain decreases market demand.

Transportation problem: About 21% of the sampled farmers were responding positively about transportation problem. The local markets were not well connected to the villages. Due to poor communication system, farmers could not transport their produce to the distant markets where higher prices prevailed.

Lack of capital and credit availability: About 45.8% of the sampled farmers complained about capital shortage and 41.6% about unavailability of credit. Farmers have an urgent need for money immediately after harvest.

Even if the price of paddy is always at lowest during that period, farmers badly needed cash during this period in order to pay their rent and debts as well as to buy certain necessities. Most of the time, lack of post-harvest credit forces farmers to sell their produce immediately after harvest, when prices are low.

Table11.2.14.1: Marketing and institutional problems faced by the farmers in the study areas

No.	Description of the problems	(%) of farmers opined
A.	**Marketing aspect**	
1	Lack of market	25
2	Problem of price setting	45.8
3	Malpractice in selling method (scaling or weighing)	29.1
4	Information exchange problem	20.8
5	Problem of storage facilities	62.5
6	Problems of threshing machine or miller /quality	25
B.	**Financial and institutional aspect**	
1	Loan repayment problem	33.3
2	Lack of capital availability	45.8
3	Problems of credit facility	41.6
4	Transport problem	20.8
5	Lack of institutional support	37.5
6	Problem of theft	16.7
7	Problems of excess water (flooding)	8.3

Source: Field Survey 2017-2018

11.2.15.2 Problems associated with the millers in the study areas

The major problems of the rice millers in the study area were high transportation costs (100%), interruption in electricity supply (100%), high marketing costs 72.7% (transportation costs plus others costs), capital shortage and access of credit in due time (54.4%) and low quality of farmers' rice due to problem of threshing (54.4%) which is shown in Table 11.2.14.2.

They also complained that, the recent increase in fuel price (which occurred for several times in recent period) was liable to increase the transportation cost for trading paddy in distant markets. The rice miller also said that, frequent interruption in electricity and also the increase in the price of per unit electricity increased their costs but decreased their total milling amount. So, they have to sell rice comparatively in high price than before to cover their costs.

Table 11.2.14.2: Problems faced by the rice millers in the study areas

Types of problems	Respond by (%) rice millers (N = 75)
Price instability	45.4
High transportation cost	100
Capital shortage and credit access in due time	54.4
Lack of standardization and grading facilities	36.4
Absence of proper marketing facilities	27.3
Storage problem	18.2
Lack of market information	18.2
High marketing costs	72.7
Uncertainty in electricity supply	100
Milling problems	36.4
Farmers reluctant to sell due to low price	45.5
Quality problem	54.5
Adulteration	27.3
Information flow	18.2
Illegal charges	36.4

Note: N = Total sample size by each category for Dinajpur Kushtia and Naogaon. Source: Field Survey 2017-2018

11.2.15.3 Problems Associated with rice traders (rice *aratdar*, wholesaler and retailer)

As indicated in Table 11.2.14.3, the major problem of rice traders was also the transportation cost followed by high marketing cost, capital shortage, credit access and price instability. The other important problems were quality problems, competition with unlicensed traders etc.

Table 11.2.14.3: Problems faced by the rice traders in the study areas

Types of Problems	Respond by (figures in %)		
	***Aratdar* (N = 30)**	**Wholesaler (N = 45)**	**Retailer (N = 60)**
Price instability	37.5	50	60
High transportation cost		75	80
Capital shortage and credit access	62.5	50	60
Lack of standardization and grading facilities	25	25	30
Lack of market information		12.5	20
High marketing costs	37.5	75	70
Quality problem	37.5	25	20
Competition with licensed traders	25	25	30
Competition with unlicensed trader	37.5	25	30
Business management	25	25	20

Note: N = Total sample size by each category for Dinajpur, Naogaon and Dhaka district. Source: Field survey 2017-2018

11.2.16 Conclusions and recommendations

Conclusion: The milling of course rice produced head rice, dead rice, broken rice, rice bran and rice husk at the rate of 62%, 3.50%, 6.50%, 8.5% and 19.50%, respectively and that of fine rice were 60.5%, 3.50%, 7.50%, 8.5% and 20.50%, respectively. This study found that, on an average costs of rice marketing for *bepari*, paddy *arathder,* miller, rice *arathder,* wholesaler and retailers were estimated at Tk. 102.08, Tk. 114.75, Tk.842.60 Tk. 81.65, Tk.108.60, and Tk. 87.88 per quintal, respectively. Share of net profit earned by the *faria/bepari*, paddy *aratdar*, miller, *aratdar(rice)*, wholesaler and retailer were 7.37%, 9.11%, 45.80%, 11.33%, 12.00% and 17.30%, respectively. Producer share and farm retail price spread were 67.03% and Tk. 2613 per quintal, respectively. For the course and fine rice, producer share was 45.19% and 51.71%, respectively. For the course and fine rice farm retail price spread was Tk. 2607 and Tk. 2807.50 per quintal, respectively. The present study identified some problems and constraints associated with aromatic rice marketing. The unavailability of labor, pest (BPH) and disease (neck blast and sheath rot diseases) infestation, high costs of inputs, high cost of labor, lodging problems were the major constraints in producing rice in Bangladesh. Whereas lack of storage facilities, lack of information, lack of regulated and co-operative market etc. were the constraints of rice marketing. Proper planning and measures from the government side to solve the problems in the production and marketing would encourage farmers for better production of rice in the country.

However, the following recommendations are made by this study for the improvement of existing rice marketing system:

- At the harvesting period as there exist lowest price of the paddy, the government should increase the direct purchase from the farmers at such a price that slightly more than the existing market price so that the growers' feel interest to sell to the government depot. Prices should be provided in cash not in credit and instantly and temporary procurement center should be opened at the rural areas not in the upazila market so that transportation cost could be minimum.
- Public storage facilities should be increased in the rice producing area so that the producers' can store their produce during harvest period instead of selling immediately after the harvest. On the other hand, storage cost should be kept lower than the private storage centers and hence seasonal fluctuations in the

prices of rice can be controlled. Farmers should have easy access to loan from the government's credit institution at easy terms and condition (lower interest rate) and if it is possible, they may not require selling their paddy at lower prices to repay the loans that were taken from local *mahajans* or private banks.

- Large number intermediaries are involved in the rice marketing system which increase the marketing cost and margins and reduce the margins of the growers. So, the proper steps should be taken so that the farmers can sell their produce through the efficient channel that was mention earlier that mean not only the large and medium farmers but also the small farmers can sell directly to the millers.
- Efficient and effective monitoring committee should be appointed who will monitor the markets, the pricing strategy in each market, the storage condition of the millers and any other discrepancy in rice marketing channels.
- The government should ensure smooth supply of inputs, especially the supply of quality seeds and keeping the price fluctuation of inputs at minimum level.
- DAM and MoF as well as MoA and other concerned government organization may be entrusted with more responsibilities of disseminating market and price information to the growers. The available information should not be confined only in their web pages but it should be disseminated to the proper way because most of the farmers are still illiterate about the present information technology.
- Any form of illegal activities like collection of subscription by the road and transportation authority itself and/or others (local *mastans*), hijacking/robbery of truck that are loaded with rice should be controlled in an efficient manner by the concerned government agency.

11.3 Value Chain Analysis of Aromatic Rice in Bangladesh

11.3.1 Introduction

Though, Bangladesh achieved self-sufficiency in rice production but still need more aromatic rice to meet local and foreign demand. Before release of BRRI dhan34 (1997), farmers of Bangladesh cultivated traditional aromatic rice varieties like *Kalizira*, *Chinigura* and *Kataribhog* mainly for home consumption. The yield and milling recovery of these traditional or indigenous varieties were very low and its use was very limited only in *Eid,* marriage ceremony and other prestigious festivals. The aromatic rice is regarded as highly premium priced compared to other coarse rice. In Bangladesh, about 54 aromatic and fine grain rice varieties are grown of which most of them are grown at Aman season, quite a few are also grown in Boro season. Islam et al. (1996) reported that the average area devoted to aromatic rice production in the Aman season was 12.5% of the total rice area of the season, with an average yield of 2.0 tons/ha (clean rice). There are some pocket areas which is more suitable for aromatic rice production. In Bangladesh, Kushtia, Dinajpur, and Naogaon district is highly concentrated in aromatic rice production where ACI, Pran group and Square Company Ltd. established aromatic rice processing plant. About 151,245 hectares of land was under BRRI dhan34 which was 26% of total Aman area and from where 3,22,570 tons of clean rice was produced with an average yield of 2.10 t/ha during 2017-18. Bangladeshi aromatic rice is expected to have a good market demand in international context for its nice aroma and fine grain quality. With low production cost and natural facilities, Bangladesh could enjoy a good opportunity to export aromatic and fine grain rice to abroad under the circumstances as our product is highly appreciated in the world market. BRRI dhan34 is a widely adopted higher yield potential aromatic rice variety in Bangladesh. So, the present study was designed to examine the value chain of aromatic rice (BRRI dhan34).

11.3.2 Production cost of aromatic rice (BRRI *dhan34)*

Table11.3.1 clearly shows input wise cultivation cost of BRRI *dhan34* in selected districts of Bangladesh. Total cost of cultivating aromatic rice (BRRI dhan34) was 92821 Tk./ha. Among the cost items, major share has been captured by the labor (45.02% of the total production cost). Overall total input cost was found 72.22% whereas total fixed cost was 25.94% of the total cost. Rental value of land was the highest among fixed costs which was 32.99 percent of the total cost of cultivation.

Table11.3.1: Average pproduction cost of aromatic rice (BRRI dhan34) in for three districts: Kushtia, Dinajpur, and Naogaon

Items	Cost Tk./ha	Total cost share
	BRRI dhan34	(%)
Seedling development	2050	2.21
Seed	1863	2.01
Tillage	4901	5.28
Human labour	41821	45.06
Hired	10750	11.58
Family	6500	7.00
Hired contract (transplanting and harvesting)	24571	26.47
Fertilizer cost	5685	6.12
Irrigation	2400	2.59
Herbicide	944	1.02
Pesticides	2972	3.20
Power thresher	4400	4.74
Total variable cost	67035	72.22
Interest on operating capital	1708	1.84
Rental change of own land	24077	25.94
Total fixed cost	25785	27.78
Total cost	92821	100.00

Note: (Here, 2.47 acre= 1 hectare and 1 quintal= 100 kg.) Source: Field Survey 2017-2018

11.3.3 Profitability

It was evident from Table 11.3.2 that the yield of aromatic rice BRRI dhan34 was 2730.50 kg/ha and gross return was 129915.00 Tk./ha where return of paddy and byproducts (straw) were Tk. 116015.00 and Tk. 13900.00 respectively. On full cost and current cost basis Benefit Cost Ratio (BCR) was found 1.40 and 1.94, respectively. That means, current return on investment of the *BRRI dhan34* production is 195 percent. Unit cost of production and return from grain of *BRRI dhan34* were 34.00 and 42.00 Tk./kg, respectively. That means, farmers are getting benefit of 8.00 Tk./kg by producing of aromatic rice BRRI dhan34.

Table 11.3.2: Average pprofitability of aromatic rice (BRRI *dhan34*) for three districts; Kushtia, Dinajpur, and Naogaon)

Items	Aromatic rice (BRRI *dhan34*)
Total costs (BDT/ha)	92820.52
Total variable costs (BDT/ha)	67035.19
Total fixed cost (BDT/ha)	26084.74
Yield (kg/ha)	2730.00
Market value of paddy (BDT/ha)	116015.00
Market value of straw (BDT/ha)	13900.00
Gross benefit (BDT/ha)	129915.00
Gross margin (BDT/ha)	62879.81
Net return (BDT/ha)	37094.48
Unit price of (paddy) grain (BDT/kg)	42.50
Unit cost of production (BDT/kg)	34.00
BCR (cash cost basis) (Undiscounted)	1.94
BCR (full cost basis) (Undiscounted)	1.40

Note: (Here, 1 acre= 100 decimals, 2.47 acre= 1 hectare) Source: Field Survey 2017-2018

11.3.4 Supply chain of aromatic rice (*BRRI dhan34*)

The Bangladesh rice marketing channel has two segments. First segment includes supplying paddy from the farm level to the millers/processors and the second segment includes supplying rice from the millers/processors to the ultimate consumers. The first segment in supplying *BRRI dhan34* paddy included *Farias*, *Beparies, Aratdar* and rice millers. On the other hand, actors included in the second segment are rice miller, *Aratdar, Bepari* or wholesaler and retailer. Moreover, the Bangladeshi fine rice is being exported in US, UK and Middle-east Asian countries. Various types of marketing channels are shown in Figure 11.3.1.
On the basis of the importance given by the respondents during their selling of paddy/rice in the study areas, the following supply chains were identified for marketing of *BRRI dhan34*.

i: Farmer > Faria > Paddy arathder > Miller > Arathder (rice) > Wholesaler > Retailer > Consumer

ii: Farmer > Bepari > Paddy arathder > Miller > Arathder(rice) > Wholesaler > Retailer > Consumer

iii: Farmer > Bepari > Paddy arathder > Miller > Companies (Pran, ACI, Chachi) > Dealer > > Retailer > Consumer

iv: Farmer > Bepari > Paddy arathder > Miller > Companies (Pran, ACI, Chachi) > Foreign country

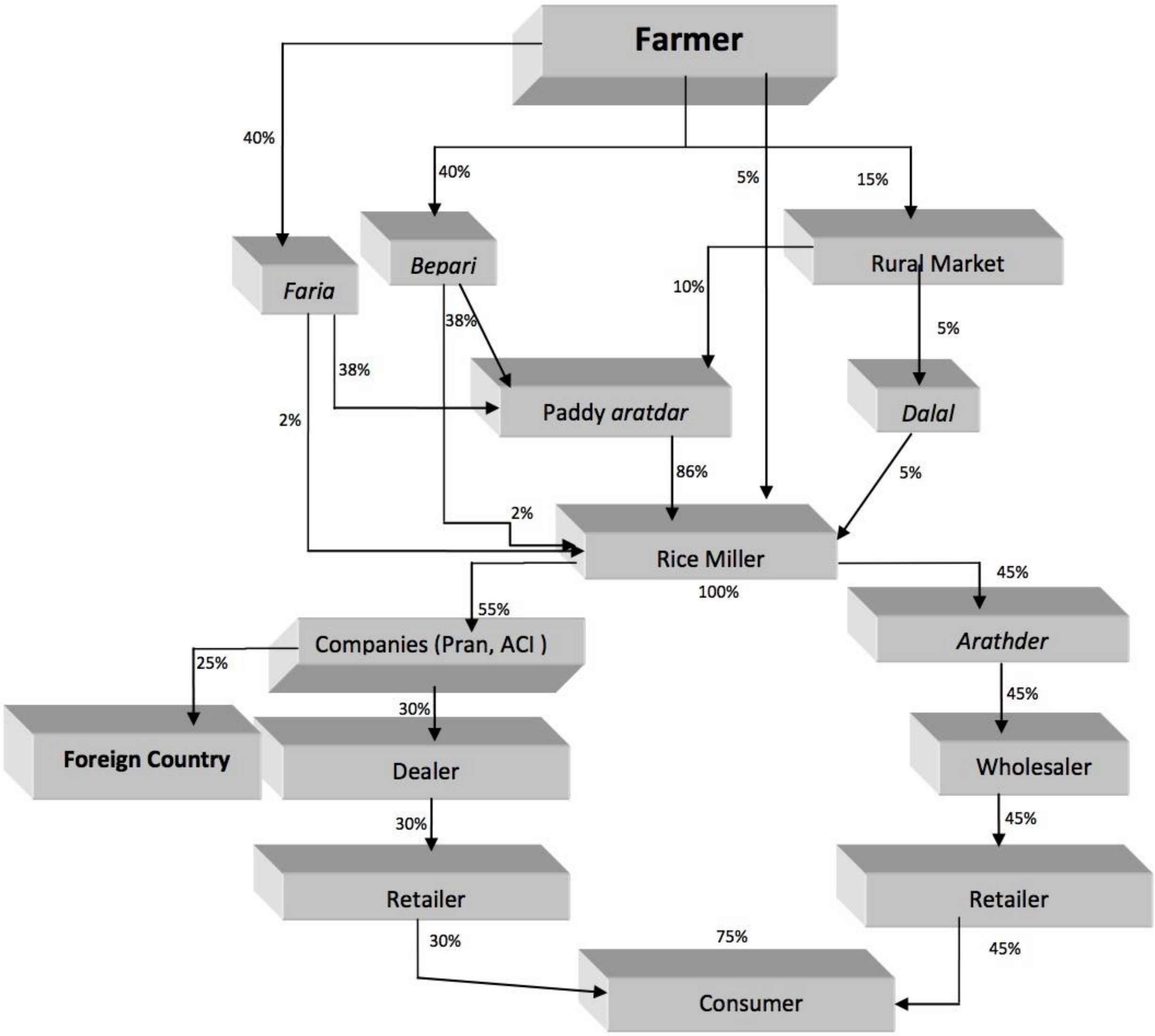

Figure 11.3.1: Supply chain of aromatic rice (*BRRI dhan34)* in the *study areas*, Bangladesh

11.3.5 Supply system of aromatic rice in the domestic market

In our domestic market, about 45% aromatic rice (unpacked) were supplied by millers with the help of arathder, wholealer and retailer. Finally, retailers sold it to the consumers. On the other hand, Different companies in Bangladesh (like: Pran, ACI, Pusti and Chashi) collected about 55% of aromatic rice from selected mills. After that these companies processed, packaged and leveled it and sold by their own brand name. Then they marketed about 30% aromatic rice in our domestic market and remaining 25% were exported in the foreign countries.

11.3.6 Ratio of clean rice and by-product from BRRI dhan34

Rice mills can produce four kinds of by-products: these are rice husk, rice bran, dead rice and broken rice. The ratios of these by-products are also different. The ratio of head rice, rice husk, rice bran and broken rice vary by mill types. On average, the surveyed automatic mills in the study areas could generate 53, 20, 9, 10 and 8% of head rice, rice husk, rice bran, broken rice and dead rice respectively (Table 11.3.3).

Table 11.3.3: Milling outturn and by-products generating from 1000 kg of paddy in Kushtia, Dinajpur and Naogaon districts

Perticulars	Amount	Achieved of head rice and byproducts (in %)
Milling Outturn (Kg)	530	53
Husk (Kg)	200	20
Rice Bran (Kg)	90	9
Broken Rice (Kg)	100	12
Dead Rice (Kg)	80	6

Source: Field survey -2017

All the by-products that a mill produces have several possible applications. For example, bran and broken rice are useful feed for poultry, livestock and fish, while rice husks have been utilized as fuel for millers and the rural community. The rice bran has high demand for producing rice bran oil.

11.3.7 Marketing cost of (paddy traders) *bepari* and *arathder*

Table 11.3.4 reveals that costs per quintal of *bepari* and a*ratdar. Baperi* marketing cost was a sum total of buying and selling cost. Total cost of *Bepari* was Tk. 102.38 per quintal among them 67.40% was buying cost. The highest cost (36.64%) incurred by *Baperi* was for transportation followed by cost of bagging (29.30%).

Table 11.3.4: Marketing cost incurred by (paddy traders) *bepari* and *arathder* in the study areas;2017

Actors		Baperi		Arathder	
	Cost Items	Cost (Tk/ql)	% of Total Cost	Cost (Tk/ql)	% of Total Cost
A. Buying Cost	Transport cost	18.75	18.32	30	26.14
	Loading and unloading	7.50	7.33	7.5	6.54
	Market toll	3.75	3.66	5.625	4.9
	Sweepers	7.50	7.33	1.5	1.31
	Cost of bagging	30.00	29.3	30	26.14
	Personal expenses	1.50	1.47	1.5	1.31
	Sub-total	69.00	67.4	76.125	66.34
B. Selling Cost	Transportation	18.75	18.32	18.75	16.34
	Loading and unloading	7.50	7.33	7.5	6.54
	Personal expenses	1.50	1.47	1.5	1.31
	Weighing charges	3.75	3.66	0	0
	Electricity	0.00	0	0.75	0.65
	Market toll	0.00	0	5.625	4.9
	Others	1.88	1.83	4.5	3.92
	Sub-total	33.38	32.6	38.625	33.66
	Total cost	102.38	100	114.75	100

The cost involved in performing these services includes transportation, loading and unloading, market tolls, cost of bagging etc. Total cost for *arathder* was Tk. 114.75 per quintal out of which 66.34% was buying cost. The highest cost (36.64%) incurred by *arathder* was for transportation followed by cost of bagging (26.14%).

11.3.8 Processing and marketing cost of miller

Cost of processing included labor required for soaking, parboiling, drying and milling, electric bill, costs of bags for packing, storage etc. were also included in the category of variable costs. Total cost of *miller* was Tk. 842.60 per quintal among them buying cost and selling cost shared 23% and 26% respectively. The cost of processing was 51% of the total cost. Details of the cost of processing and selling are provided in Table 11.3.5.

Table 11.3.5: Processing and marketing cost incurred by the miller for aromatic rice;2017

	Cost Item	Tk/ql	% of cost
A. Buying Cost	Labour (Buying, weighing & loading)	44.00	5.22
	Market toll	8.25	0.98
	Cost of bags	55.00	6.53
	Rope (Sutli)	2.75	0.33
	Helping man (Koyal)	5.50	0.65
	Commission to Aratdar	27.50	3.26
	Transportation	55.00	5.22
	Unloading	5.50	0.65
	Sub-total	199.10	22.85
B. Processing Cost	Labour (drying, milling &processing)	192.50	22.85
	Electricity cost	99.00	14.53
	Personal expenses	2.37	0.28
	Subscription for association	1.16	0.14
	Telephone charge	0.22	0.03
	Storage	11.00	1.31
	Bagging cost	94.60	9.79
	Others	22.00	2.61
	Sub-total	410.74	51.53
C. Selling Cost	Transportation cost for Dhaka	192.50	22.85
	Commission to rice Aratdar	27.50	3.26
	Sub-total	220.00	26.11
	Total	842.60	100

11.3.9 Marketing cost of rice traders *arathder,* wholesaler and retailer

Data in table 11.3.6 show average costs per quintal of *Aratdar, wholesaler and retailer*. *Aratdars* bear less cost because of that they are commission agents. They are not responsible for transportation and labor costs in this case. As commission agents', the main costs of traders are salary of permanent staffs (43.61%) and rent of the premise (18.69%). The transaction cost of a quintal of rice calculated for *aratdars* is Tk. 81.65.

The total marketing cost of wholesaler was Tk 108.60 per quintal. Of the total marketing cost, transportation cost was the highest (34.13%) which was followed by cost of bagging (29.86%).

Table 11.3.6: Marketing cost incurred by *aratder,* wholesaler and retailer in the study areas 2017

Actors	Arathder		Wholesaler		Retailer	
Cost Items	Cost (Tk/ql)	% of Total Cost	Cost (Tk/ql)	% of Total Cost	Cost (Tk/ql)	% of Total Cost
Unloading	12.50	15.58	15.00	12.80	15.00	16.53
Rent	15.00	18.69	2.50	2.13	1.00	1.10
Electricity charge	2.50	3.12	2.00	1.71	3.35	3.69
Labor charge-permanent	35.00	43.61	10.00	8.53	10.00	11.02
Transportation cost	0.00	-	40.00	34.13	35.00	38.57
Cost of bagging	35.00	29.86	35.00	29.86	15.00	16.53
Telephone charge	0.20	0.17	0.20	0.17	0.15	0.17
Market toll	0.40	0.49	7.50	6.40	7.50	8.26
Market search cost	0.25	0.31	0.00	-	0.00	-
Cost of lost in transportation & handling	0.75	0.92	0.00	-	0.50	0.98
Personal Expenses	0.75	0.92	0.00	-	1.00	0.82
0thers	5.00	6.23	5.00	4.27	3.75	4.13
Total	81.65	100.00	108.60	100.00	87.88	100.00

Retailers have to incur costs like labor cost, loading and unloading charge, transportation cost etc. In Table 11.3.6 it was observed that the total cost of marketing incurred by retailers in the terminal market was Tk.87.88/quintal. Among them transportation cost was the highest (38.57% of the total marketing cost) followed by loading and unloading (16.53%) and cost of bagging (16.53%).

11.3.10 Marketing margin of different actors of aromatic rice (BRRI dhan34)

Table 11.3.7 reveals that the miller shared highest cost (54.20%) and captured highest percentage of total value addition (45.80%) amongst the traders. The second highest cost was incurred by *faria* (7.21%) and they earned 7.37% of the total value addition. The rice retailer captured 17.29% of the total value addition by incurring 5.70% of the total marketing cost.

Table 11.3.7: Marketing margin of different actors of aromatic rice (BRRI dhan34) (Tk/ql)

Actors	Purchase Price	Sale Price	Gross Margin	% of GM	Cost of marketing	% of MC	Net margin/Value addition	% of NM/VA
Faria/Baperi	4550	4738	187.5	7.19	102.38	7.21	85.13	7.37
Aratder (paddy)	4738	4958	220.0	8.44	114.75	4.09	105.25	9.11
Miller	4958	6413	1455.0	55.8	842.60	54.2	612.40	45.8
Arathder	6413	6625	212.5	8.15	81.65	4.72	130.85	11.33
Wholesaler	6625	6870	245.0	9.4	108.60	6.58	136.40	11.81
Retailer	6875	7163	287.5	11.03	87.88	5.7	199.63	17.29

The wholesaler earned 11.81 % of the net marketing margin by incurring 6.58 % of the total marketing cost. Share of value addition earned by the *bepari*, paddy *aratdar*, miller, *aratdar(rice)*, wholesaler and retailer were 7.37%, 9.11%, 45.80%, 11.33%, 12.00% and 17.30%, respectively.

11.3.11 Producer share and farm retail price spread of aromatic rice (BRRI dhan34)

Producer sharers in consumers taka is the price received by the producer expressed as percentage of the retail price (price paid by the consumer). For the aromatic rice (BRRI dhan34) producer share and farm retail price spread were 67.03% and Tk. 2613 per quintal, respectively (table 11.3.8). High producers share was taken as an evidence of increase the efficiency of the marketing system in favorer of the farmer, while low producer share was taken as evidence of the fact that middlemen retained a large share.

Table 11.3.8: Producer share and farm retail price spread of aromatic rice (BRRI dhan34)

Items	Tk/ql
Producer price	4550
Retail price	7163
Producer share (%)	67.03
Farm retail price spread	2613

11.3.12 Farm level constraints faced by the farmers

The constraints narrated by the respondents regarding production of aromatic rice are presented in table 11.3.9. Major constraints pertaining to cultivation of aromatic rice were high infestation of neck blast and sheath rot diseases. Ninety five percent of the respondent farmers reported these as the most vulnerable constraints. The other most exposed constraints were labor crisis on transplanting and harvesting period (85 percent), high price of pesticide and insecticide (80.66 per cent) etc. Lack of storage, rational price and capital formation were the considerable constraints of *aromatic* rice production in the study areas.

Table 11.3.9: Production, marketing and institutional problems of farmers in the study areas

No.	Description of the Problems	Farmers opined (%)
A	**Production and Marketing aspect**	
1	Neck blast and sheath rot diseases	95.0
2	Labor crisis on transplanting and harvesting period	85.0
3	Lodging problems	83.0
4	High price of pesticide and insecticide	80.8
5	Problem of price setting	75.0
6	Problem of storage facilities	62.5
7	Lack of market	52.0
B	**Financial and Institutional aspect**	
1	Loan repayment problem	33.3
2	Lack of capital availability	45.8
3	Problems of credit facility	41.6
4	Transport problem	20.8
5	Lack of institutional support	37.5
6	Problem of theft	16.7
7	Problems of excess water (flooding)	8.3

Source: Field Survey, 2017-2018

11.3.13 Miller's constraints

The major problems faced by the rice millers in the study areas were interruption in electricity supply (reported by 96% respondents), high transportation costs (94%), high marketing costs (transportation costs plus others) (72.7%), capital shortage and access to credit in due time (64.4%), price instability (65.40%), storage unavailability (48.20%) etc. (Table 11.3.10).

Table 11.3.10: Stated problems commonly faced by the rice millers

Types of Problems	Percent millers opined Rice millers (N = 75)
Uncertainty in electricity supply	96.00
High transportation cost	94.00
High marketing costs	72.70
Capital shortage and access to credit in due time	64.40
Storage problem	48.20
Price instability	65.40
Milling problems	46.40
Illegal charges	56.40

Note: N = Total sample size by each category for *Dinajpur*. Source: Field Survey 2017-2018

11.3.14 Conclusion

Bangladesh produces several varieties of aromatic rice which command high prices in the country and also believed to have export potential. In our domestic market about 75% aromatic rice were supplied by millers and different companies and remaining 25% were exported in the foreign countries. This study found that on an average costs of aromatic rice marketing for *bepari*, *aratder(paddy),* miller, *aratder(rice),* wholesaler and retailers were Tk. 102.08, Tk. 114.75, Tk.842.60 Tk. 81.65, Tk.108.60, and Tk. 87.88 per quintal, respectively. Share of net profit earned by the *faria/bepari*, paddy *aratdar*, miller, *aratdar(rice)*, wholesaler and retailer were 7.37%, 9.11%, 45.80%, 11.33%, 12.00% and 17.30%, respectively. Producer share and farm retail price spread were 67.03% and Tk. 2613 per quintal, respectively. The present study identified some problems and constraints associated with aromatic rice marketing. The unavailability of labor, pest (BPH) and disease (neck blast and sheath rot diseases) infestation, high costs of inputs, high cost of labor, lodging problems were the major constraints of producing aromatic rice in Bangladesh. Whereas lack of storage facilities, lack of information, lack of regulated and co-operative market etc. were the constraints of aromatic rice marketing. Proper planning and measures from the government side to solve the problems in the production and marketing would encourage farmers for better production of aromatic rice in the country.

11.3.15 Suggestions

- ✓ Rice production is highly labor intensive. As such, specific policies have to be developed by the government for its availability during the peak period of crop production.
- ✓ Disease (Blast & Sheath rot) and pest (BPH) resistant aromatic rice varieties should be introduced.
- ✓ Marketing infrastructure and storage facilities should be developed.
- ✓ Market regulatory authorities should address the issues of unfair deduction at the market places.

11.4 Value chain of Broken Rice in Bangladesh

11.4.1 Introduction:

One of the by-products of rice milling is broken rice. Broken rice has different uses such as feed for cattle (dairy cow and beef cattle), poultry and as raw material of feed manufacturing mills. Sometimes it is also used as food as the price is relatively lower and in some areas the hotels offer cooked broken rice with pulse as breakfast item. Broken rice is being used to cook hotchpotch in street food shop as well. Therefore, broken rice has significant economic value in the rice processing sector. The aim of this study also looked into identifying the marketing scenario of broken rice in Bangladesh along with its supply chain.

11.4.2 Scenario of broken rice processing from automatic rice mill in Kushtia, Dinajpur and Naogaon

It was evident from table11.4.1 that, 75 auto rice mills processed 1960.00 thousand-ton raw rice in Kushtia, Dinajpur and Naogaon districts during 2017, which produced 146.62 thousand-tons broken rice. On an average conversion ratio of broken rice was 7.44%.

Table11.4.1: Scenario of broken rice processing from automatic rice mills in Kushtia, Dinajpur and Naogaon districts in 2017

(000) ton/year

Districts	No of mills *surveyed*	Types of Paddy	Paddy	Broken rice
Kushtia	25	Parboiled	533.81	37.37
		Aromatic	72.79	8.01
		Sub total	**606.60**	**45.37**
Dinajpur	25	Parboiled	562.85	39.40
		Aromatic	76.75	8.44
		Sub total	**639.60**	**47.84**
Naogaon	25	Parboiled	628.32	43.98
		Aromatic	85.68	9.42
		Sub total	**714.00**	**53.41**
Total	**75**		**1960.20**	**146.62**
% share			**100%**	**7.44%**

Source:2017-18 field survey

Supply chain of Broken Rice

On the basis of the importance given by the respondents during their selling of broken rice in the study areas, the following supply chains were identified in case of broken rice marketing (Fig.11.4.1):

i. $Miller > Arathder > Wholesaler > Retailer > Consumer$
ii. $Rice\ miller > Broken\ rice\ party > Feed\ industry$
iii. $Rice\ miller > Retailer > Rural\ farmer$

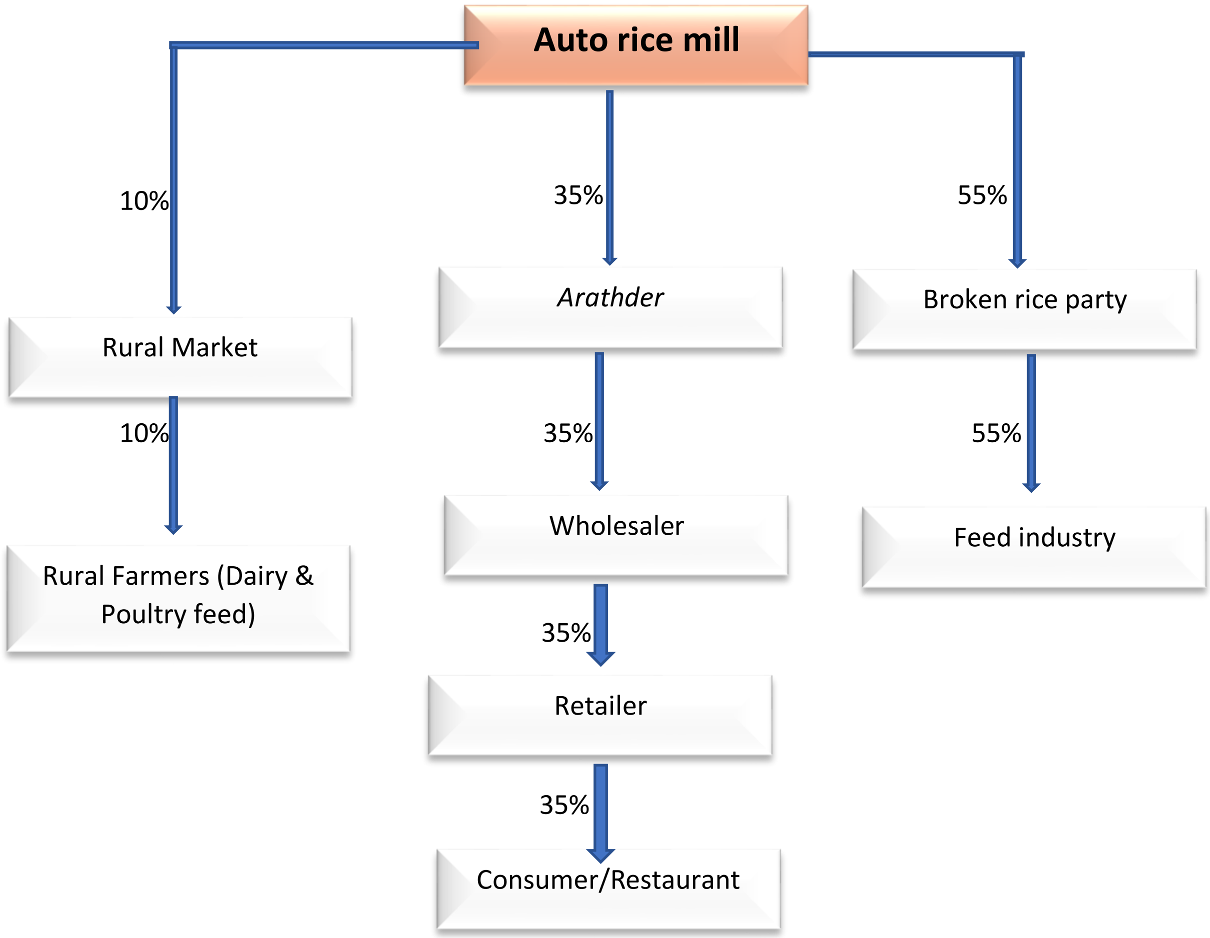

Fig: 11.4.1 Supply chain of broken rice in the study areas

11.4.3 Supply system of broken rice

Auto rice millers supplied 55% of broken rice in the feed industry with the help of the broken rice party. This broken rice was used to produce feed for livestock, poultry and fisheries. Other than the feed industry, 10% broken rice were used by the farmers as rural feed. About 35% broken rice was used for human consumption. This amount has separate supply chain. The consumers get the broken rice from rice millers through a chain of *aratder*, wholesaler and retailer.

11.4.4 Marketing cost incurred by *Aratder*, wholesaler and retailer for broken rice

Data in table 11.4.2 shows average costs per quintal of broken rice for A*ratdar, wholesaler and retailer*. *Aratder*s bears less cost as they are commission agents. They are not responsible for transportation and labor costs in this case. As commission agent, the main costs of traders are salary of permanent staffs (31.50 %) and rent of the premise (18.69%). The transaction cost of a quintal of broken rice calculated for *aratdars* is Tk. 73.49. The total marketing cost of wholesaler was Tk. 95.57 per quintal. The transportation cost was the highest (34.13%) of total marketing cost, which was followed by cost of bagging (29.86%). On the other hand, the total marketing cost of retailer was Tk. 75.57 per quintal, where, transportation cost was the highest (30.10%), followed by cost of bagging (16.53 %).

Table 11.4.2: Marketing cost incurred by the *aratders*, wholesalers and retailers in the study areas (Tk/ql)

Actors	*Aratder*		Wholesaler		Retailer	
Cost Items	Cost	% of Total Cost	Cost	% of Total Cost	Cost	% of Total Cost
Unloading	11.25	15.58	13.20	12.80	12.90	16.53
Rent	13.50	18.69	2.20	2.13	0.86	1.10
Electricity charge	2.25	3.12	1.76	1.71	2.88	3.69
Labor charge-permanent	31.50	43.61	8.80	8.53	8.60	11.02
Transportation cost	0.00	-	35.20	34.13	30.10	38.57
Cost of bagging	31.50	29.86	30.80	29.86	12.90	16.53
Telephone charge	0.18	0.17	0.18	0.17	0.13	0.17
Market toll	0.36	0.49	6.60	6.40	6.45	8.26
Market search cost	0.23	0.31	0.00	0.00	0.00	0.00
Cost of lost in transportation & handling	0.68	0.92	0.00	0.00	0.43	0.98
Personal Expenses	0.68	0.92	0.00	0.00	0.86	0.82
0thers	4.50	6.23	4.40	4.27	3.23	4.13
Total	73.49	100.00	95.57	100.00	75.57	100.00

Note: Figures within parentheses indicate percentages. Source: Field Survey 2017-2018

11.4.5 Value addition of different actors of broken rice

Data in table 11.4.3 reveal that the marketing cost (MC) of retailer was the lowest (29.74 %) and captured highest percentage of total value addition (50.08%) amongst the traders. The highest cost was incurred by wholesaler (39.72%) and earned 23.29% of the total value addition. The rice *aratder* captured 26.84% of total value addition by incurring 26.84% of the total marketing cost.

Table 11.4.3: Marketing margin of different actors of broken rice in the study areas (Tk/ql)

Actors	Purchase price	Sale Price	Gross Margin	% of GM	Cost of marketing	% of MC	net margin/Value addition	% of NM/VA
Aratder	2750	2910	160	30.19	73.49	30.54	86.51	26.84
Wholesaler	2910	3050	140	26.42	95.57	39.72	74.43	23.09
Retailer	3050	3280	230	43.40	71.57	29.74	161.43	50.08

11.4.6 Conclusion:

As a rice by-product, broken rice has different uses such as feed for livestock (dairy cow and beef cattle), poultry and as raw material of feed manufacturing mills. In the study area, 75 auto rice mills processed 1960.00-thousand-ton raw rice in Kushtia, Dinajpur and Naogaon districts. Moreover, they produced 146.62 thousand-ton broken rice. On an average conversion ratio of broken rice was 7.44%. About 55% of the broken rice was used to produce feed. Two dominant supply chain of broken rice were Miller > Aratder > Wholesaler> Retailer>Consumer, and Rice miller > Broken rice party > Feed industry. The retailers shared lowest cost (29.74

%) and captured highest percentage of total net profit (50.08%) amongst the traders. The highest cost was incurred by wholesaler (39.72%) and earned 23.29 % of the total value addition. The *aratder* captured 26.84 % of total value addition by incurring 26.84 % of the total marketing cost.

11.5 Value chain of Dead Rice in Bangladesh

11.5.1 Introduction

Dead rice is the output of milling the dead paddy. There are some mixed dead paddy in the sound paddy for processing rice in the mills. Unlike broken rice, dead rice is used as feed for livestock (dairy cow and beef cattle), poultry and as raw material of feed manufacturing mills. Although, dead rice is not used for human consumption, but has economic consequences as input for feed industry, textile mills, and directly used as feed for rural livestock and poultry. This study also took attempt to present different uses of dead rice and its supply chain system in Bangladesh.

11.5.2 Scenario of dead rice processing from automatic rice mill in Kushtia, Dinajpur and Naogaon

It was evident from table 11.5.1 that, in Kushtia, Dinajpur and Naogaon disticts the sampled 75 auto rice mills were processing 1960.00 thousand-ton raw rice per year where dead rice was 83.74 thousand-ton. On an average conversion ratio of dead rice, was 4.42%.

Table 11.5.1: Scenario of dead rice processing from automatic rice mills in selected districts in 2017

				(000) ton/year
Districts	No of mills surveyed	Types of Paddy	Paddy	Dead Rice
Kushtia	25	Parboiled	533.81	20.82
		Aromatic	72.79	5.10
		Sub total	**606.60**	**25.91**
Dinajpur	25	Parboiled	562.85	21.95
		Aromatic	76.75	5.37
		Sub total	**639.60**	**27.32**
Naogaon	25	Parboiled	628.32	24.50
		Aromatic	85.68	6.00
		Sub total	**714.00**	**30.50**
Total	**75**	**Total**	**1960.20**	**83.74**
% share			**100%**	**4.42%**

Source: Field Survey 2017-2018

11.5.3 Supply chain of Dead rice

On the basis of the importance given by the respondents during their selling of dead rice in the study areas the following supply chains were identified in case of dead rice marketing (Fig. 11.5.1):

$$i: \ Rice\ miller\ >\ Dead\ rice\ party\ >\ Feed\ industry$$
$$ii: Rice\ miller\ >\ Dead\ rice\ party > Retailer >\ Rural\ farmer$$

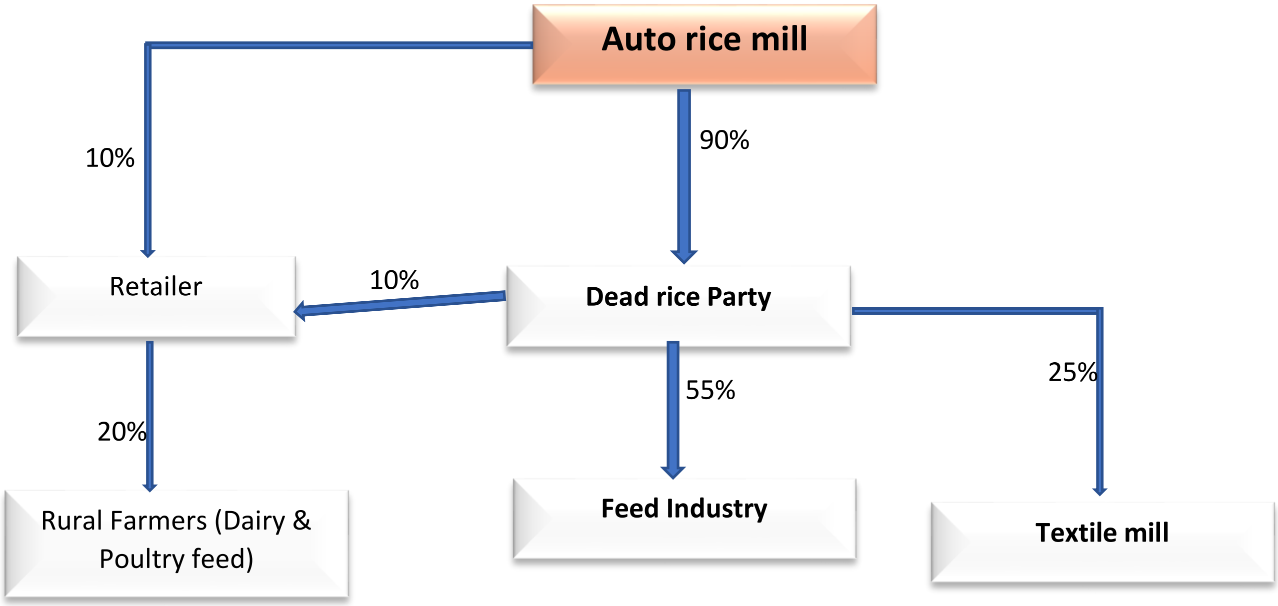

Fig: 11.5.1 Supply chain of Dead rice

11.5.4 Supply system of Dead rice in the domestic market

About 90% of dead rice was purchased by dead rice party from auto rice mills. After that dead rice party supplied 55%, 25% and 10% dead rice in feed mill, Textile mill and Retailer, respectively. Remaining 10% was supplied directly to the rural retailer to use as raw feed for the rural livestock and poultry.

11.5.5 Marketing cost of dead rice party and retailer

The average marketing cost of dead rice party and retailers are presented in the table 11.5.2. Dead rice party have to incur costs like labor cost, loading and unloading charge, transportation cost etc. The total cost of marketing incurred by dead rice party was Tk. 115.79 per quintal among them transportation cost was the highest (43.82 % of the total marketing cost) followed by permanent labor charge (15.43%) and cost of bagging (17.25%).

On the other hand, retailer have to incur costs like labor cost, loading and unloading charge, transportation cost etc. The total cost of marketing incurred by retailer was Tk. 89.02 per quintal among them transportation cost was the highest (37.36 % of the total marketing cost) followed by shop rent (12.94%) and cost of bagging (11.12%).

Table 11.5.2 Marketing cost incurred by dead rice party and retailer (Tk/ql)

Actors	Dead rice party		Retailer	
Cost Items	Cost	% of Total Cost	Cost	% of Total Cost
Loading & unloading	8.50	5.83	8.5	9.55
Rent	0.00	0.00	11.52	12.94
Electricity charge	0.00	0.00	3.25	3.65
Labor charge-permanent	12.50	15.43	7.52	8.45
Transportation cost	45.34	43.82	33.5	37.63
Cost of bagging	25.00	17.15	9.9	11.12
Telephone charge	2.05	1.41	2.25	2.53
Market toll	5.30	3.64	4.15	4.66
Market search cost	4.50	3.09	2.25	2.53
Cost of lost in transportation & handling	3.50	2.40	2.2	2.47
Personal Expenses	2.50	1.71	1.5	1.69
0thers	4.40	3.02	2.48	2.79
Total	115.79	100.00	89.02	100.00

Note: Figures within parentheses indicate percentages. Source: Field Survey 2017-2018

11.5.6 Marketing margin of different actors of dead rice

Data in table 11.5.3 represent that the dead rice party shared highest cost (57.09%) and captured highest percentage of total value addition (58.08%) among the actors. The retailers received 42.92% of total net marketing margin by incurring 42.91% of the total marketing cost.

Table 11.5.3: Marketing margin of different actors of dead rice (Tk/ql)

Actors	Purchase Price	Sale Price	Gross Margin	Cost of marketing	% of MC	Net margin/Value addition	% of NM
Dead rice party	2400	2650	250	115.79	57.09	104.21	58.08
Retailer	2650	2800	150	89.02	42.91	60.98	42.92

Source: Field Survey 2017-2018

11.5.7 Conclusion:

Dead rice has different uses such as feed for cattle (dairy cow and beef cattle), poultry and as raw material of feed manufacturing mills. It is also used in the textile mills for processing fiber. The sampled 75 auto rice mills were processing 1960.00 thousand-ton raw rice in Kushtia, Dinajpur and Naogaon disticts in 2017 of which 83.74 thousand ton were dead rice. On an average conversion ratio of dead rice was 4.42%. Dead rice party shared the highest cost (57.09%) and captured highest percentage of total net profit (58.08%). The retailer captured 42.92% of total net marketing margin by incurring 42.91% of the total marketing cost. Two dominant supply chain of dead rice were: Rice miller > Dead rice party > feed industry, and Rice miller >Retailer> Rural farmer. About 90% of dead rice purchased by the dead rice party from auto rice mills. After that dead rice party supplied 55%, 25% and 10% dead rice to the feed mills, Textile mills and Retailers, respectively. Remaining 10% were supplied to the rural retailer as raw feed.

11.6 Value chain of Rice bran in Bangladesh

11.6.1 Introduction

One of the key by-products of rice milling is rice bran. Bran is a part of rice kernel obtained from milling. Rice bran contains 20% extractible, but bran produced in commercial mills contains 13 to 18 % extractible. Rice bran is the main raw material of rice bran oil mills. There are fourteen mills which are involved in producing oil from rice bran in Bangladesh. In the rice milling process, first the outermost layer, the hull, is removed to produce brown rice. This process is least damaging to the nutritional value of the rice and avoids the unnecessary loss of nutrients that occurs with the further processing to produce white milled rice. Brown rice would be considered whole grain. Normally, one hundred kilograms of paddy on milling yields 56 to 58 kg white rice, 10 to 12 kg broken rice, 18 to 20 kg husk, and 10 to 12 kg rice bran. Rice bran, a byproduct of the milling process, contains the enzyme lipase, which rapidly degrades the oil making the bran rancid and inedible. In addition, a considerable portion of rice bran is also exported to other country that is earning foreign currency. Stabilized rice bran (SRB) has an estimated shelf life of about six months and could potentially be used as a food ingredient. Oil can be extracted from the bran and used as a healthful food component. In each year, 63 to 76 million tons of rice bran (rice milling by-product) is produced in the world and more than 90% of rice bran is sold cheaply as animal feed. The remainder is stabilized and could be used as a value-added food product (…). Currently there are some markets for SRB as a horse-feed supplement. In the United States, rice oil is being extracted from 15-20% of the rice bran. Parboiling, a steam treatment of paddy, gelatinizes the starch beneath the bran layer of the rice kernel, and yields more white rice, less broken rice, and higher fiber bran.

11.6.2 Scenario of rice bran processing from automatic rice mill in Kushtia, Dinajpur and Naogaon

It was evident from table 11.6.1 that, 75 auto rice mills processed 1960.00 thousand-ton raw rice in Kushtia, Dinajpur and Naogaon disticts where millers were found rice bran 166.62 thousand ton. On an average conversion ratio of rice bran was f8.56%.

Table 11.6.1 Rice bran processing from automatic rice mill in Kushtia, Dinajpur and Naogaon district in 2017

(**000) ton/year**

Districts	No of surveyed mills	Types of Paddy	Paddy	Bran
Kushtia	25	Parboiled	533.81	45.37
		Aromatic	72.79	6.19
		Sub total	**606.60**	**51.56**
Dinajpur	25	Parboiled	562.85	47.84
		Aromatic	76.75	6.52
		Sub total	**639.60**	**54.37**
Naogaon	25	Parboiled	628.32	53.41
		Aromatic	85.68	7.28
		Sub total	**714.00**	**60.69**
Total	**75**	**Total**	**1960.20**	**166.62**
% share			**100%**	**8.56%**

Source: Field Survey 2017-2018

11.6.3 Supply chain of rice bran

On the basis of the importance given by the respondents during their selling of rice bran in the study areas the following supply chains were identified in case of rice bran marketing (Fig. 11.6.1).:

$$i:\ Rice\ miller\ >\ Bran\ party\ >\ Rice\ bran\ oil\ mill$$
$$ii:\ Rice\ miller\ >\ Bran\ party\ >\ Feed\ industry$$
$$iii: Rice\ miller\ >\ Retailer > \ Rural\ farmer$$
$$iv: Rice\ miller\ >\ Rural\ farmer$$

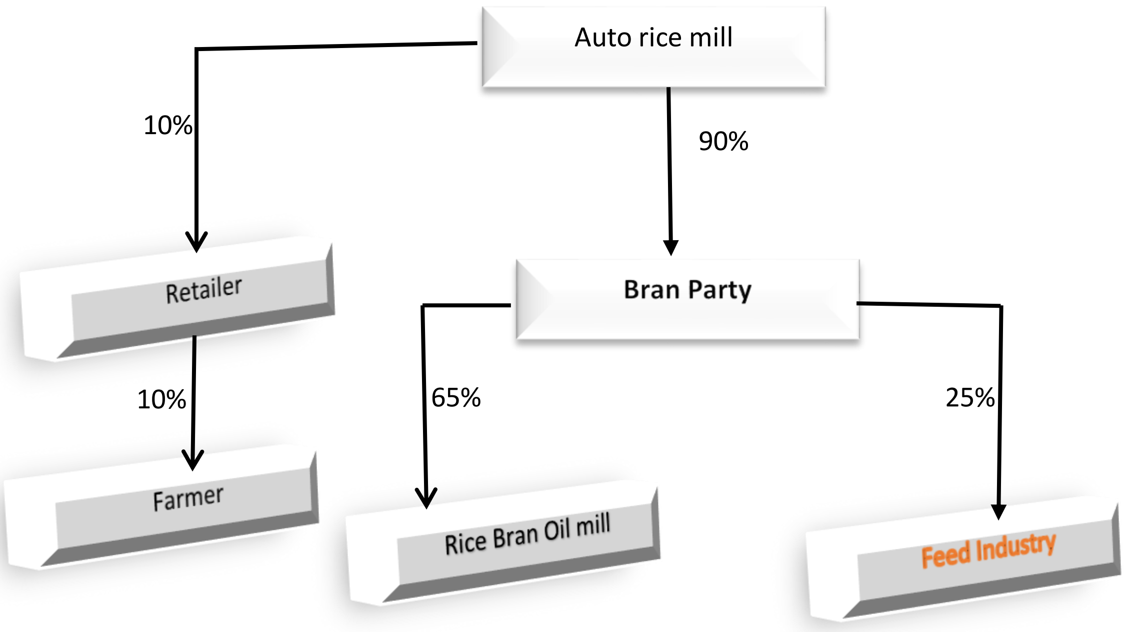

Fig: 11.6.1 Supply chain of rice bran

11.6.4 Supply system of rice bran

From this supply chain of rice bran, about 90% rice bran were supplied by the millers with the help of bran party. After that, rice bran party supplied about 65% best qualitative rice bran in the rice bran oil mill to produce the bran oil. Remaining 25% of bran were supplied by bran party in the feed industry. On the other hand, auto rice millers supplied remaining 10% of rice bran to the rural farmer through the rice bran retailers as raw feed for fishery, livestock and poultry.

11.6.5 Marketing cost of Bran party and retailer

The average marketing cost incurred by the rice bran party and retailers are presented table 11.6.2. Rice bran party have to incur costs like labor cost, loading and unloading charge, transportation cost etc. The total cost of marketing incurred by bran party was Tk. 145.79 per quintal out of which them transportation cost was the highest (44.82% of the total marketing cost) followed by permanent labor charge (15.43%) and cost of bagging (17.15%).

On the other hand, retailer have to incur costs like labor cost, loading and unloading charge, transportation cost etc. In Table11.6.2 it was observed that the total cost of marketing incurred by retailer was Tk. 89.02 per quintal out of which transportation cost was the highest (37.36 % of the total marketing cost) followed by shop rent (12.94%) and cost of bagging (11.12%).

Table11.6.2: Marketing cost of rice bran party and retailers in the study areas (Tk/ql)

Actors	Bran party		Retailer	
Cost Items	Cost	% of Total Cost	Cost	% of Total Cost
Loading & unloading	8.50	5.83	8.5	9.55
Rent	0.00	0.00	11.52	12.94
Electricity charge	0.00	1.51	3.25	3.65
Labor charge-permanent	22.50	15.43	7.52	8.45
Transportation cost	65.34	44.82	33.5	37.63
Cost of bagging	25.00	17.15	9.9	11.12
Telephone charge	2.05	1.41	2.25	2.53
Market toll	5.30	3.64	4.15	4.66
Market search cost	4.50	3.09	2.25	2.53
Cost of lost in transportation & handling	3.50	2.40	2.2	2.47
Personal Expenses	2.50	1.71	1.5	1.69
Others	4.40	3.02	2.48	2.79
Total	145.79	100.00	89.02	100.00

Source: Field Survey 2017-2018

11.6.6 Marketing margin of different actors of rice bran

It was evident from the analysis that the bran party shared the highest cost (62.09%) and captured highest percentage of total value addition (63.08%) among the actors (Table 11.6.3). The bran retailer captured 36.92% of the total value addition by incurring 37.91% of the total marketing cost.

Table 11.6.3: Marketing cost and margin of different actors of rice bran (Tk/ql)

Actors	Purchase Price	Sale Price	Gross Margin	Cost of marketing	% of MC	Net margin/Value addition	% of NM/VA
Barn party	2600	2850	250	145.79	62.09	104.21	63.08
Retailer	2850	3000	150	89.02	37.91	60.98	36.92

Source: Field Survey 2017-2018.

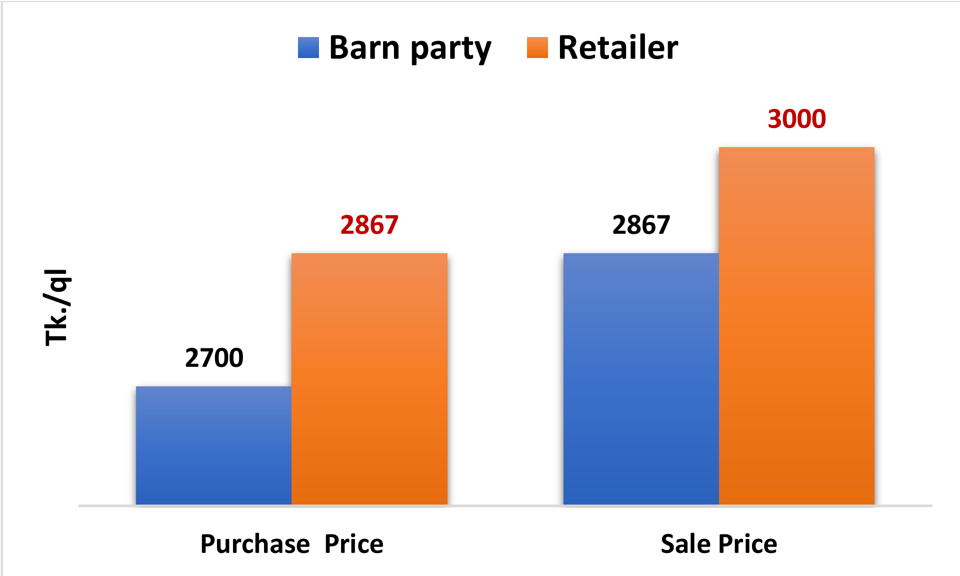

Fig: 11.6.2 Purchase and sales price of rice bran at bran party and retailer level

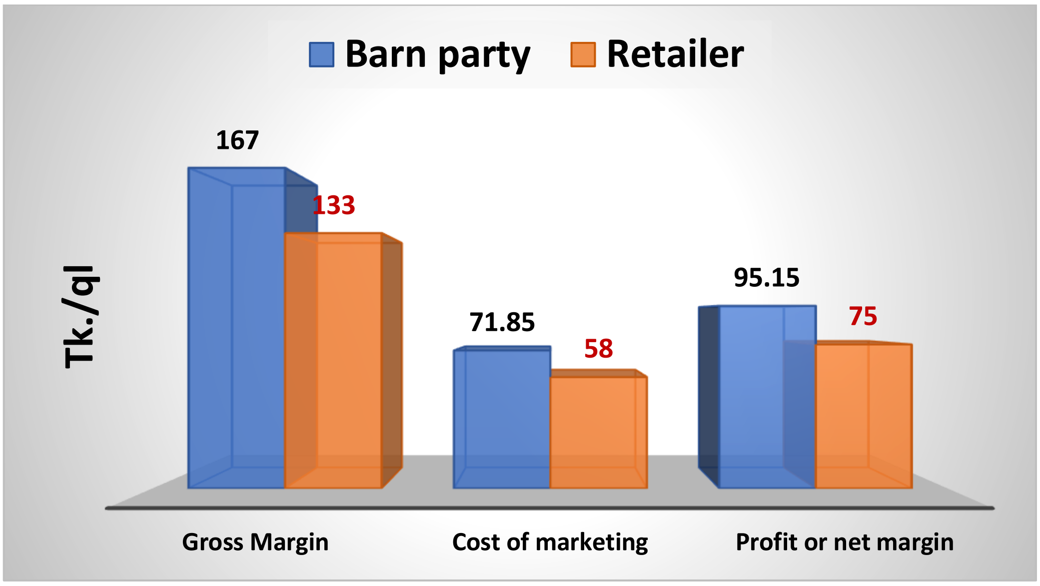

Fig: 11.6.3 Gross margin, marketing cost and net margin of rice bran at bran party and retailer level

11.6.7 Conclusion:

Bran is a part of rice kernel obtained from milling. Polish rice contains 0.3% fat whereas brown rice contains 2.2% fat on a moisture free basis. Rice bran contains 20% extractible, but bran produced in commercial mills contains 13 to 18% extractible. Rice bran is the main raw material of rice bran oil producing mills. The sampled 75 auto rice mills processed 1960.00 thousand tons raw rice in Kushtia, Dinajpur and Naogaon disticts from which millers found 166.62 thousand-ton rice bran. On an average conversion ratio of rice bran was found 8.56%. About 90% rice bran were supplied by millers with the help of bran party. After that bran party supplied about 65% best qualitative rice bran in the rice bran oil mill to produce bran oil. Remaining 25% bran were supplied by bran party in the feed industry. On the other hand, millers supplied 10% bran to the rural farmer as raw feed for fisheries, livestock and poultry. The bran party shared highest cost (62.09%) and obtained the highest percent of total net profit (63.08%) among the actors. The bran retailer captured 36.92% of total net marketing margin by incurring 37.91% of the total marketing cost.

11.7 Value chain of Rice Husk in Bangladesh

11.7.1 Introduction

Rice husk is light in weight, yellowish in color and convex in shape, slightly larger than the rice grain. It is separated from the brown rice grain as part of the milling process, after which the rice is polished. Forming one fifth of the volume of paddy, it is bulky and hence difficult to store. Rice husk is another byproduct of rice which consists of the outermost covering of the rice kernels that is separated from the rice grains during the milling process. In majority of rice producing countries, major portion of rice husk is either burnt for heat or dumped as a waste. Rice husk is used in various sectors of Bangladesh; such as power plant, cement and briquette production. It is estimated that every ton of paddy produces about 0.20 tons of husk and every ton of husk produces about 0.18 to 0.20 tons of ash, depending on the variety, climatic conditions and geographical location (Prasad et al., 2000 and Bouzoubaa and Fournier, 2001). Bangladesh has produced 10.50 million tons rice husk that has been used in the fuel industry as a raw material of producing briquette, in the poultry industry as poultry litter, in cement industry, in generating power and as fuel for rice boiling.

11.7.2 Scenario of rice husk processing from automatic rice mill in Kushtia, Dinajpur and Naogaon district

It was evident from table 11.7.1 that, sampled 75 auto rice mills processed a total of 1960.00 thousand-ton raw rice in Kushtia, Dinajpur and Naogaon disticts, which produced 392.04 thousand-ton husk. On an average conversion ratio of rice husk were found 20%.

Table: 11.7.1 Rice husk processing from automatic rice mill in Kushtia, Dinajpur and Naogaon district in 2017

(000) ton/year

Districts	No of mills	Types of paddy	Paddy	Rice husk
Kushtia	25	Parboiled	533.81	106.76
		Aromatic	72.79	14.56
		Sub total	**606.60**	**121.32**
Dinajpur	25	Parboiled	562.85	11.26
		Aromatic	76.75	15.35
		Sub total	**639.60**	**127.92**
Naogaon	25	Parboiled	628.32	125.66
		Aromatic	85.68	17.14
		Sub total	**714.00**	**142.80**
Total	**75**	**Total**	**1960.20**	**392.04**
% share			**100%**	**20%**

Source: Field Survey 2017-2018

11.7.3 Supply system of rice husk in the Kushtia, Dinajpur and Naogaon district

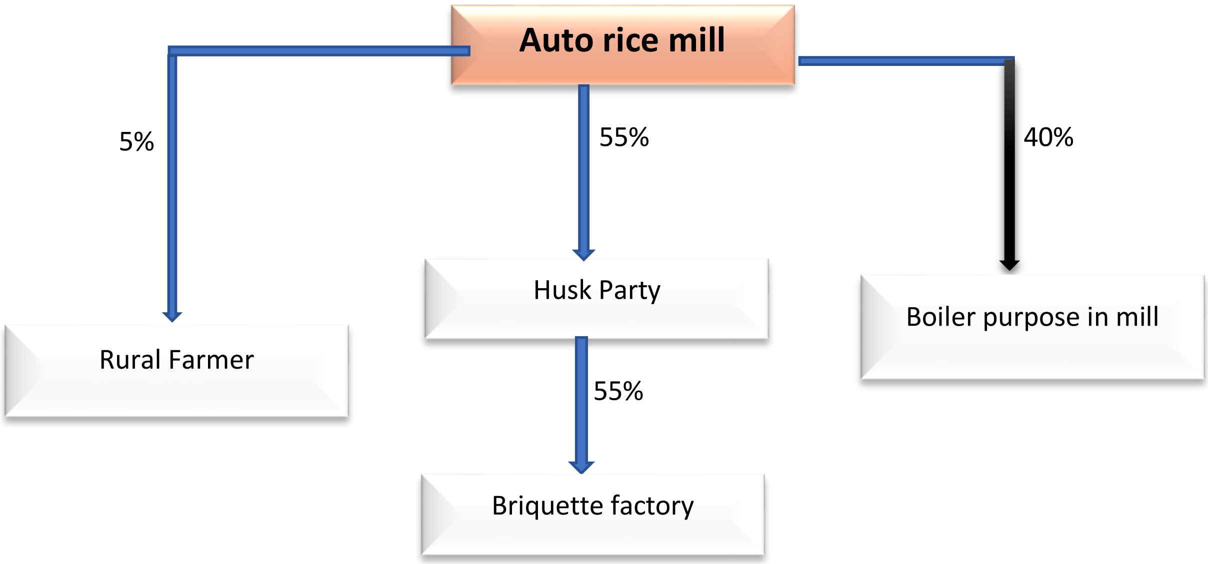

Fig: 11.7.1 Supply chain of Rice Husk

On the basis of the importance given by the respondents during their selling of rice husk in the study areas the following supply chains were identified in case of rice husk marketing (Fig. 11.7.1).

$$i\text{: } Rice\ miller\ >\ Husk\ party\ >\ Briquettes\ Factory$$
$$ii\text{: } Rice\ miller\ >\ Own\ consumption$$
$$iv\text{: } Rice\ miller\ >\ Rural\ farmer$$

11.7.4 Supply system of rice husk in Bangladesh

Analysis further indicated that, about 40% of rice husk were used in parboiling purposes of the rice mills. About 5% rural farmer purchased rice husk directly from the rice mill to use in the dairy and poultry purposes. On the other hand, remaining 55% rice husk was purchased by husk party from the mills and sold it in the Briquettes factory to produce the Briquettes.

11.7.5 Marketing cost of Husk party

The level of average marketing cost of husk party has been presented in table 11.7.2. Husk party had to incur costs like labor cost, loading and unloading charge, cost of bagging, transportation cost etc. In Table 11.7.2 it was observed that the total marketing cost of husk party was Tk.112.47/ql out of which transportation cost was the highest (40.01% of the total marketing cost) followed by cost of bagging (27.39%) and permanent labor charge (16.00%).

Table 11.7.2: Marketing cost incurred by rice husk party in the study areas (Tk/ql)

Actors	Rice husk party	
Cost Items	Cost	% of Total Cost
Loading & unloading	10	8.89
Electricity charge	2.2	1.96
Labor charge-permanent	18	16.00
Transportation cost	45	40.01
Cost of bagging	30.8	27.39
Telephone charge	0.18	0.16
Market toll	0.35	0.31
Market search cost	0.22	0.20
Cost of lost in transportation & handling	0.66	0.59
Personal Expenses	0.66	0.59
0thers	4.4	3.91
Total	**112.47**	100.00

11.7.6 Marketing margin of different actors of rice husk

Data in table 11.7.3 reveal that the husk party bear 47.32% cost and captured highest percentage of total net profit (52.92%). In husk marketing system, husk party is the single actor.

Table:11.7.3 Marketing margin of different actors of rice husk (Tk/ql)

Actors	Purchase Price	Sale Price	Gross Margin	Cost of marketing	% of MC	Net margin/Value addition	% of NM
Husk party	1050	1280	230	112.47	47.32	117.53	52.92

11.7.7 Conclusion

Rice husk is another byproduct of rice which consists of the outermost covering of the rice kernels that is separated from the rice grains during the milling process. The husk party bear 47.32% cost and received highest percent of total net profit (52.92%). In husk marketing system, husk party is the single actor. About 40% of rice husk were used in parboiling purposes of the rice mill. About 5% rural farmer purchased rice husk directly from the rice mill to use in the dairy and poultry purposes. On the other hand, remaining 55% rice husk were used in the Briquettes factory to produce the Briquettes. Two dominant supply chain of rice husk were Rice miller > Husk party > Briquettes Factory and Rice miller > Rural farmer. Among this chain 60% husk were supplied in the market.

11.8 Value Chain Analysis of Rice Bran Oil in Bangladesh

11.8.1 Introduction

Rice bran, an important byproduct of rice milling process is brown outer layer of rice kernel mainly comprised of pericarp, aleurone, subaleurone layer and germ. It contains appreciable amount of nutrients like protein, fat and dietary fiber (Singh et, al. 2013). The most useful by-products of rice milling industry is undoubtedly the rice bran which has an immense importance to the rice mills as it is used for producing fat-free edible oil and also as a raw material of solvent plant. Rice bran oil has a very good market value, which can substantially increase the profitability of rice mills. The Rice Bran Oil is a new, infant and potential sector in Bangladesh. This sector started its journey in our country since 2009. Currently there are fifteen industries producing the Rice Bran Oil in the Country. Rice bran oil (RBO) has garnered attention from consumers in recent years, owing to its high concentrations of health promoting compounds, ranging from tocopherols to phytocotrienols, phytosterols and ϒ-goryzanol. Tocopherols and tocotrienolsare lipid antioxidants that collectively constitute vitamin E and are found in rice bran oil (Sen et. al, 2006, Bakuta et. al, 2013). It also can help to lower cholesterol level, fight against diseases, and enhance the immune system. The nutritional qualities and health effects of rice bran oil are also established and are considered rich in unsaponifiable fraction (unsap). Rice bran oil which is extremely light, versatile and delicious is popular in several countries like Japan, India, Korea, China and Indonesia as edible oil. The demand for rice bran oil is increasing in Bangladesh due to its nutritional as well as beneficial impact to human health. Consumers are now a days, using rice bran oil as cooking oil side by side soybean oil and its production and marketing is increasing in Bangladesh. Many investors are showing enthusiasm to invest in this sector. Bangladesh Tariff Commission (BTC) in a study showed that per day per capita consumption of edible oil in Bangladesh is about 26.57 gm (BTC, 2014). However, the total demand for edible oil in Bangladesh is about 1.44 million tons of which 2-2.5% is coming from rice bran oil. At present, daily production of rice bran oil is about 250-300 tons in Bangladesh and its demand is increasing by 5-10% per year (BBS, 2013). The present study also attempted to explore the prospect and potentiality of this sector in the economy of Bangladesh.

11.8.2 Production capacity and actual production of rice bran oil mills in the year of 2016 and 2017

Data in table 11.8.1 showed the production capacity, actual production and capacity utilization of rice bran oil. During the period of 2016, fourteen rice bran oil mills produced 154,020 of tons rice bran oil where 67% of production capacity were utilized by these mills. Among the rice bran oil mills, highest amount (31160 tons) was produced by Mazumder Products Ltd where 64.92% production capacity were utilized. Besides, in the same year lowest amount of oil was produced by Krishani Rice Bran oil mill (7540 tons), where 50.27% production capacity were utilized.

Table 11.8.1: Capacity utilization and actual production of rice bran oil mill (ton/year)

SL	Rice bran oil mills	Production Capacity	2016		2017	
			Actual production	% capacity utilization	Actual production	% capacity utilization
1	KBC Agro Products Pvt. Ltd.	30000	17500	58.33	18000	60.00
2	Rashid Oil Mills Ltd	18000	13040	72.44	13740	76.33
3	Emerald Oil Industries Ltd.	18000	0	0.00	0	0.00
4	Mazumder Products Ltd.	48000	31160	64.92	31960	66.58
5	Green Oil & Poultry Feed	15000	8550	57.00	9070	60.47
6	Ali Natural Oil Mills & Ind.	18000	10160	56.44	10760	59.78
7	Mazumder Bran Oil Mills Ltd	18000	9520	52.89	10020	55.67
8	Al Noor Oil Company Ltd.	15000	8150	54.33	8800	58.67
9	Weaster Agro Ltd.	15000	9750	65.00	10250	68.33
10	Jamuna Agro Products Ltd.	15000	8850	59.00	9370	62.47
11	Agrotech International	12000	8520	71.00	8970	74.75
12	Tamim Agro Ind. Ltd.	15000	9000	60.00	9420	62.80
13	Abdul Monem oil mill Ltd.	21000	12280	58.48	12800	60.95
14	Krishani Rice Bran Oil Mill	15000	7540	50.27	7960	53.07
15	Prodhan Oil Mill	15000	0	0.00	7420	49.47
	Total	**258,000**	**154,020**	**59.70**	**168,540**	**65.33**

Source: Feld survey 2017

During the period of 2017, fourteen rice bran oil mills actually produced **168,540** tons of rice bran oil where 65.33% production capacity were utilized. Among the rice bran oil mills, highest amount (31960 tons) were produced by Mazumder Products Ltd where 65.33% production capacity were utilized. Besides, in the same year lowest amount of RBO was produced by Prodhan Oil Mill (7540 tons) where 49.47% production capacity were utilized. Prodhan Oil Mill started its activities current year and only 08 months ran during survey periods.

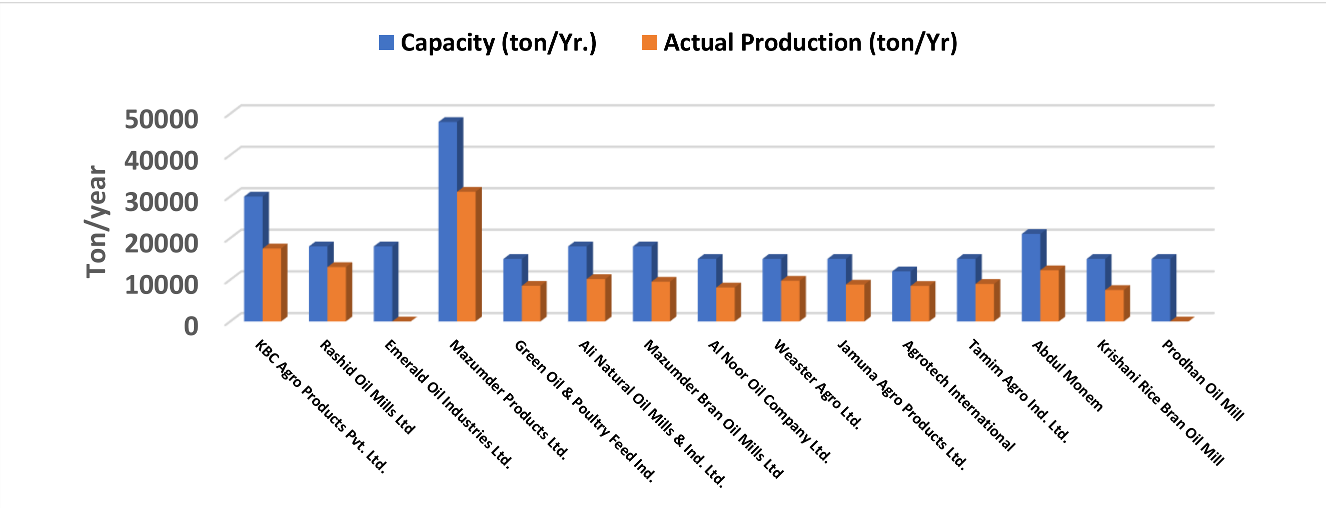

Fig: 11.8.1 Production capacity and actual production of rice bran oil in 2016

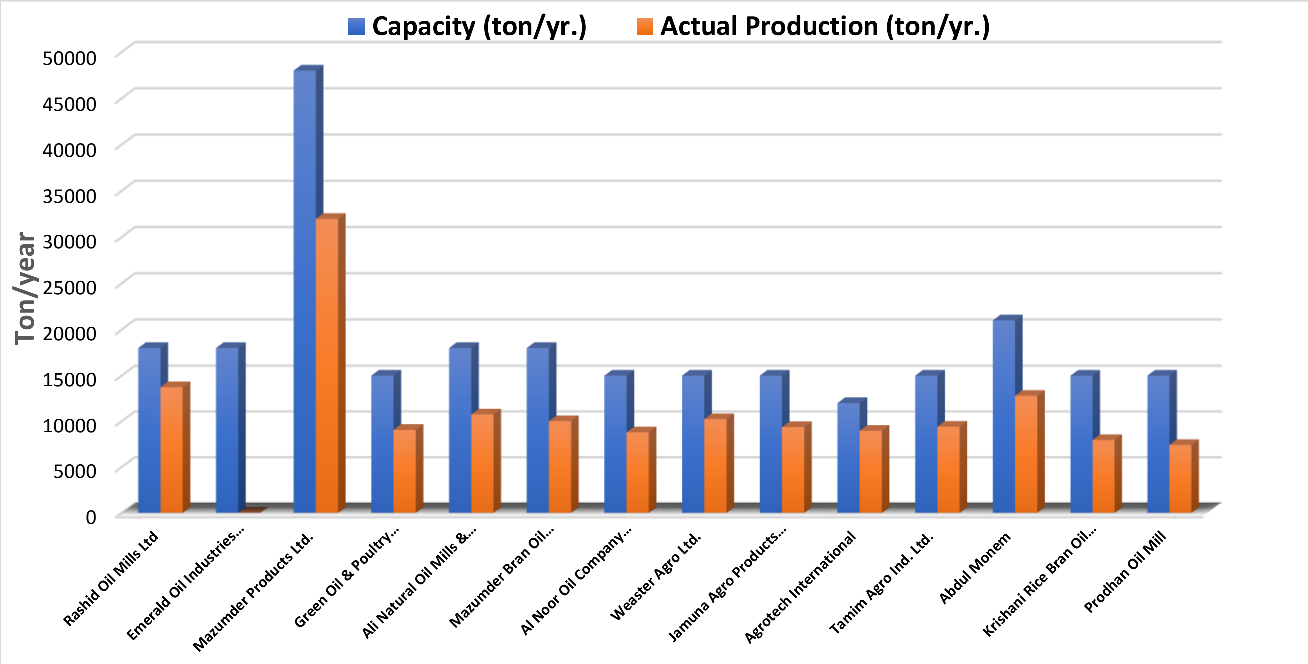

Fig: 11.8.2 Production capacity and actual production of rice bran oil in 2017

11.8.3 Availability of rice bran and bran oil in Bangladesh

One of the important byproducts of rice milling process is rice bran which is used for production of rice bran oil. Availability of rice bran depends on the supply of paddy. In Bangladesh, maximum rice mills are husking type and most of the paddy is being processed into these types of mills, where quality and quantity of products always not remain usual. Rice bran from such kind of husking mills could not produce maximum quantity and better quality of bran oil. The quality of rice bran from semi auto and automatic rice mills are better than that of normal husking mills in terms of oil extraction and quality. As the rice bran from semi auto and automatic mills contained good quality and higher amount of oil, all of the husking type rice mills in our country should be converted into semi auto and automatic mills to get maximum and better quality of bran for producing RBO. Table 11.8.2 showed the availability of rice bran and bran oil in Bangladesh since 2009/10 to 2014/15. It revealed that from 2009/10 to 2016/17 production of rice was almost static, so the availability of rice bran was also more or less static, as there is a direct relationship between supply of paddy and rice bran. In 2005, there were only 200 semi-automatic and automatic rice mills but now (2015) the figure is almost tripled (600). So, it can be noted that if all the rice mills were to be converted into auto and semi-automatic mills, then there is possibilities to obtain around 4.46 million tons of rice bran and would produce about 0.92 million tons of rice bran oil (RBO) which is half of the total demand of domestic edible oil.

Table 11.8.2: Availability of rice bran and rice bran oil in Bangladesh (million ton)

Items	% of share	Year 2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Paddy	100	49.86	50.06	50.58	50.50	51.28	51.64	52.00	52.50
Rice	**59.56**	**29.42**	**29.54**	**29.84**	**29.80**	**30.26**	**30.47**	**30.68**	**30.98**
Rice Bran (RB)	8.56	4.24	4.26	4.30	4.29	4.36	4.39	4.42	4.46
Crude Rice Bran Oil (CRBO)	22 of RB	0.93	0.94	0.95	0.94	0.96	0.97	0.97	0.98
Rice Bran Oil	**94 of CRBO**	**0.88**	**0.88**	**0.89**	**0.89**	**0.90**	**0.91**	**0.91**	**0.92**

11.8.4 Cost of production of rice bran oil

All the cost items related to rice bran oil production constituted the costs of the production and marketing. Production costs were mainly of two types i.e. variable and fixed costs. Total variable costs are the sum of costs of all variable inputs. Total variable cost was 89% of the total production and marketing costs of rice bran oil followed by marketing costs (5%) and fixed costs (6%). Major item of variable costs was purchasing rice bran (81%) followed by chemicals (4%) and fuels (2). It was found that the summation of total costs for rice bran oil production (byproducts also) including marketing costs was Tk. 176,206/ton. After deducting the returns obtained from byproducts; actual cost of RBO was TK. 87019/ton (Table 11.8.3).

Tables 11.8.3: Costs of bran oil production (Tk/ton)

Items	Amount (Tk.)	(% of total production)
A. Total variable cost (Tk./ton)	**156,375**	**88.746**
a) Rice bran*	143,000	81.155
b) Chemicals*	7,202	4.087
c) Labors	740	0.420
d) Gas bill	3,600	2.043
e) Electricity	38	0.022
f) Lubricant	29	0.016
g) Income tax	100	0.057
h) Repair and maintenance	1,667	0.946
B. Total fixed cost (Tk./ton):	**10,801**	**6.135**
a) Opportunity cost of land	8	0.005
b) Staff salary	4,583	2.601
c) Depreciation of building	2	0.001
d) Depreciation of machines	92	0.052
e) Interest on investment for building	1,513	0.859
f) Interest on investment for machines	1,361	0.772
g) Tax	210	0.119
h) Insurance	38	0.022
Administrative cost*	2,994	1.699
C. Marketing Cost (Tk./ton) *	**9,029**	5.124
D. Total costs (A+B+C)	**176,206**	**100**
E. Returns from by-products (Tk./ton RBO production) *	89,187	50.615
F. Cost of production of rice bran oil (D - E)	**87,019**	
G. Per Kg costs of production of rice bran oil	**87.02**	

Source: field survey 2017. * Details are in Appendices. *Appendix A-1 presents requirements of rice bran and chemicals inputs, and their costs for per ton rice bran oil production. Appendix A-2 and A-3 detailing out the item wise administrative and marketing costs of bran oil production. Finally, Appendix 4 shows the returns from the byproducts of rice bran oil production process.*

11.8.5 Byproducts of rice bran oil

During the rice bran oil production, it produces some other byproducts; like De-Oiled Rice Bran (DORB), wax, Free Fatty Acid (FFA) and gum, etc. Some revenues are generated from these byproducts. Analysis revealed that total byproducts revenue was Tk. 89187.00, where Tk. 81120 was for DORB, Tk. 550 was for wax, Tk. 6845 was for FFA and Tk. 672 was for gam, respectively (Appendix A- 4).

11.8.6 Production and marketing costs of RBO

Table 11.8.4 represents item wise production, and marketing cost of rice bran oil. Total production cost was Tk. 87018.58/ton, it was the sum of production and marketing cost in the mill. Total production cost of per kg RBO in the mill was Tk. 87.01.

Table 11.8.4: Total Production and marketing cost of RBO in the mill after deducting the returns of by products

Items	Tk/ton	Tk/kg
Production cost	77989.91	77.98
Marketing cost	9028.67	9.03
Total cost of rice bran oil in mill gate	87018.59	87.02

Source: Feld survey 2017

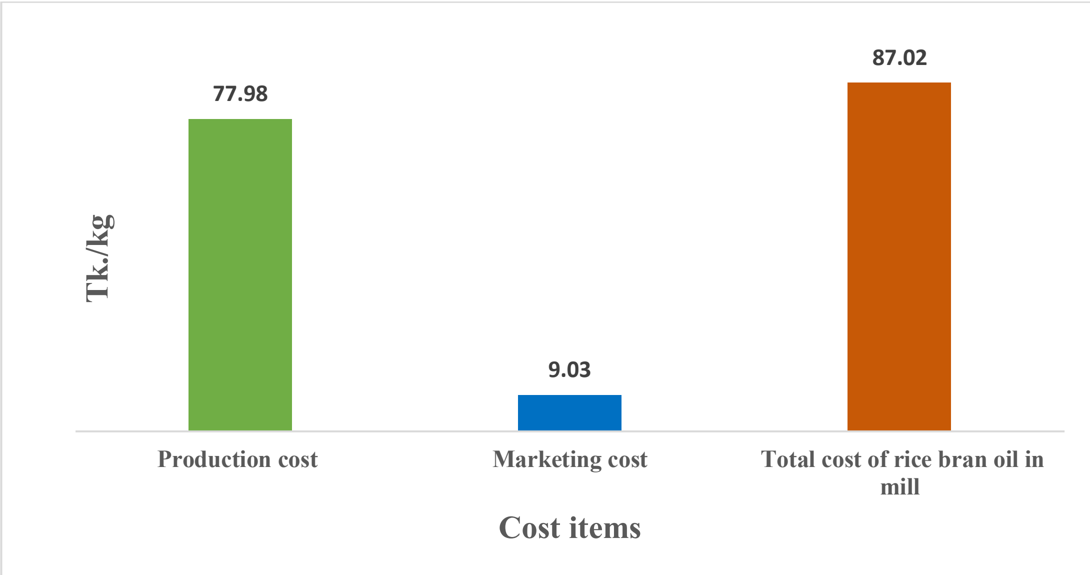

Fig: 11.8.3Total production cost of per kg RBO in the mill after deducting of returns of by products

11.8.7 Disposal pattern of rice bran oil in domestic and foreign market

From table 11.8.5 it was found that during the period of 2017, fourteen rice bran oil mills produced a total of 168,540 tons rice bran oil in our country where 64.04 % (107940 tons) were supplied in the domestic market and 35.96% (60600.00 tons) were exported to the foreign countries (specially India, China and Japan).

Table 11.8.5 Disposal patterns of rice bran oil in domestic and foreign market in 2017

	Rice Bran oil Industries	Actual production	Supplied in domestic market (ton)	% of Domestic market	Supplied to foreign market (ton)	% of Foreign market	Exporting country
1	KBC Agro Products Pvt. Ltd.	18000	18000	100.00	0.00	0.00	
2	Rashid Oil Mills Ltd	13740	13740	100.00	0.00	0.00	
3	Emerald Oil Industries Ltd.	0	0	0.00	0.00	0.00	
4	Mazumder Products Ltd.	31960	10960	34.29	21000.00	65.71	India
5	Green Oil & Poultry Feed Ind.	9070	9070	100.00	0.00	0.00	
6	Ali Natural Oil Mills & Ind. Ltd.	10760	10760	100.00	0.00	0.00	
7	Mazumder Bran Oil Mills Ltd	10020	3020	30.14	7000.00	69.86	India
8	Al Noor Oil Company Ltd.	8800	4200	47.73	4600.00	52.27	India
9	Weaster Agro Ltd.	10250	6250	60.98	4000.00	39.02	India
10	Jamuna Agro Products Ltd.	9370	9370	100.00	0.00	0.00	
11	Agrotech International	8970	2970	33.11	6000.00	66.89	China & Japan
12	Tamim Agro Ind. Ltd.	9420	4420	46.92	5000.00	53.08	India
13	Abdul Monem oil mill Ltd.	12800	3800	29.69	9000.00	70.31	Thailand
14	Krishani Rice Bran Oil Mill	7960	7960	100.00	0.00	0.00	
15	Prodhan Oil Mill	7420	3420	46.09	4000.00	53.91	India
	Total	168,540	107940	64.04	60600.00	35.96	

Source: Feld survey 2017

Among the mills, Rashid Oil Mills, Green Oil & Poultry Feed Ind, Ali Natural Oil Mills & Ind. Ltd., Jamuna Agro Products Ltd., And Krishani Rice Bran Oil Mill Ltd supplied their total production to the domestic market. On the other hand, Mazumder Products Ltd., Al Noor Oil Company Ltd., Mazumder Bran Oil Mills Ltd., Agrotech International, Tamim Agro Ind. Ltd., Abdul Monem, and Prodhan Oil Mill exported 65.71%, 52.27%, 69.86%, 66.89%, 53.08%, 70.31% and 53.91% of their total production, respectively to the foreign countries.

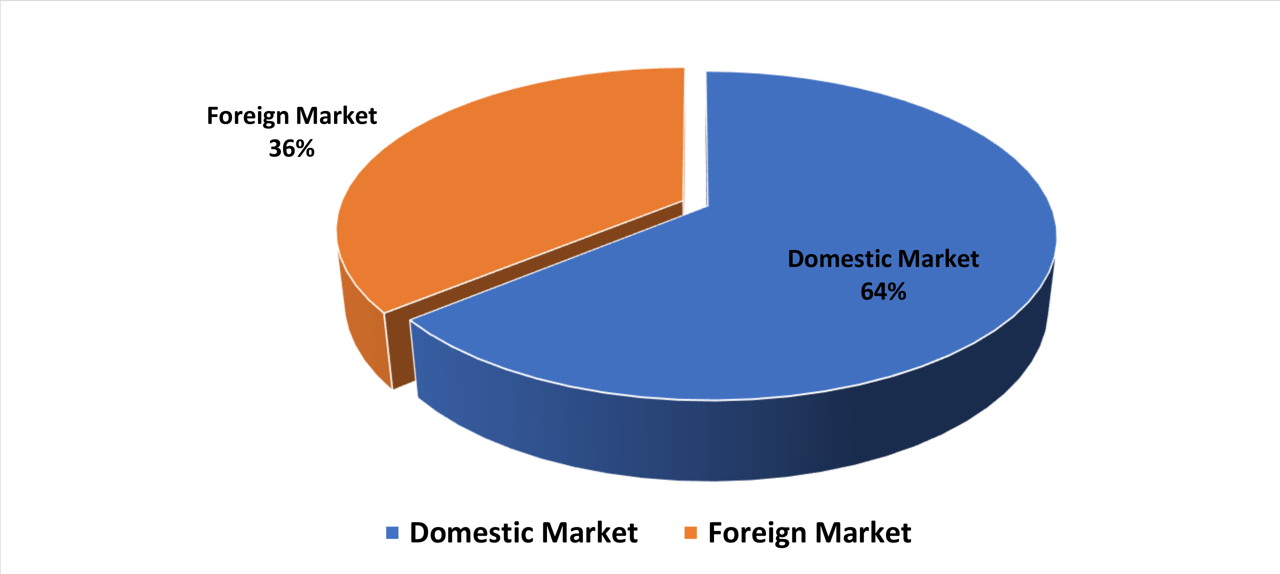

Fig: 11.8.4 Supply of rice bran oil in domestic and foreign market

11.8.8 Supply system of rice bran oil in domestic market

In our country rice bran oil mills supplied their product in two ways. One way was rice bran oil miller sold their product by their own with the help of their dealer and retailer in our domestic market with their own brand name. In our national market currently these types of (White gold, Sorna, Kollani, Pure gold, Puriva, Dhani and Krisani) branded rice bran oil were supplied by the rice bran oil mills with the help of their dealers and retailers. Another way is; different company such as Pran, ACI, Pusti and Aristocrat collected bulky refined rice bran oil from different rice bran oil mills. After collection of bulky rice bran Oil, Companies have done some kind of activities such as processing, packaging, Leveling and marketing etc. After that, company (Pran, ACI, Aristrocate and Pusti) sold these oil in our domestic market by their own brand name (Pran rice bran oil,ACI rice bran oil, Aristrocate rice bran oil). Company supplied these oils in our domestic market with the help of their dealer and retailer.

11.8.9 Actors involved in rice bran oil value chain

Actors are the main players of the value chain. The Rice Bran Oil value chain consists of the different actors like producer, Company (Pran, ACI and Pusti and Aristrocate), dealer/wholesaler, retailer, and consumer. The value chain below shows the flow chart of product distribution.

11.8.10 Value chain of rice bran oil

The value chain describes the full range of activities required to bring a product or service from conception, through the different phases of production and delivery to final consumers (Porter, 1980; Kapilinsky and Morris, 2000). Economic value chain analysis describes the range of activities required to bring a product to the final consumer and, in the case of international products, the extent to which intermediaries/agents gain from participating in the chain (Jacinto, 2004). The following value chains were identified in case of rice bran oil marketing (Fig.11.8.5).

$\boldsymbol{Value\ chain - i}: Rice\ Bran\ Oil\ Miller\ >\ Dealer\ >\ Retailer\ >\ Consumer$

$\boldsymbol{Value\ chain - ii}$: $Rice\ Bran\ Oil\ Miller > \boldsymbol{Company}\ (\boldsymbol{Pran}, \boldsymbol{Pusti}, \boldsymbol{ACI}, \boldsymbol{Aristrcate} > Dealer > Retailer > Consumer$

$\boldsymbol{Value\ chain - iii}$: $Rice\ Bran\ Oil\ Miller > Exporter > Foreign\ country$

$\boldsymbol{Value\ chain - iv}$: $Rice\ Bran\ Oil\ Miller > Consumer$

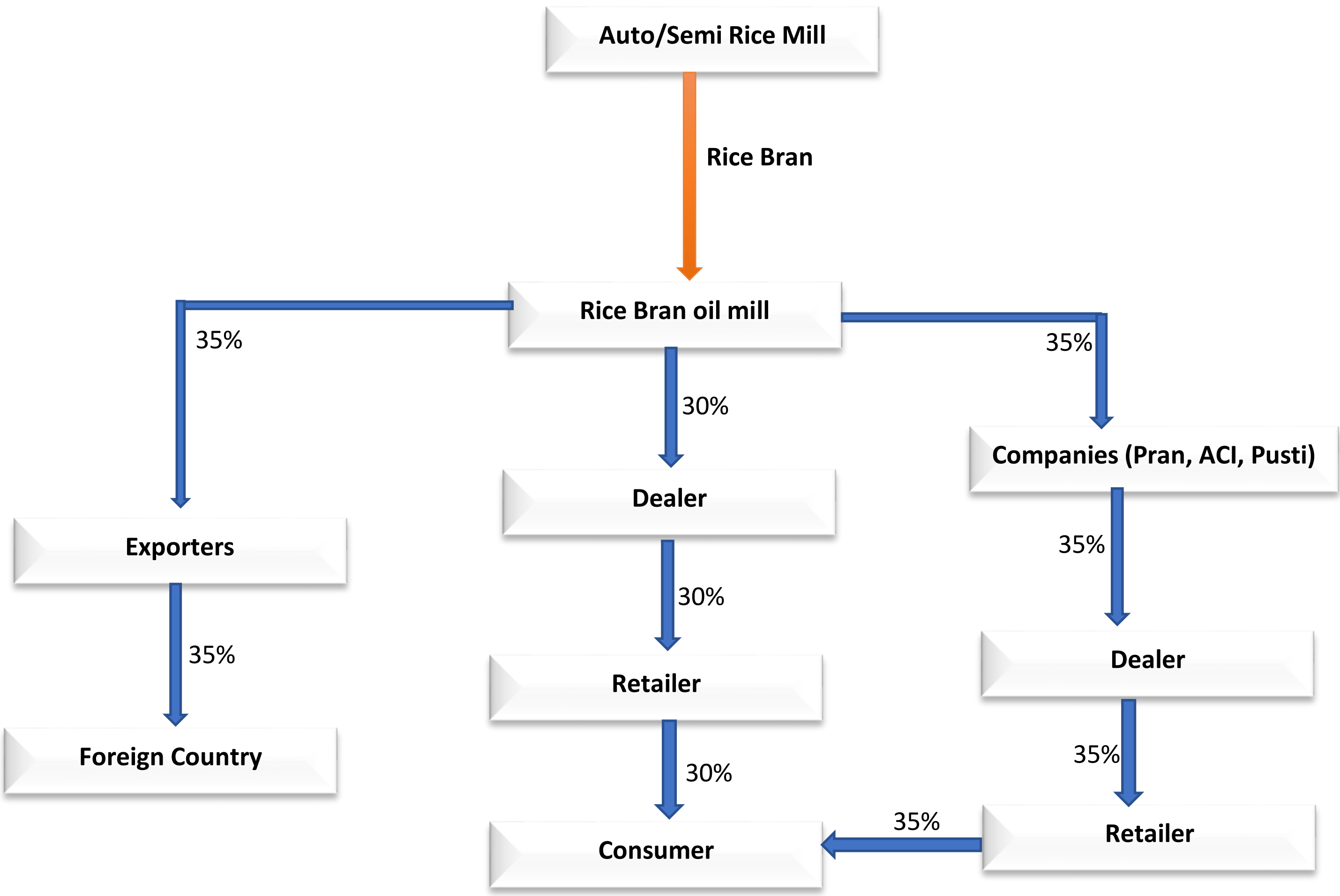

Fig: 11.8.5: Supply chain of rice bran oil

11.8.11 Value addition for rice bran oil at different level of actors

Item wise marketing cost of per ton rice bran oil at different levels of actors of value chain are presented in table 11.8.6. Transportation cost and shop rent were the major items of marketing cost which covers about 29.35% and 11.18% of total marketing cost for dealer and retailer, respectively. The transportation cost varied from area to area depending on distance coverage. On average, marketing cost of rice bran oil was higher for dealer (Tk. 7360.00/ton), compared to that of retailer (Tk. 3130.00/ton).

Table 11.8.6: Marketing costs of different actors involved in rice bran oil value chain (Tk. /ton)

Cost components	Dealer	% of dealer cost	Retailer	% of retailer cost
Transportation	2160.00	29.35	-	-
Loading	250.00	3.40	-	-
Unloading	280.00	3.80	-	-
Wages & salaries	580.00	7.88	290.00	9.27
Shop rent	540.00	7.34	350.00	11.18
Commission	320.00	4.35	270.00	8.63
Khajna	400.00	5.43	250.00	7.99
Sweeper	250.00	3.40	150.00	4.79
Market toll	280.00	3.80	180.00	5.75
Weighing cost	330.00	4.48	220.00	7.03
Shopping Bag	350.00	4.76	250.00	7.99
Electricity	220.00	2.99	190.00	6.07
Night guard	420.00	5.71	300.00	9.58
Accountant cost	210.00	2.85	210.00	6.71
Telephone/Mobile	450.00	6.11	220.00	7.03
Entertainment	320.00	4.35	250.00	7.99
Total	7360.00	100.00	3130.00	100.00

Source: Feld survey 2016

11.8.12 Value addition of different actors involved in the chain

Data in table 11.8.7 present the total value addition of rice bran oil which was Tk. 24591 at different level of actors. It was found that value addition of RBO were respectively 52.79%, 10.74% and 36.48% at miller, dealer and retailer level.

Table 11.8.7: Value addition of different actors of rice bran oil (Tk/ton)

Different actors	Sale price	Purchase price	Gross margin	Marketing cost	Value addition	Value addition (%)
Miller	100000	87019	12981	0.00	12981	52.79
Dealer	110000	100000	10000	7360.0	2640	10.74
Retailer	122000	110000	12000	3130.0	8970	36.48
Total Value addition					24591	100.00

Source: Feld survey 2017

11.8.13 Quality of the rice bran oil

It was observed that the level of fatty acid increased if the millers preserved the rice bran in the open air. RBO producer collected up to 13% fatty acid rice bran at their respective mill gates. In this regard, after producing rice bran from auto rice mill, rice bran should be sent to RBO mill immediately but usually it takes more than a week or 10 days for collection and RBO mills do not have ready storage facilities. Quality standard of the rice bran is lost at the consequence of hydrolysis reaction by the lipase enzyme already exist in bran. About 10-20% free fatty acid (FFA) is produced by enzyme. It should be noted that quantity of FFA should not be more than 3% in edible oil and not more than 8% in crude Oil. Since there is no systematic collection system of rice bran from auto and semi auto rice bran mills to RBO mills, they have suggested physical heat treatment and chemical treatment for stabilizing the bran keeping FFA in ranges between 3-8%. However, RBO extraction, dewaxing, degumming, bleaching and refining procedures were found satisfactory level other than stabilization of rice bran.

11.8.14 Problems faced by rice bran oil millers in Bangladesh

Organization and managerial body of rice bran oil mills faced some problems, those are as follows:

a. **Lack of public awareness about the nutritional status of rice bran oil:** Since rice bran edible oil is a new item in consumers market of Bangladesh, so people hesitate to buy it thinking that it is beneficial for health or not.

b. **High price of rice bran oil:** Market price of rice bran oil is relatively higher than other edible oils available in the market. It is because of higher manufacturing cost of rice bran oil. It also has a negative impact on attracting consumers to purchase rice bran edible oil.

c. **Interruption of power and gas supply**: Gas and electricity supply is not smooth in Bangladesh. So, millers frequently faced disruption from supply of gas and electricity which increased the costs of production.

11.8.15 Conclusion

Rice bran oil as a cooking oil is extremely light, versatile, delicious and beneficial for human health getting popularity among the consumers of Bangladesh. During the period of 2017, fourteen rice bran oil mills actually produced **168,540** tons rice bran oil where 65.33% of production capacity were utilized by these mills. Among the rice bran oil mills, highest amount (31960 tons) was produced by Mazumder Products Ltd., where 65.33% production capacity were utilized. Fourteen rice bran oil mills produced 168,540 tons rice bran oil in our country where 64.04% (107940 tons) was supplied to the domestic market and 35.96% (60600.00 tons) was exported to the foreign countries (specially India, China and Japan). Average total costs of rice bran oil production (byproducts also) including marketing and administrative costs was Tk. 176206/ton. After deducting the returns from by products; actual cost of RBO was Tk. 87019/ton. Two dominant supply chain of RBO were Miller > Dealer > Retailer > Consumer and Rice Bran Oil Miller > **Company (Pran, Pusti, ACI, Aristrcate >** Dealer > Retailer > Consumer. Value additions by miller, dealer and retailer of the supply chain were 14.92%, 10.00% and 10.91% and gross margin obtained by those actors were 37.11%, 28.59% and 34.30%, respectively. The key problems of RBO were unavailability of adequate rice bran and lack of promotional activities at consumer level. Present production capacity of the fourteen-rice bran oil mills was about 2.58 million tons of bran oil, but due to shortage of bran the current production level is about 1.68 million tons. Considering the importance of rice bran oil government should provide desired incentives to the rice bran oil miller to increase the supply of bran oil which could save huge amount of foreign exchanges.

11.8.16 Recommendations

The following polices/ suggestion should be implemented which deserves immediate attention for improving the existing production and marketing system of rice bran oil in Bangladesh:

- Attempt can be made to convert the manual and husking rice mill to semi-auto (installation of rubber role huller mills instead of anglebrug huller mill) and automated rice mill;
- The owner of poultry and fish feed industries should be encouraged to use of de-oiled rice bran (DORB) instead of rice bran;

- Initiatives should be taken by the manufacturers to create demand of the consumers through the promotional activities.
- The consumers need to be awarded about the quality and benefit of bran oil and side by side fix up reasonable price.
- Effort should be made to ensure the maximum utilization of the production capacity and thereby decrease the cost of production of rice bran oil;
- Capacity building of skilled manpower should be strengthened in this sector. Improved to training programs should be launched to train up the national technical personnel to replace the foreign expert.

11.9 Value chain of de-oiled rice bran (DoRB) in Bangladesh

11.9.1 Introduction

De-oiled rice bran is one of the important raw materials of feed production. After oil extraction from rice bran de-oiled rice bran is produced. DORB is one of the main byproducts of rice bran oil and most widely used in feed mills for feed processing. In Bangladesh more than hundred feed mills currently use de-oiled rice bran (DORB) as a raw material of feed production. The importance of use DORB in feed is its protein content and small percentage of oil content in it. Before using DORB rice bran is directly used with rice polish in feed processing. But better-quality feed production is possible by using DORB with other raw materials such as maize, wheat straw, soybean, fish feed, dry fish etc. Feed demand in cattle farm, poultry farm and fisheries are increasingly high. A large number of people in Bangladesh are directly connected with these farms for their livelihood. Ultimately DORB has potential for value addition and increased revenues at all levels of the value chain. Based on the potential usages and demand, and priory of the key informants, the de-oiled rice bran value chain was selected for detail investigation. De-oiled rice bran (DORB) is obtained after crude oil has been extracted from rice bran. It is obtained in pellet form. After extraction DORB, contains 8% Protein, 28% Fiber, 14.50% Sand & Silica and 10% Moisture. It is used as cattle feed, poultry feed, fish feed, pig feed, dog feed and horse feed all over the world. In Bangladesh DORB is widely used in manufacturing different feeds like of cattle, poultry and fish feeds etc.

11.9.2 Production scenario of De-oiled rice bran in Bangladesh

It is evident from table 11.9.1 that during the period of 2016, fourteen rice bran oil mills used 770100 tons rice bran to produce rice bran oil. After oil extraction from rice bran, a total of 6,16,080 ton de-oiled rice bran were produced in the country. Among the rice bran oil mills, Mazumder Products Ltd. the highest amount of DoRB were produced (124640 ton of DoRB) where rice bran was used 155800 ton. In 2017 fourteen rice bran oil mills used 842700-ton rice bran to produce rice bran oil. After oil extraction from rice bran, about 6,74,160 ton de-oiled rice bran in our country.

Table 11.9.1 Production scenario of de-oiled rice bran from rice bran oil mills in Bangladesh (ton/year) :2016-2017

Rice bran oil mills	Production		Production 2016		Production 2017		
	RBO Capacity	Use of bran	RBO	DoRB	Use of bran	RBO	DoRB
KBC Agro Products Pvt. Ltd.	30000	87500	17500	70000	90000	18000	72000
Rashid Oil Mills Ltd	18000	65200	13040	52160	68700	13740	54960
Emerald Oil Industries Ltd.	18000	0	0	0	0	0	0
Mazumder Products Ltd.	48000	155800	31160	124640	159800	31960	127840
Green Oil & Poultry Feed Ind.	15000	42750	8550	34200	45350	9070	36280
Ali Natural Oil Mills & Ind. Ltd.	18000	50800	10160	40640	53800	10760	43040
Mazumder Bran Oil Mills Ltd	18000	47600	9520	38080	50100	10020	40080
Al Noor Oil Company Ltd.	15000	40750	8150	32600	44000	8800	35200
Weaster Agro Ltd.	15000	48750	9750	39000	51250	10250	41000
Jamuna Agro Products Ltd.	15000	44250	8850	35400	46850	9370	37480
Agrotech International	12000	42600	8520	34080	44850	8970	35880
Tamim Agro Ind. Ltd.	15000	45000	9000	36000	47100	9420	37680
Abdul Monem Oil Mills Ltd	21000	61400	12280	49120	64000	12800	51200
Krishani Rice Bran Oil Mill	15000	37700	7540	30160	39800	7960	31840
Prodhan Oil Mill	15000	0	0	0	37100	7420	29680
Total:	258000	770100	154020	616080	842700	168540	674160

Source: Field survey 2017

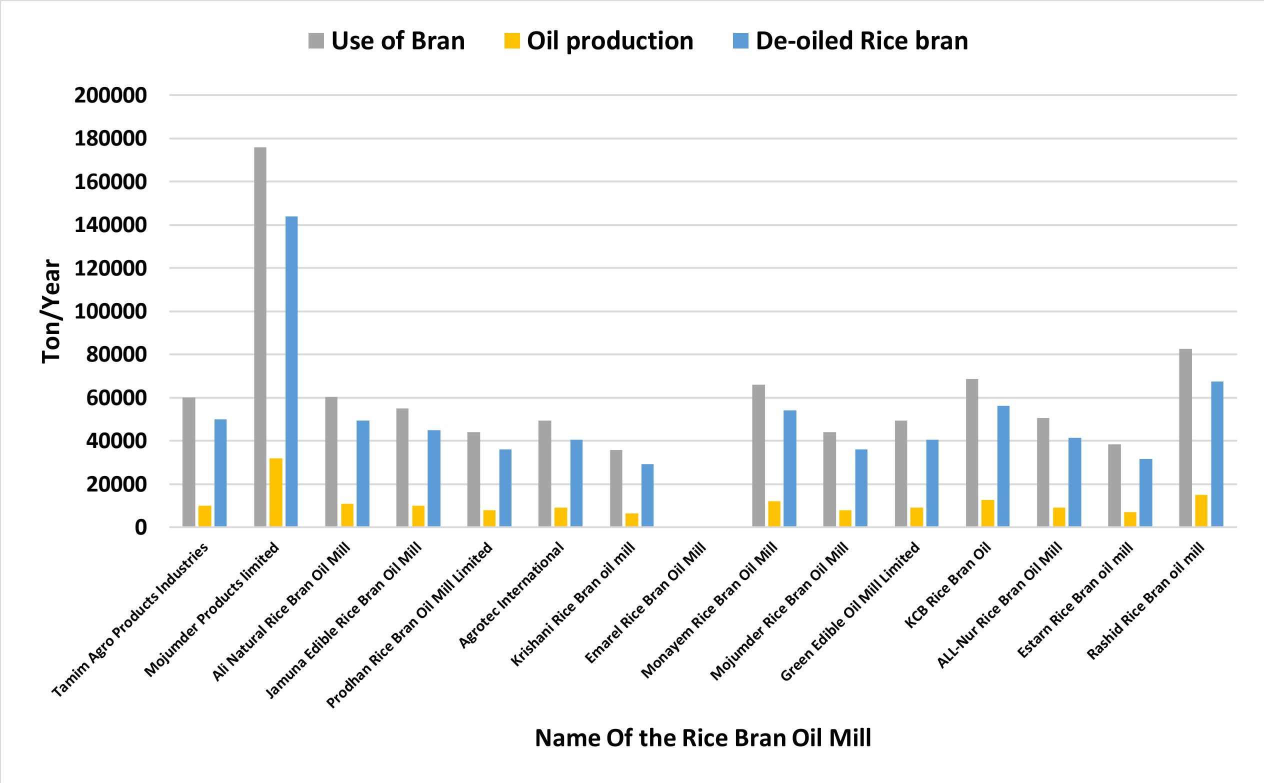

Fig: 11.9.1 Production scenario of De-oiled rice bran in Bangladesh in 2017

11.9.3 Actors involved in de-oiled rice bran value chain

Actors are the main players of the value chain. The De-oiled rice bran value chain consists of the different actors like producer, dealer/wholesaler, retailer, and consumer. The de-oiled rice bran value chain below shows the flow chart of product distribution.

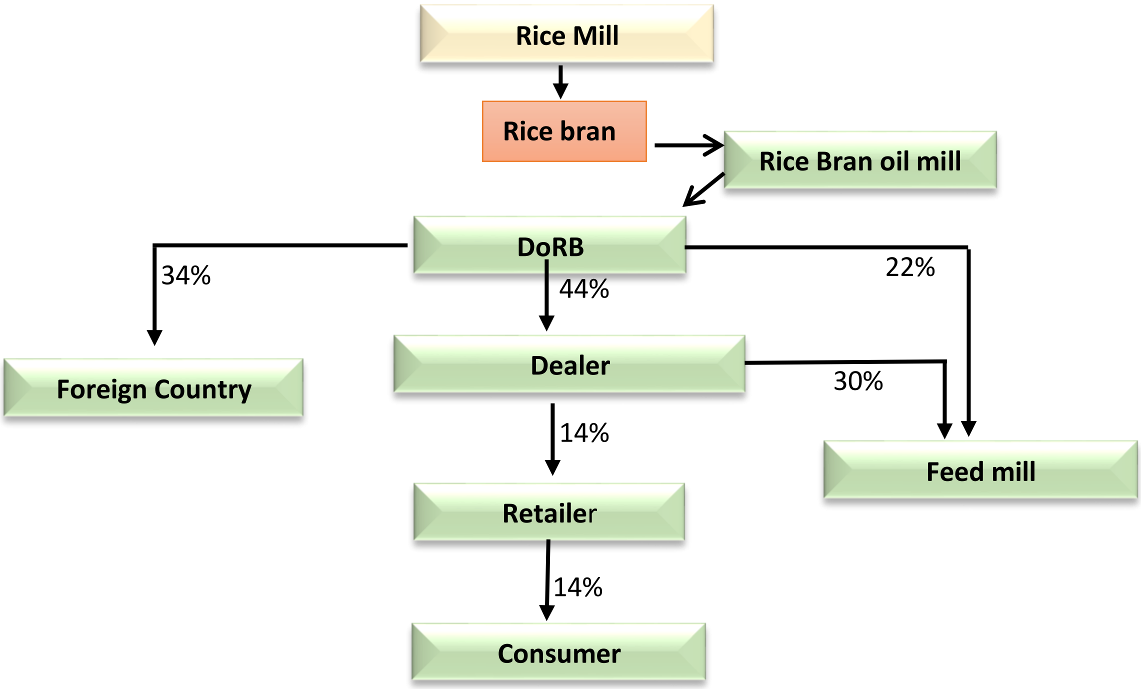

Fig: 11.9.2 Supply chain of de-oiled rice bran in Bangladesh

11.9.4 Value chain of de-oiled rice bran

The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production and delivery to final consumers (Porter, 1980; Kapilinsky and Morris, 2000). Economic value chain analysis describes the range of activities required to bring a product to the final consumer and, in the case of international products, the extent to which intermediaries/agents gain from participating in the chain (Jacinto, 2004). The following value chains were identified in case of de-oiled rice bran marketing (Fig. 11.9.2).

$\boldsymbol{i}$: $De - oiled\ rice\ bran\ Miller\ >\ Dealer\ >\ Retailer$
$>\ Consumer\ (Farmer\ of\ Poultry, dairy\ and\ fisheries)$

$\boldsymbol{ii}$: $De - oiled\ rice\ bran\ Miller\ >\ Dealer\ >\ Feed\ miller$

$\boldsymbol{iii}$: $De - oiled\ rice\ bran\ Miller\ >\ Feed\ miller$

$\boldsymbol{iv}$: $De - oiled\ rice\ bran\ Miller\ >\ Foreign\ market$

11.9.5 Disposal pattern of de-oiled rice bran in domestic and foreign market

It is evident in table 11.9.2 that during the period of 2017, fourteen rice bran oil mills produced a total of 674160 ton de-oiled rice bran in our country where 65.21 % (439620 ton) were supplied in the domestic market and 34.79% (234540 ton) were exported in the foreign countries (specially India, China and Thailand). Among the mills, Rashid Oil Mills, Green Oil & Poultry Feed Ind, Ali Natural Oil Mills & Ind. Ltd. Jamuna Agro

Products Ltd. And Krishani Rice Bran Oil Mill Ltd supplied their total production to the domestic market. On the other hand, remaining nine rice bran oil mills exported 234540 ton of DoRB in the foreign countries. Among the nine rice bran oil mills; the highest amount of DoRB 41000 ton (80.08%) was exported from Abdul Monem oil Mills Ltd. Feed miller is dominant user of DoRB in our domestic market.

Table 11.9.2 Supply of de-oiled rice bran in domestic and foreign market (ton/year): 2017

Rice bran oil mills	Actual Production (ton)	Domestic Market (ton)	% of Domestic Market	Foreign Market (ton)	% of Foreign Market	Exporting Country
KBC Agro Products Pvt. Ltd.	72000	40000	55.56	32000	44.44	India
Rashid Oil Mills Ltd	54960	54960	100.00	0	0.00	
Emerald Oil Industries Ltd.	0	0	0.00	0	0.00	India
Mazumder Products Ltd.	127840	77840	60.89	50000	39.11	China
Green Oil & Poultry Feed Ind.	36280	36280	100.00	0	0.00	India
Ali Natural Oil Mills & Ind. Ltd.	43040	7500	17.43	35540	82.57	
Mazumder Bran Oil Mills Ltd	40080	15080	37.62	25000	62.38	India &
Al Noor Oil Company Ltd.	35200	20200	57.39	15000	42.61	India
Weaster Agro Ltd.	41000	41000	100.00	0	0.00	
Jamuna Agro Products Ltd.	37480	37480	100.00	0	0.00	
Agrotech International	35880	35880	100.00	0	0.00	
Tamim Agro Ind. Ltd.	37680	20680	54.88	17000	45.12	
Abdul Monem Oil Mills Ltd	51200	10200	19.92	41000	80.08	Thailand
Krishani Rice Bran Oil Mill	31840	31840	100.00	0	0.00	
Prodhan Oil Mill	29680	10680	35.98	19000	64.02	
Total	**674160**	**439620**	**65.21**	**234540**	**34.79**	

Source: Feld survey 2018

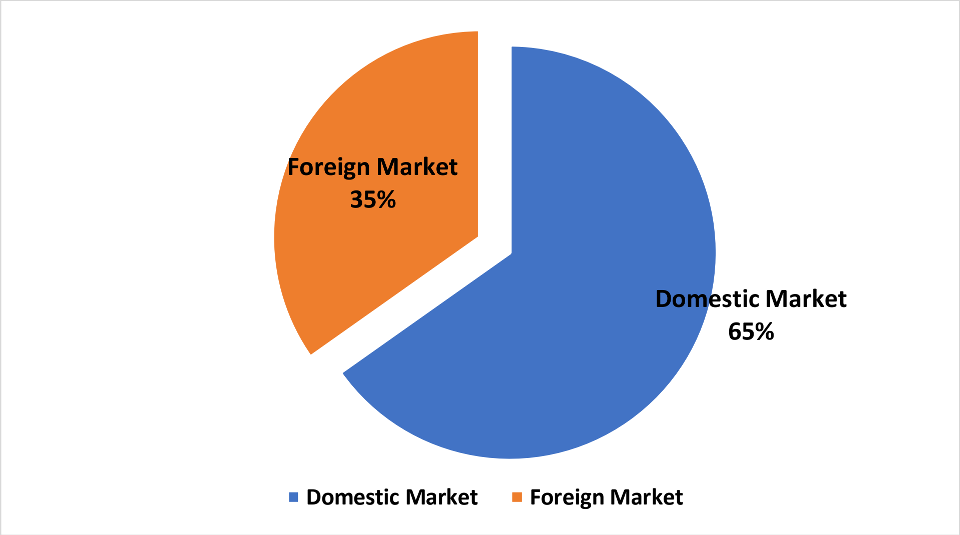

Fig: 11.9.3 Supply of de-oiled rice bran in domestic and foreign market

11.9.6 Value addition for de-oiled rice bran at different level of actors

Data in table 11.9.2 represent item wise marketing cost of per quintal de-oiled rice bran at different level of actors of value chain. Transportation cost was the major item of marketing cost which covers about 55.63% and 34.31% of total marketing cost of dealer and retailer, respectively. The transportation cost varied from area to area depending on distance coverage. On average, per quintal marketing cost of de-oiled rice bran was higher for dealer (Tk. 117.2/ql), compared to that for the retailer (Tk. 73.5/ql).

Table 11.9.3: Marketing costs of different actors involved in de-oiled rice bran value chain (Tk. /ql)

Cost components	Incurred by Dealer	Dealer's Share (%)	Incurred by Retailer	Retailer's Share (%)
Transportation	65.2	55.63	25	34.01
Loading	2.5	2.13	2.5	3.40
Unloading	2.8	2.39	2.8	3.81
Wages & salaries	5.8	4.95	8.7	11.84
Shop rent	5.4	4.61	2.4	3.27
Commission	3.2	2.73	3.2	4.35
Khajna	4.0	3.41	2.3	3.13
Sweeper	2.5	2.13	2.5	3.40
Market toll	2.8	2.39	2.8	3.81
Weighing cost	3.3	2.82	3.3	4.49
Shopping Bag	3.5	2.99	4.5	6.12
Electricity	2.2	1.88	2.2	2.99
Night guard	4.2	3.58	1.5	2.04
Accountant cost	2.1	1.79	2.1	2.86
Telephone/Mobile	4.5	3.84	4.5	6.12
Entertainment	3.2	2.73	3.2	4.35
Total	117.2	100.00	73.5	100.00

Source: Feld survey 2017

11.9.7 Value addition of different actors involved in the chain

It is evident in table 11.9.4 that the total gross margin of de-oiled rice bran which was 360 Tk./ql at different level of actors. It was found that gross margin of DoRB were respectively 52.78%, and 47.22% at dealer and retailer level. On the other hand, Value addition of DoRB were respectively 43.00% and 57.00 % at dealer and retailer level respectively.

Table 11.9.4: Value addition of different actors of de-oiled rice bran under the study (Tk/ql.)

Different actors	Sale price	Purchase price	Gross margin	Marketing cost	Net margin/ Value addition	% of Value addition
Dealer	2040	1850	190 (52.78%)	117.2 (61.46%)	72.8	43.00
Retailer	2210	2040	170 (47.22%)	73.5 (38.54%)	96.5	57.00

Source: Feld survey 2017

11.9.8 Conclusion

De-oiled rice bran is one of the important raw materials of feed production. After oil extraction from rice bran de-oiled rice bran is produced. DORB is one of the main by- products of rice bran oil and most widely used in feed mills for feed processing. During the period of 2017 fourteen rice bran oil mill produced 674160 ton de-oiled rice bran in our country where 65.21 % (439620 ton) were supplied in the domestic market and 34.79% (234540 ton) were exported to the foreign countries (specially India, China and Thailand). Two dominant supply chain of DoRB were De-oiled rice bran Miller > Dealer > Feed miller and De-oiled rice bran Miller > Dealer > Retailer > Consumer (Farmer of Poultry, dairy and fisheries). Gross margin by dealer and retailer of the supply chain were 52.78, and 47.22% and Value addition obtained by those actors were 43.00% and 57.00 % respectively. The key problems faced by the rice bran oil miller's unavailability of adequate rice bran. Considering the importance of rice bran oil government should provide different incentives to the rice bran oil millers to increase the supply of bran oil and de-oiled rice bran which could save huge amount of foreign exchanges and fulfill the demand of dairy and poultry sector in our country.

11.9.9 Recommendations

The following polices/ suggestions were derived and these deserve immediate attention for improving the existing production and marketing system of de-oiled rice bran in Bangladesh:

- Public and private sector entrepreneurs need to come forward to establish modern technology based several rice bran processing units in the country to increase the amount of oil production as well as increase the amount of by products such as DORB, which is used as an ingredients of animal feed that would save huge amount of foreign currency and create employment opportunity.
- The government should have appropriate policies and regulations to ensure priority based continuous supply of gas and electricity for smooth running of the oil mills.
- The government should develop appropriate policies and regulations to ensure that, artificial crisis of products is not created in market, and to ensure right price of raw materials for all business traders.
- Trade association should be established among the oil and feed mill owners to strengthen the business environment related to credit recovery. The government should have policies and regulations to stop the illegal supply of rice bran in foreign countries and save our national economy.

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

- The average recovery ratio for head rice, dead rice, broken rice, rice bran and husk were 61.00%, 3.51%, 6.49%,8.50% and 20.50% respectively from the automatic rice millers. Bangladesh produced 52.50 million-tons of paddy, which earned 30.98 million-tons head rice. Other than the head rice, the byproducts are dead rice, broken rice, husk and rice bran which stand at 2.31, 3.89, 10.50 and 4.46 million-tons, respectively during the period of 2017.
- In our domestic market, about 45% aromatic rice (unpacked) were supplied by millers with the help of arathder, wholesaler and retailer. On the other hand, Different companies of Bangladesh (like: Pran, ACI, Pusti and Chashi) collected about 55% of aromatic rice from selected mills. After that these companies processed, packaged and leveled it and sold by their own brand name. Then they marketed about 30% aromatic rice in our domestic market and remaining 25% were exported to the foreign countries.
- Automatic rice millers supplied 55% of broken rice in the feed industry with the help of the broken rice party. About 90% rice bran were supplied by millers with the help of bran party. After that, bran party supplied best qualitative rice bran (65%) in the rice bran oil mills to produce the bran oil.
- Rice husk party purchased about 55% rice husk from the automatic rice mills and sold it in the Briquettes factory to produce the Briquettes.
- Total production capacity of fourteen surveyed rice bran oil mills was258000 ton/year where as these mills utilized 67% of the capacity which produced 168,540 ton of rice bran oil.
- The manufacturing cost of rice bran oil was Tk.176, 206/ton; including value of byproducts (Tk. 89,187). After deducting the returns of byproducts; actual cost of bran oil was Tk. 87019/ton.
- Two dominant supply chains of rice bran oil (RBO):
  - ✓ Miller > Dealer > Retailer> Consumer and
  - ✓ Rice Bran Oil Miller > Company (Pran, Pusti, ACI, Aristocrat > Dealer > Retailer > Consumer.
- During the period of 2017, fourteen rice bran oil mills produced 168,540-ton rice bran oil in our country where 64.04 % (107940 ton) were supplied to the domestic market and 35.96% (60600.00 ton) were exported in the foreign countries (specially India, China and Japan).
- During the period of 2017, fourteen rice bran oil mills produced 674160-ton de-oiled rice bran where 65.21 % (439620 ton) were supplied in the domestic market and 34.79% (234540 ton) were exported to the foreign countries (specially India, China and Thailand).
- The key problems of RBO production were unavailability of adequate rice bran and lack of promotional activities at consumer level.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a)Office equipment (furniture)					
Executive Table	1	20000.0	1	20000.00	Required items were successfully procured
Executive Chair	1	10000.0	1	10000.00	
Steel almira	1	24000.0	1	24000.00	
File cabinet	1	20000.0	1	20000.00	
Front Chair	3	12000.0	3	11886.00	
Computer table	2	10000.0	2	10000.00	
Computer chair	2	7000.0	1	7000.00	
(a)Office equipment (Computer Accessories)					
Laptop	1	60000.0	1	59950.0	Required items were successfully procured
Desktop Computer	1	60000.0	1	59950.0	
UPS	1	10000.0	1	10000.0	
Scanner	1	10000.0	1	10000.0	
Laser Printer	1	25000.0	1	19950.0	
Large size Stapler machine	1	2000.0	1	1900.0	
Camera (SLR	1	25000.0	1	25000.0	
(b) Lab &field equipment					
(c) Other capital items					

2. Establishment/renovation facilities:

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

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

Description	Number of participants			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop					

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	531896	531896	531896	0	100.0	
B. Field research/lab expenses and supplies	822000	822000	822000	0	100.0	
C. Operating expenses	244580	241162	240162	0	100.0	Needed extra money for operating the project
D. Vehicle hire and fuel, oil & maintenance	429972	388423	388423	0	100.0	
E. Training/workshop/seminar etc.	0	0	0	0	0.0	
F. Publications and printing	112800	0	0	0	0.0	
G. Miscellaneous	74116	72037	72037	0	100.0	
H. Capital expenses	284636	284636	284636	0	100.0	

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

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
To identify and examine major value chains for rice and rice by-products (rice bran and bran oil, rice husk, feeds) in Bangladesh.	• Personal Observation • FGD • Key Informant Interview • Survey Research • Reiewing Previous Wroks	• Research Report • MS Thesis • Research Papers in Peer Reviewed Journal	• Updated knowledge of major value chains for rice and rice by-products
To map the different activities of the actors and value addition processes of the respective chains focusing distributional issues as well as costs and margins of the actors involved	• Personal Observation • FGD • Key Informant Interview • Survey Research	• Research Report • MS Thesis • Research Papers in Peer Reviewed Journal	• Updated knowledge of value chain, value addition, cost margin of the different actors of rice and its byproduct
Sketch the feasibilities and future prospects of value chains of rice byproducts as a new dimension for the economy of Bangladesh.	• Personal Observation • FGD • Key Informant Interview • Survey Research	• Research Report • MS Thesis • Research Papers in Peer Reviewed Journal	• Upated knowledge about rice and its byproducts (broken rice,dead rice,bran,husk ricebran oil and deoiled rice bran) production and marketing

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

Publication	Number of publications		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.			
Journal publication			
Information development	➢ Production and supply system of parboiled rice and aromatic rice ➢ The average recovery ratio for head rice, dead rice, broken rice, rice bran and husk from the automatic rice millers. ➢ Using pattern of rice and its byproducts ➢ Production and supply system of dead rice and broken rice in Bangladesh ➢ Using pattern and supply system of rice bran in Bangladesh ➢ Production scenario of rice bran oil in Bangladesh ➢ Total manufacturing cost of rice bran oil ➢ Production scenario and disposal pattern of rice bran oil in Bangladesh ➢ Production scenario and disposal pattern of De-oiled rice bran in Bangladesh ➢ Using pattern and supply system of rice husk in Bangladesh		
Other publications, if any			

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

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

- The average recovery ratio for head rice, dead rice, broken rice, rice bran and husk were 61.00%, 3.51%, 6.49%,8.50% and 20.50% respectively from the automatic rice millers.

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

- ✓ The average recovery ratio for head rice, dead rice, broken rice, rice bran and husk were 61.00%, 3.51%, 6.49%,8.50% and 20.50% respectively from the automatic rice millers.
- ✓ Bangladesh has produced 52.50 million-tons paddy, which earned 30.98 million-tons head rice. Other than the head rice, the byproducts are dead rice, broken rice, husk and rice bran that produced 2.31, 3.89, 10.50 and 4.46 million-tons, respectively.
- ✓ The rice bran has been used to produce crude rice bran oil. Here, 4.46 million-tons rice bran can produce 0.98 million-ton crude rice bran oil, which can be refined to 0.92 million-ton rice bran oil.
- ✓ Total production capacity of fourteen surveyed rice bran oil mill was258000 ton/year where as these mills utilized 67% of the capacity which produced 168,540 ton of rice bran oil.
- ✓ Total manufacturing cost of rice bran oil was Tk.176, 206/ton; including value (Tk. 89,187) of byproducts. After deducting the returns from by products; actual cost of bran oil was Tk. 87019/ton.

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

Considering the importance of rice bran oil, government should provide different incentives to the rice bran oil miller to increase the supply of bran oil which could save huge amount of foreign exchanges.

iv. Policy Support

- Effort can be made to conversion of manual and husking rice mill to semi-auto (installation of rubber role huller mills instead of anglebrug huller mill) and automated rice mill;
- Encourage owner of poultry and fish feed industry to use of DORB instead of rice bran;
- Initiatives should be taken by the manufacturers to create demand of the consumers through the promotional activities.
- Effort can be made to ensure the maximum utilization of the production capacity and thereby decrease the cost of production of rice bran oil;
- Capacity building of skilled manpower should be strengthened in this sector.
- Initiative to training program should be launched to train up national technical personnel to replace the foreign expert.

G. Information regarding desk and field monitoring

i) Desk monitoring [description & output of consultation meeting, monitoring, workshops/seminars etc.): Not applicable

ii) Field monitoring (Time and no of visit, Team visit and output):

Types of Audit	Major observations /issues/objections raised, if any	Status at the sub-project end	Time of visit
BARC \Team	Verified and found correct		06/02/18
GoB audit (Foreign aid)	Verified and found correct		28/10/18

I. Lesson Learned/Challenges (if any)

- ✓ Production and supply system of parboiled rice and aromatic rice
- ✓ The average recovery ratio for head rice, dead rice, broken rice, rice bran and husk from the automatic rice millers.
- ✓ Using pattern of rice and its byproducts
- ✓ Production and supply system of dead rice and broken rice in Bangladesh
- ✓ Using pattern of supply system of rice bran in Bangladesh
- ✓ Production scenario of rice bran oil in Bangladesh
- ✓ Total manufacturing cost of rice bran oil
- ✓ Production scenario and disposal pattern of rice bran oil in Bangladesh
- ✓ Production scenario and disposal pattern of De-oiled rice bran in Bangladesh
- ✓ Using pattern of supply system of rice husk in Bangladesh

J. Challenges (if any)

- ✓ The project is running well, but unable to purchase capital items due to delay in disbursing related fund.
- ✓ Delay of fund disbursement
- ✓ Cheque payment system was complex
- ✓ Sometimes faced shortage of trained enumerators for data collection

Signature of the Principal Investigator
Date ………………………..
Seal

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

Literature review

Value chain analysis is a new concept in economic and marketing related research area. In home and abroad the literature related to value chain is very scanty, especially on rice byproducts. However, some available literature on rice and rice byproducts are furnished below:

Alam (2005) in this study found major value addition of husking mills as rice milling (51.59%), retailing (26.58%) and wholesaling (13.49%) for parboiled rice. The profit margin at husking mill was found about Taka 465.5 (28.65% of value addition at this level). In semi-automatic mills, rice milling (47.62%), retailing (25.39%) and wholesaling (13.49%) constituted the major value addition for parboiled rice. For aromatic rice the major value additions were- rice milling (54.46%), retailing (16.34%) and wholesaling (12.38%). The profit margins were identified as Taka 715.75/ton (47.72% of value addition at this level) and Taka 865.75/ton (62.96% of value addition at this level) for parboiled and aromatic rice, respectively. In case of parboiled rice, the profit margins per ton for husking, semi-automatic and automatic rice mills were found Taka 466/ton, 716/ton and 1190/ton, respectively. The variation in profit margins was because of variation in processing in different types of rice mills. The labour requirement per ton of rice processing at husking mill (Taka 538/ton) was much higher than automatic (Taka 59/ton) and semi-automatic (Taka 338/ton) rice mills. Moreover, high capacity and capacity utilization of automatic rice mills provided an edge over processing cost of rice in husking and semi-automatic rice mills.

Kapur (2003) identified value addition of raw rice (Grade-A) milling unit as process cost which includes Rs. 69.6 per quintal. (12%) for taxes and levies, cleaning, loading and miscellaneous costs (Vat-4%, Arat-2.5%, market fee-2%, process fee 2%, miscellaneous-1.5%), Rs. 9 per quintal for drying, Rs.20 per quintal for de-husking and polishing, Rs. 2 per quintal for grading. After grading yield of raw rice @ 67% accumulated value becomes Rs. 1015.8. Cost of rice bran (7%) at 500 per quintal. Cost of rice husk (19%) at Rs. 100 per quintal. was Rs.19. Overall gross profit was Rs. 79.2 per quintal. The author also found that percentage of gross profit on sale in respect of rice as 7.5% for raw rice and 6.2% for parboiled rice. In view of the quantum of work load given by purchasing agencies this profit margin appears to be rational. *Grade-A (Basmati rice and superfine quality). (*Here exchange rate of Rupee (and Bangladeshi Taka was 1 Rupee= 1.49 Taka)

Reardon et al. (2012) in this study found that rice value chains in Bangladesh and India were “geographically long” and “intermediationally shorten” indicating involved an orientation from subsistence to commercial agriculture in these zones near large cities, from selling to local final consumers toward selling to the big cities, and from selling to village traders to selling to wholesale market traders and mills. The findings of the study also revealed that the farmers captured about 60% of the final urban retail price of rice; which can be compared to about 23% in the US in 1998 and 37% in 1980 (Elitzak 1999), but it can also be compared to a much higher share of capture in traditional situations where farmers sold into local markets in their same villages.

Stryker (2008) concluded that major advances were made in rice competitiveness through liberalization of rice marketing and milling. This led to the introduction of small rice hullers, which were able to process rice relatively inexpensively compared with larger mills. There were also substantial savings in the cost of transporting paddy and the value for animal feed of the hulling byproducts. However, with rice prices having risen on world markets and with advances in milling technology, it is time to revisit this question. The imported rice with which domestic production competes is of a quality standard not met by most small hullers, resulting in price discounts and lost profits. Evidence from Rwanda and a few other countries suggests that milling technology currently exists that allows for upgrading of quality without necessarily losing the advantages of operating on a relatively small scale. Better milling should take care of the problems of impurities, lack of uniformity, and high percentage of broken grains. Complementary investment in storage should also ensure that adequate supplies of local rice are available year-round. This will not necessarily solve problems of taste, storability, cooking time, water absorption and other characteristics that are not apparent to the eye.

Rice bran**,** a by-product of rice milling industry consists of 9-12% biomass of brown rice and about 8% of rough rice (Houston, 1972). Rice bran is also sometimes called cargo or cow bran. Rice bran is commerce is a considerable mixture of substances including the polish. The terms bran and polish, through according to the suggestion of the FAO differ, however, bran includes a by-product from the milling of rice, consisting of the outer bran layers of the kernel with part of germ; while „polish‟ or „polishing‟ a by-product from milling rice consisting of the inner bran layers of the kernel with the part of the germ and small portion of the starchy interior. According to (Juliano, 1985) polish (white bran) is a by-product of brown rice whitening process and constitutes about 2-3% of rough rice.

Cicero et al. (2001) observed that the use of rice bran oil and gamma-orayzonol in the treatment of hypoproteinaemias and other condition.Rice bran oil and its main components (unsaturated fatty acids, triterpene alcohols, phytosterols, tocotrienols, and alpha-tocopherol) have demonstrated an ability to improve the plasma lipid pattern of rodents, rabbits, non-human primates and humans, reducing total plasma cholesterol and triglyceride concentration and increasing the high-density lipoprotein cholesterol level. Other potential properties of rice bran oil and gamma-oryzanol, studied both in vitro and in animal models, include modulation of pituitary secretion, inhibition of gastric acid secretion, antioxidant action and inhibition of platelet aggregation. This paper reviews the available data on the pharmacology and toxicology of rice bran oil and its main components with particular attention to those studies relating to plasma lipid altering effects.

Gopal-Krishna *et al*. (2001) studied on effect of refining of crude rice bran oil on the retention of oryzanol in the refined oil. The effect of different processing steps of refining on retention or the availability of oryzanol in refined oil and the oryzanol composition of 18 Indian paddy cultivars and commercial products of the rice bran oil (RBO) industry were investigated. Degumming and de- waxing of crude RBO removed only 1.1 and 5.9% of oryzanol while the alkali treatment removed 93.0 to 94.6% of oryzanol from the original crude oil.

Rahman (2009) studied on the prospect of rice bran oil production in Rangpur district. In Rangpur district, 0.23 million tons of rice bran can be obtained from 3 million tons of paddy. In Bangladesh context, the study observed that the potential bran oil production was found to be 0.134 million tonnes to 1.05 million tonnes rice bran. The number of rice bran oil mills that can be established in Bangladesh was estimated to be 35 with a minimum processing capacity of 100 tonnes bran per day with 300 days of operation per year. Such a rice bran oil mill can produce about 12.8 tonnes edible oil per day.

Sharif (2009) studied on rice industrial by products management for oil extraction and value-added products. From the present investigation it was concluded that rice bran has a potential to be used for oil extraction and preparation of value-added products like cookies, leavened pan bread. The author also analyzed and evaluated the physical and chemical characteristics of rice bran, fatty acid profile and antioxidants potential of rice bran sample etc. After crude oil has been extracted from rice bran, De-Oiled Rice Bran (DORB) is obtained. It should be in the pellet form. After extraction DORB must contain 8% Protein,28% Fiber, 14.50% Sand & Silica, 10% Moisture. DORB is one of the most important raw materials of feed production. Feed mills of Bangladesh mainly collect DORB from rice bran oil mills.

Mahmud (2010) worked on a project named an overview of a fish feed industry and it‟s operational &management approaches. The author observed that a field level study on fish feed industry operation (SHUSOMO feed limited) was carried out to know the feed formulation procedure and plant operation. During manufacture of feed meat and bone meal, de-oiled rice bran, dry fish, fish meal, rape seed, soybean meal having high content of protein are used as protein sources and rice polish, oil are used as lipid source and flour is used as binder. Different types of vitamins are used: for example, fish grower contains vitamin A, D, E, K, pantothenic acid, folic acid, biotin. The fish grower also contains mineral like copper, iron, manganese, zinc, amino acid like lysine, all are used for growth promoter of fish.

Sasithorn Sunphorka *et al*. (2012) studied on protein and sugar extraction from rice bran and de-oiled rice bran using subcritical water in a semi-continuous reactor: optimization by response surface methodology. The extraction of protein and sugar from rice bran and de-oiled rice bran using subcritical water was evaluated in a 30-ml semi-continuous reactor. The effects of the three main factors, operating temperature, time and pressure, on the total sugar and protein yields obtained were investigated using analysis of variance and response surface methodology. The developed models had a very high regression coefficient (R^2) value (0.94–0.98), and demonstrated that the three main factors investigated had a significant effect on the sugar yield, whilst only time and its interaction with temperature were significant factors controlling the extracted protein yield. Based on the response surface and contour plots, the optimum conditions were evaluated for maximal extracted sugar and protein yields, which reached 100% for protein, from the two materials.

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Appendix (A): Table

Appendix Table-1: Details of chemical costs incurred for producing rice bran oil (Tk./ton)

Cost Items	Quantity (kg)	Price (Tk/kg)	Amount (Tk/ton)
Rice Bran Cost	6500	22	**143000.00**
Total Chemical Cost:			**7202.28**
i) Hexane	9.00	119	1710.00
ii) Citric acid	0.54	15	8.10
iii) Phosphoric acid	2.70	200	540.00
iv) Bleaching earth	60.00	62	3720.00
v) Activated carbon	10.14	105	1064.70
vi) Salt	6.30	25	157.50
vii) Caustic soda	0.06	33	1.98

Source: Field survey 2017

Appendix Table-2: Administrative cost of rice bran oil production (Tk/ton)

Cost Items	Tk/ton
Audit Fees	28.75
Board Meeting Fees	1.75
Computer Accessories	18.42
Depreciation	804.10
Dish Bill	1.84
Donation & Subscription	49.18
Electricity Bill	27.03
Food & Entertainment	105.54
Consultancy & Other Fees	137.50
Internet & Server Expenses	48.32
MD’s Remuneration	56.25
Miscellaneous Expenses	66.45
Mobile & Telephone Bill	74.01
Newspaper & Periodicals	0.92
Office Maintenance	81.02
Office Rent	156.66
Postage & Courier	10.17
Printing & Stationery	36.83
Registration & Renewals	208.26
Salary & Allowances	593.98
Travelling & Conveyance	99.32
Vehicle Maintenance	219.78
Write off of Intangible Assets	166.38
Water Bill	1.75
Total Administrative Cost	**2994.21**

Source: Field survey 2017

Appendix Table-3: Marketing cost of rice bran oil production (Tk/ton)

Cost Items	Tk/ton
Packing Material	3934.64
Stores & Spares	992.10
Advertisement	799.97
Delivery Expenses	497.08
Electricity Bill	8.30
Food & Entertainment	16.08
Office Rent	94.42
Printing & Stationery	12.99
Salary & Allowances	1610.95
Sales Promotion Expenses	679.28
Sample Expenses	13.19
Marketing Office Maintenance	26.47
Vehicle Maintenance	5.69
Trade Fair	321.47
Training Expenses	16.06
Total Marketing Cost	**9028.67**

Source: Field survey 2017

Appendix Table-4: Returns (Tk. /ton) from byproducts of rice bran oil

SI No:	Items	Quantity (kg)	Price (Tk/Kg)	Amount (Tk)
1	DORB	5070	16	81120
2	Wax	55	10	550
3	FFA	185	37	6845
4	Gam	24	28	672
Total returns from byproducts				**89,187**

Source: Field survey 2017

Appendix Figure: B

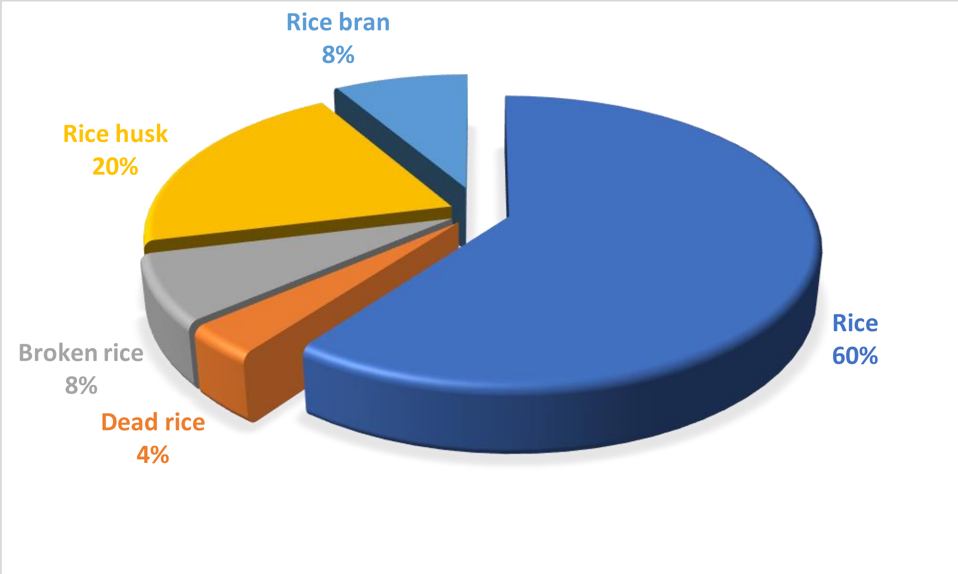

Fig 1: % share rice and its byproducts for parboiled fine rice

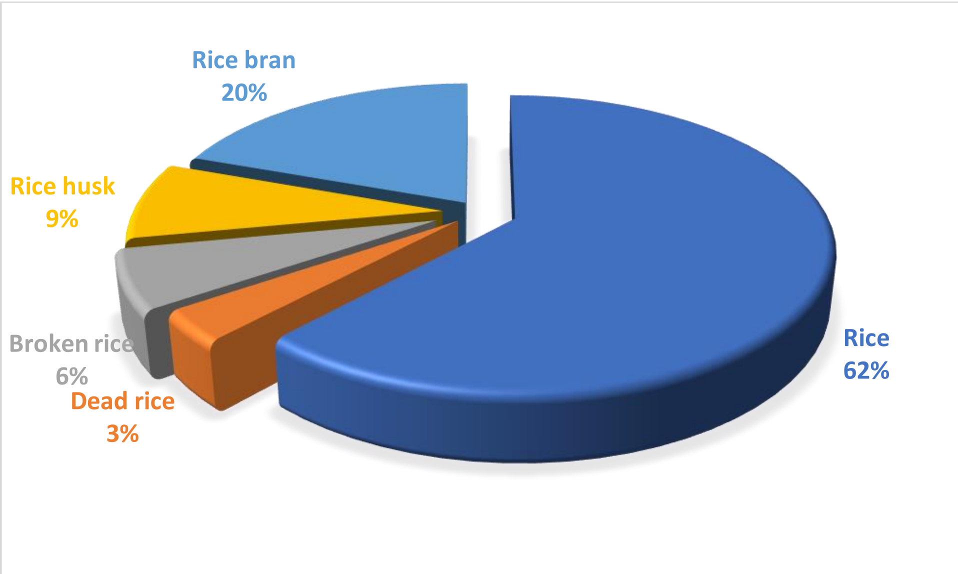

Fig 2: % share rice and its byproducts for parboiled course rice

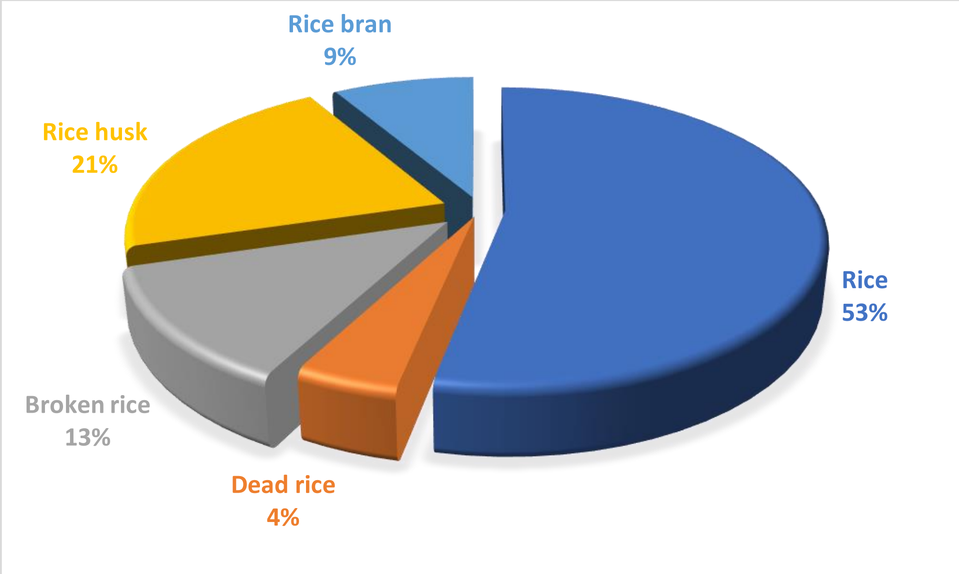

Fig 3: % share rice and its byproducts for aromatic rice

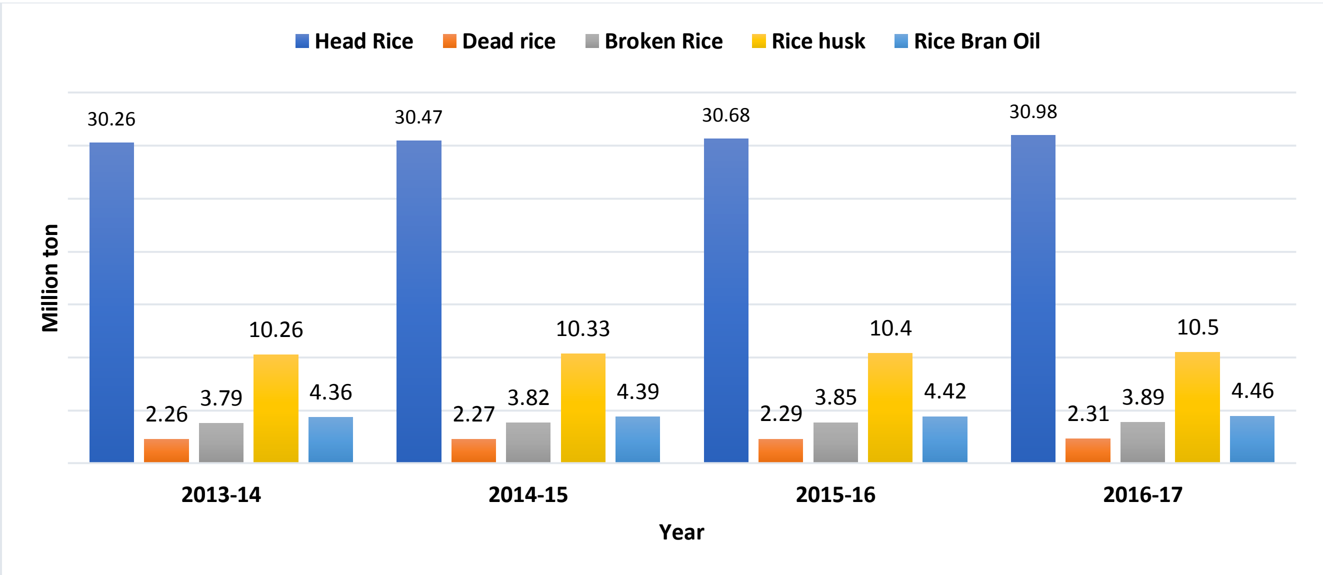

Fig 4: Amount of rice and its byproducts production from 2013 to 2017 in Bangladesh

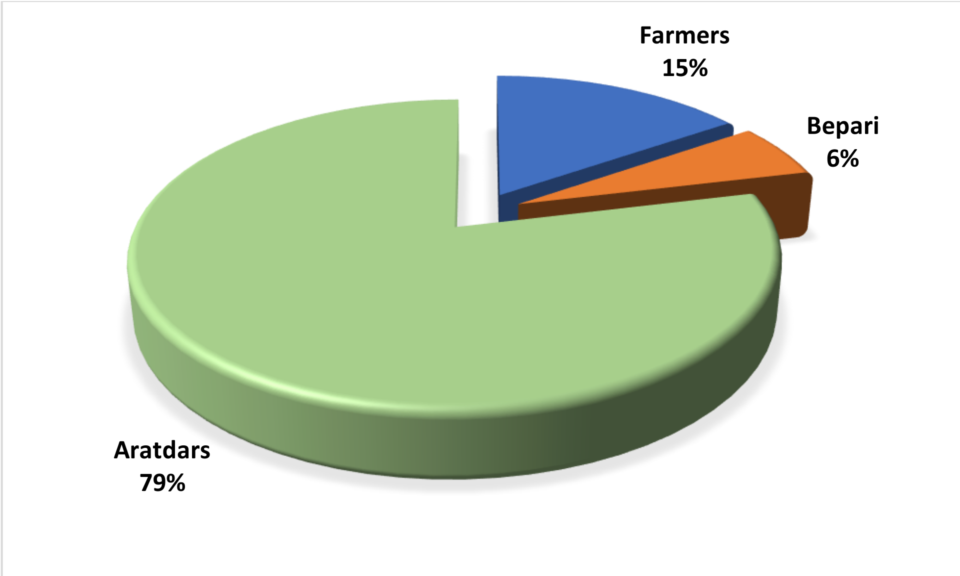

Fig 5: Share of paddy supplied to the millers by farmers, bepari and aratdars in the study areas

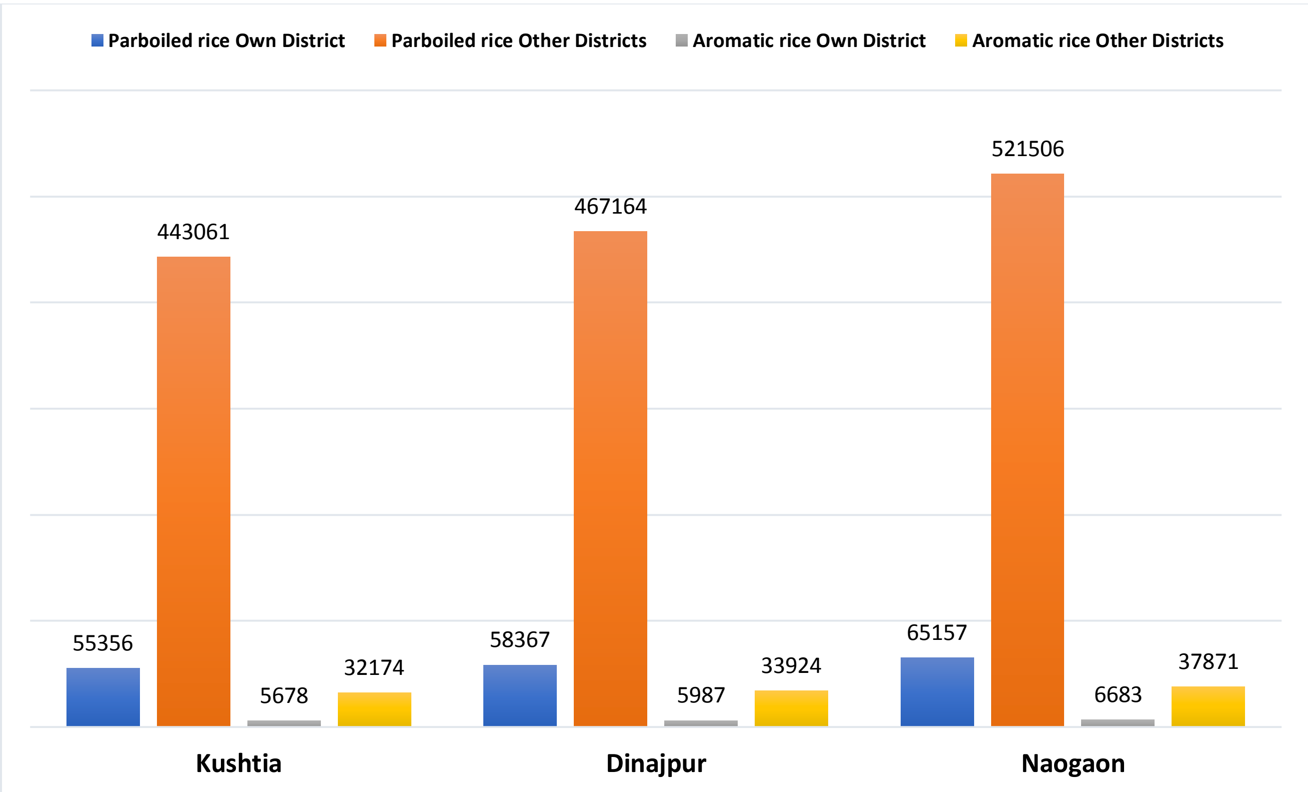

Fig 6: Trading scenario of parboiled and aromatic rice in the study areas (in '000' tones) in 2017

Some snapshots (Figs 1 to 9) on data collections are shown below.

		
Fig 1: Visiting Auto rice mill, Mymensingh	Fig 2: Interviewing with Manager at auto rice mill, Mymensingh	Fig 3: Focus group discussion with farmer, Kustia
		
Fig 4: Interviewing with paddy traders, Kustia	Fig 5: Interviewing with paddy farmer, Kustia	Fig 6: : Interviewing rice bran party, Kustia
		
Fig 7: Interviewing rice bran party, Kustia	Fig 8: Interviewing broken rice party, Kustia	Fig 9: Interviewing husk party, Kustia
		
Fig 1: Visiting Auto rice mill, Mymensingh	Fig 2: Interviewing with Manager at auto rice mill, Mymensingh	Fig 3: Focus group discussion with farmer, Kustia

		
Fig 4: Interviewing with paddy traders, Kustia	Fig 5: Interviewing with paddy farmer, Kustia	Fig 6: : Interviewing rice bran party, Kustia
		
Fig 7: Interviewing rice bran party, Kustia	Fig 8: Interviewing broken rice party, Kustia	Fig 9: Interviewing husk party, Kustia

Data collection from Auto rice mill	Packaging of Head rice

Broken rice	Dead rice

Packaging head rice	Head rice

Data collection from Bran party

Data collection from Husk party

Data collection from paddy traders *(Faria)*

Data collection from paddy traders *(bepari)*

	
Farmers level data collection	Farmers level data collection from market

	
Data collection from rice bran oil mill	Rice bran

	
Rice bran oil mill	Rice bran collection from auto rice mill