VALUE CHAIN ANALYSIS OF FREE FATTY ACID OF RICE BRAN OIL IN BANGLADESH

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Abstract

The study was conducted at Emerald oil mill and Poultry Industries Limited, Sherpur and Square Toiletries Ltd. at Shalghoria, Pabna to assess the financial analysis of the rice bran oil mill and to determine the value chains system of rice bran edible oil chemical by-products specially free fatty acid and actors involved in marketing of FFA in Bangladesh during the year 2013-2014. Tabular and statistical analyses were done. Results revealed that the rice bran edible oil was produced as the main product (7948 t/mill/year), and de-oil rice bran (39600 t/mill/year), free fatty acid (1495 t/mill/year), gum (332 t/mill/year), wax (329 t/mill/industry) and splint earth (808 t/mill/industry) products were also produced as chemical by-products in oil mill. Free fatty acids, gum and wax were used in soap factories. The oil mill purchased 49,500 tonnes of rice bran annually. Total cost of production was estimated at lakh Tk. 13969.85 and total variable cost was lakh Tk. 13032.98. Gross return of the oil mill was calculated at lakh Tk. 14838.03/year and lakh Tk. 867.10 was obtained from free fatty acids annually. The net profit lakh TK. 868.18/year/ industry was achieved from rice bran, while the FFA earned Tk. 30344 per ton as net profits. The benefit cost ratio was 1.06 in the oil mill. The higher return on investment was gained in free fatty acid. Minimum marketing cost was found in shorter chain-I (Oil mill – soap factory) and longer chain-III (Oil mill – Commission agent 1 – Commission agent 2 – Soap factory) produced maximum marketing cost in the FFA value chain system. Total marketing margin and total profit were achieved Tk. 10.50/kg and Tk. 2.90/kg, respectively. Free fatty acid as a chemical by-product in rice bran oil processing has esteemed market value in soap factories that contribute to the national economy.

Keywords: Rice bran edible oil, Free fatty acid, Profitability, Value chain

Introduction

Rice is the main cereal crop in Bangladesh and its production was about 35.85 million tonnes in 2019-20 (USDA, 2021). Rice kernels are composed of roughly 20% rice husk, 11% bran layers, and 69% starchy endosperm in milled rice

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(Dhankhar, 2014). Moreover, rice bran, rice husk, and broken rice are used as industrial and bioactive products for humans and animals (Rohman *et al.*, 2014). The potential bran oil production is found to be 0.134 to 1.05 million tonnes of rice bran in Bangladesh and about 35 oil mills need to be established with a minimum capacity of 100 tonnes bran per day with 300 days per year. Such a rice bran oil mill can produce about 12.8 tonnes edible oil per day (Rahman, 2009). Twenty five lakh tonnes bran are produced in our country whilst RBO industries utilizes only 13 lakh tonnes of rice bran to produce 2.58 lakh tonnes of rice bran oil, rest of the bran is used in poultry farm or fish industries. But domestic sources can provide 36.15 lakh tonnes rice bran (Ali *et al.,* 2015).

Approximately, ∼10–23% rice bran oil (RBO) is found in rice bran (Friedman, 2013). Rice bran consists of fat (10-23%) and unsaponifiable components (4.2%) (Sharif *et al.*, 2014). Rice bran oil contains raw oil 21.44% and its constituents of unsaturated fatty acids as linoleic acid (35.26%), oleic acids (48.48%), palmitic acid (14.54%) and free fatty acid (8.15%) which are more nutritional and beneficial (Gul *et al.*, 2015; Zúñiga-Diaz *et al.*, 2017). Chemical compositions of saturated and unsaturated rice bran free fatty acid in rice bran oil have added valuable utilization in cooking and industry, and alternative to palm oil (Oluremi *et al.*, 2013). Free fatty acid (FFA) is obtained in the extracted rice bran oil that is defined as non-edible oil, while it is also used for soap production and animal feed (Rajan and Krishna, 2009). Higher amounts of free fatty acids release hydrolytic enzymes and the large amount of soaps are produced by using free fatty acids (Singh and Singh, 2009).

Exactly, rice bran contains 10-23% crude oil and 70-80% DORB. After refining of 10-23% crude oil, 78% edible oil and 22% chemical by-products are also found. Wax (2-3%), gum (2-3.5%) and free fatty acid (10-14%) are released as chemical by-products in the rice bran edible oil extraction process. The chemical by-products especially free fatty acid (FFA) results in good usage to soap factories and cosmetic factories, and its potential effect for value addition. Rice bran contains a high amount of three types of fatty acids such as palmitic, oleic and linoleic. The extracted fatty acids in rice bran help in raising high-density lipoprotein (HDL) as "good cholesterol." Distilled rice bran fatty acid contains vitamin E complex lipids, lecithin, tocotrienol, T_3squalene, phytosterol 5% and 2.5% oryzanol. They are used in dressing and frying, and it is an excellent raw material for food making. Rice industrial by products management for oil extraction and its value added products (cookies & leavened pan bread) are studied (Sharif, 2009). The physical and chemical characteristics of rice bran, fatty acid profile and antioxidants potential of rice bran sample are also analysed (Sharif, 2009).

Evidently bran comes from rice mills that are utilized in the rice bran oil mill at a large scale. Rice bran edible oil is the main product of the rice bran oil mill. On the other hand, FFA is an important by-product and a huge amount of FFA is

produced each year. The FFA is a very efficient ingredient for soap making purpose. The oil miller sells the FFA to the soap factory through commission agents. Finally FFA is used to make the Chaka laundry soap and Chaka ball soap under Square toiletries Ltd., and the end user of the FFA is Laundry soap and Ball soap consumer.

Many commission agents in the supply chain system earn a huge amount of money between distributor and local market (BIFT, 2016). Consequently, value is changed in transportations. Product quality in each step of the supply chain is predicted early while good flows can be controlled and comprehensive chain results in quality product availability and less product losses in retailers (Van Der Vorst *et al*., 2014).

Eventually, the value chain is an important element in improving profitable business. As the service progresses in the value chain, it adds value with the company to turn a profit by the time and the product or service is finally delivered to the consumer. Value chain is the whole series of activities that create and build value at every step. However, in-depth analysis of the value chain of rice bran oil chemical by-products FFA has contributed to efficient utilization for better economic return. Moreover, no research finding in published form on value chain analysis of rice bran free fatty acid was found before this study in Bangladesh. But it is important for business men and policy makers for better utilization of FFA. With this view in mind, the present study was designed with the following specific objectives:

1. To assess the financial analysis of the rice bran oil mill;

2. To determine the value chains system of rice bran edible oil chemical by-products specially free fatty acid and actors involved in marketing of FFA in Bangladesh and

3. To identify the key constraints to FFA usages and its opportunities in soap factory.

Materials and Methods

The study was conducted at two factories such as Emerald oil mill and Poultry Industries Limited, Sherpur and Square Toiletries Ltd. at Shalghoria, Pabna. Square Toiletries Ltd. Shalgaria, Pabna factory produced Chaka ball soap and Chaka laundry soap. The Rice Bran Free Fatty Acid (FFA) was used in making soaps.

Survey questionnaire: A set of semi-structured questionnaire was prepared to collect data from key informants (KI) experts from the relevant fields and selected rice bran oil mill as well as soap factory. Besides, a checklist was developed for KIs. The draft questionnaires and checklist were pre-tested and necessary corrections, modification and alterations were prepared accordingly.

Finally data were collected from KIs using pre-tested questionnaire during the year 2013 - 2014.

Analytical techniques: The collected data were analyzed by tabular and statistical methods. The profitability of the rice bran oil mill and soap factory was examined on the basis of gross margin, net return and rate of return over cost.

Cost estimation: Profitability of FFA in the processing of rice bran oil and soap production was calculated on the basis of financial analysis as fixed and variable costs. Fixed costs were the costs that were independent from the size of production. Fixed costs generally included as depreciation (D), interest on investment (I), taxes (T), insurance (In) and cost of housing or shelter (S). These were dependent on the calendar year and they were used independently. Depreciation cost of the machine was determined by the Sinking Fund Method.

Interest on investment was determined using the following formula:

Interest on investment, $I = (\dfrac{P + S}{2}) \times I$

Where, P= Purchase price, S = Salvage, i = Interest rate

Interest on investment was taken as average value considering 10% interest rate. The cost of taxes was considered as 1.4% purchase price of the machine and equipment. The cost of insurance was considered at 0.25% of purchase price of the machine and equipment. The rice miller has to pay the amount of money for the land or the value, he gets from the investment of the rice mill area was considered as opportunity cost of land. The depreciation cost of the building was determined by the Sinking Fund Method also assuming the life of the brick building 100 years and the metal roof sheds 50 years.

In a small mill, staff salary is negligible because mill owners themselves operate and maintain the mill. Sometimes they use labour for operation. Current value of the salary for the staff was considered as management cost.

Variable costs of rice bran processing oil mill were estimated by the cost of bran, labour, chemicals, repair & maintenance, electricity used of the machines etc. as per year basis.

Returns: Returns were calculated by multiplying the volume sold (Q) with the selling price (P) and, subsequently, by adding additional sources of income, such as revenues of selling the production waste of a product.

Returns = $(Q \times P)$

Where Q = Volume of product sold, kg

P = Selling price Tk/kg

Value chain analysis:

Analytical technique of value chain: The collected data and information were summarized to tabular form which included classification of tables in meaningful results by using the arithmetic mean, percentage and ratio. For FFA marketing, the involvement of intermediaries in marketing channels were identified, and marketing costs and margins were determined by using the following formula and the estimated values were placed in tables for understanding. Supply chain, value chain and value addition to FFA was shown by flow channel.

Marketing cost: Marketing cost was the sum of transport cost, storage cost, labour cost and other costs that were associated with moving commodity from the point of purchase to the customer or final consumer. The total marketing cost was determined by the following formula

$$Tc = Cp + \sum Mci$$

Where, i=1; Tc= Total cost of marketing; Cp= Producer cost of marketing; Mci= Marketing cost by the ith trader

Marketing margin: The absolute margin of the middleman, wholesaler, trader and retailers was determined as follows

$$Mm = Psa - (Pba + Mc)$$

Where, Mm = Marketing margin; Psa = Selling price; Pba = Buying price; Mc = Marketing cost. The cost of marketing was calculated and the lowest cost of marketing channel was ranked I and that of the highest cost marketing channel was considered as last one. The same approach was followed in ranking the margin of middlemen in each channel.

Results and Discussions

Emerald oil mill and Poultry industries Ltd: Basic information was recorded on various items of Emerald oil mill and Poultry Industries Ltd. factory which was founded in 2008 covering 1.22 ha land (Table 1). The total number of manpower (permanent and temporary) was 350 and its establishment cost was at lakh Tk.5000. Rice bran oil (7948 tonnes) was produced as the main product and byproducts were released as 39600 tonnes DORB, Free fatty acid 1495 tonnes, Wax 329 tonnes, Gum 332 tonnes and 808 tonnes of splint earth in a year. Various chemicals viz. 74250 tonnes, 4455 tonnes, 22275 tonnes, 495000 tonnes, 83655 tonnes, 51975 tonnes and 495 tonnes were used in hexane, citric acid, phosphoric acid, bleaching earth, activated carbon, salt and costic soda, respectively in rice bran oil processing. Laboratory chemicals were also required at lakh Tk. 20.00 in this factory. These chemicals were needed in different steps of processing rice bran oil. Hexane was applied for separation of DORB from crude rice bran oil. Citric acid and phosphoric acid were required for the degumming process in the oil refining sector. Bleaching earth was used to reduce

the color of bran oil and also separated the splint earth. Application of Nacl in the boiler section and costic soda were used for the separation of FFA from the rice bran edible oil.

Square Toiletries Ltd: The factory was established in 1988 and its area was 0.18 ha. The factory had permanent manpower of 150 numbers and temporary manpower was 50 numbers. The factory produced 5000 tonnes of Chaka laundry soaps and Chaka ball soaps, and its turnover was attained at lakh Tk. 48300, while its establishment cost required lakh Tk 60000. Different chemicals such as 750 tonnes, 1750 tonnes, 150 tonnes, 600 tonnes, 500 tonnes and 0.65 tonnes were required in NaOH, palm fatty acid, coconut oil, RBD (Refined, bleached, and deodorized) palm stearin, palm oil and nerolin yeara yeara, respectively in soap production during the year 2013.

Table. 1. Basic information of Emerald oil mill and Poultry industries limited, and Square Toiletries Ltd. Shalghoria, Pabna

Items	Emerald oil mill and Poultry Industries Ltd.	Items	Square Toiletries Ltd. Shalghoria, Pabna
Factory area (ha)	1.22 ha	Factory area (ha)	0.178 ha
Establishment year	2008	Establishment year	1988
Total manpower (nos.)	350	Total manpower (nos.)	permanent 150 Temporary 50
Establishment cost (lakh Tk.)	5000	Establishment cost (lakh Tk.)	60000
Main product (t/yr):		**Main product (t/yr):**	
Rice bran oil	7948	Chaka ball soaps and Chaka laundry soaps	5000
By-products (t/yr):		Turn over ((lakh Tk.)/yr	48300
De-Oil Rice Bran (DORB)	39600	Naoh (t/yr)	750
Free Fatty Acid (FFA)	1495	Palm fatty acid (t/yr)	1750
Wax	329	Coconut oil (t/yr)	150
Gum	332	RBD palm stearin (t/yr)	600
Splint earth	808	Palm oil	500
Used raw materials (t/yr):		Nerolin yeara yeara (t/yr)	0.65
Rice bran	49500		
Hexane (T/yr)	74250		
Citric acid (T/yr)	4455		
Phosphoric Acid (T/yr)	22275		
Bleaching Earth (T/yr)	495000		
Activated carbon (T/yr)	83655		
Nacl (T/yr)	51975		
Costic Soda (T/yr)	495		
Laboratory chemicals (Tk/yr)	20.00		

Annual cost of production of rice bran oil and its by-products FFA

The annual cost of production was calculated on the basis of total variable cost and total cost. The annual total cost of production of rice bran oil was estimated at lakh Tk. 13969.85 and its by-products FFA achieved at lakh Tk.13032.98 per industry (Table 2). Rice bran cost was composed of the lion share (76.77%) of total cost followed by fixed cost (6.71%), while interest on operating capital attained 4.44% and chemical cost was 4.33%. Similar findings were reported by Kabir *et al.* (2016).

Table 2. Annual cost of production of rice bran oil and its by-products FFA

Item	Cost (lakh Tk./industry/year)	% of total cost
A. Fixed cost		
Depreciation of machines	11.06	0.08
Interest on investment on machines	163.35	1.17
Taxes	25.20	0.18
Insurances	4.50	0.03
Stuff salary	550.00	3.94
Depreciation of building	0.26	0.00
Interest on investment on building	181.50	1.30
Opportunity cost of land	1.00	0.01
Total fixed cost (A)	**936.88**	**6.71**
B. Total Variable cost		
Rice bran	10724.18	76.77
Labour	88.78	0.64
Repair and maintenance	200.00	1.43
Electricity	0.72	0.01
Gas bill	432.00	3.09
Lubricant	350.00	2.51
Tax	12.00	0.09
Chemical cost :	604.69	4.33
Interest on operating capital	620.62	4.44
Total variable cost (B)	**13032.98**	**93.29**
Total cost (A+B)	**13969.85**	**100.00**

Annual outputs and returns from rice bran oil and its by-products FFA

Annual outputs: Annual total quantity of outputs of rice bran oil and its by-products FFA etc. was found to observe 50512 t/industry as presented in table 3. The main product rice bran oil (packed oil and loose oil) was computed at 7948 t/industry/year that is 16% of total rice bran, while the DORB, FFA, Wax, Gum and Splint earth were 39600, 1495, 329, 332 and 808 t/industry/year, respectively. Similar result was found by (Friedman, 2013). Ali *et al.,* (2015) reported that 7.96 lakh tonnes bran oil was produced from 38.5 lakh tonnes of rice bran. Ali *et al.* (2015) also observed that DORB was found as a by-product in pellet form in crude oil processing and it was used for feed production. Henderson *et al.* (2012) reported that rice bran oil, which has some components with biological effects is attributed with fatty acid and flavonoid. The Highest amount of edible oil 7948 t/year and valuable by-products as DORB, free fatty acid, gum, wax and splint earth were exerted in bran oil processing as reported (Kabir *et al.*, 2016).

Annual returns: Annual total returns of rice bran oil and its by-products FFA etc. was earned lakh Tk. 14838.03/industry (Table 3). Maximum (53.19%) share of returns was observed in rice bran oil and minimum share (0.11%) was in both gum and splint earth, while FFA exhibited (5.84%). It was evident that 15.74% refined oil was found to occur in crude oil and the free fatty acid showed 2.96%. Kabir *et al.* (2016) found that maximum return was obtained from refined oil in bran oil processing and remarkable return was obtained in FFA while gum and splint as minimum.

Table 3. Annual outputs and returns from rice bran oil and its by-products FFA

Items	Quantity (t/industry/year)	Price (Tk/lt/kg)	Return (lakh Tk/industry/year)	% of total returns
Packed oil	155 (0.31%)	165	255.75	1.72
Loose oil	7793 (15.43%)	98	7637.14	51.47
DORB	39600 (78.39%)	15	5940.00	40.03
Free Fatty Acid	1495 (2.96)	58	867.10	5.84
Wax	329 (0.65%)	32	105.28	0.71
Gum	332 (0.66)	5	16.60	0.11
Splint earth	808 (1.60)	2	16.16	0.11
Total	**50512**		**14838.03**	100.00

Profitability of rice bran oil and its by-product FFA production

The annual gross margin and net return/profit of rice bran oil and its by-product FFA etc. was estimated at lakh Tk. 1805.05/industry and lakh Tk. 868.18/industry, respectively (Table 4). The benefit cost ratio of rice bran oil and

its by-product FFA etc. was obtained 1.06. The annual net margin of the rice bran oil and its by-product FFA etc. showed at lakh Tk. 1718.76/industry while return on investment marked 0.06/industry. The net profit of rice bran oil mill was lakh Tk. 636.07 as studied by Kabir *et al.* (2016).

Rice bran oil: The total cost of rice bran edible oil per ton was calculated at Tk. 27656 and total variable cost was Tk. 25802 (Table 4). Gross return, gross margin and net return of rice bran edible oil per ton was found to have Tk. 99307, Tk. 73505 and Tk. 71650, respectively. Total costs and variable costs were determined by Kabir *et al.* (2015) in a survey report of the rice bran oil mill. Both gross return and net return resulted in significant output of rice bran edible oil in bran oil processing in Emerald oil mill that investigated the ways for further study as the factory was profitable.

Table 4. Profitability of rice bran edible oil and FFA production

Items	Industry/year
Gross return (lakh Tk)	14838.03
Total cost (lakh Tk)	13969.85
Total variable cost (lakh Tk)	13032.98
Gross margin (lakh Tk)	1805.05
Net return/profit (lakh Tk)	868.18
Benefit cost ratio	1.06
Net Margin (currency)	1718.76
Return on investment	0.06
Cost of rice bran edible oil (Tk/ton) @TC	27656
Cost of rice bran edible oil (Tk/ton) @TVC	25802
Return of rice bran edible oil (Tk/ton)	99307
Net return of rice bran edible oil (Tk/ton)	71650
Gross margin of rice bran edible oil (Tk/ton)	73505
Cost of FFA (Tk/ton) @TC	27656
Cost of FFA (Tk/ton) @TVC	25802
Return of FFA (Tk/ton)	58000
Net return of FFA (Tk/ton)	30344
Gross margin of FFA (Tk/ton)	32198

Free Fatty Acid (FFA): The cost of FFA per ton was calculated at Tk. 27656 and Tk. 25802 on the basis of total cost and total variable cost, respectively (Table 4). Gross return, gross margin and net return of FFA per ton was found to be Tk. 58000, Tk. 32198 and Tk. 30344, respectively. Total cost and net return of

FFA in this study were found to show profound effect in rice bran oil processing as its importance in value chain analysis.

Mapping the Value Chains

The value chain mapping of FFA in graphical form and all the major actors of oil and FFA processing value chains were presented. It involved the main actors in the processes, flows of products with volume percentage in the value chain.

Actor mapping in FFA value chain

Actor mapping is one of the important steps in value chain analysis. Actor mapping showed the performance of the people who were involved in the chain. Mapping of FFA was started from a rice mill. Commission agents collected the bran from the automatic and semi- automatic rice mills and delivered to the oil mills. Bran oil was extracted from rice bran with the chemicals in the oil mill extraction process, and refined oil was gained from crude oil. As a result, FFA, DORB, wax, gum and splint earth were produced as the main oil milled by-products. There were so many chains observed in the value chain system of FFA. One was: the oil miller sold the FFA to the soap factory directly. Another was: the oil miller sold the FFA to the commission agents and they sold to soap factory and the third was: the oil miller sold the FFA to the commission agents and they sold to another commission agents and the second commission agents sold to the soap factory. The actor mapping of the FFA value chain is shown in Figure 1.
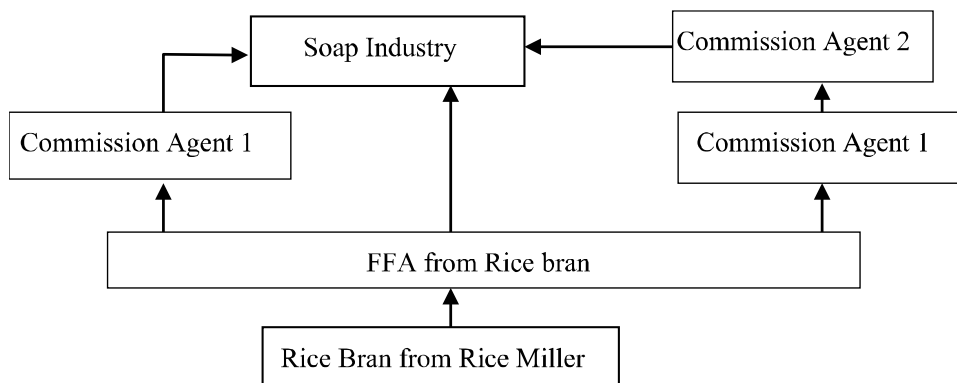
Actor mapping of FFA value chain

Fig. 1. Flow diagram of Actor mapping of FFA value chain.

Product mapping with volume percentage in FFA value chain

In the oil mill by processing rice bran, rice bran edible oil was found as the main product. Different types of chemicals and mechanical procedures were used for the extraction of rice bran edible oil and FFA etc. Crude oil was

separated from the rice bran after the extraction process and the retained rice bran was called DORB. Free fatty acid was obtained from chemical by-products. The FFA was used in soap factories for making soap. The flow of products is shown in Figure 2.
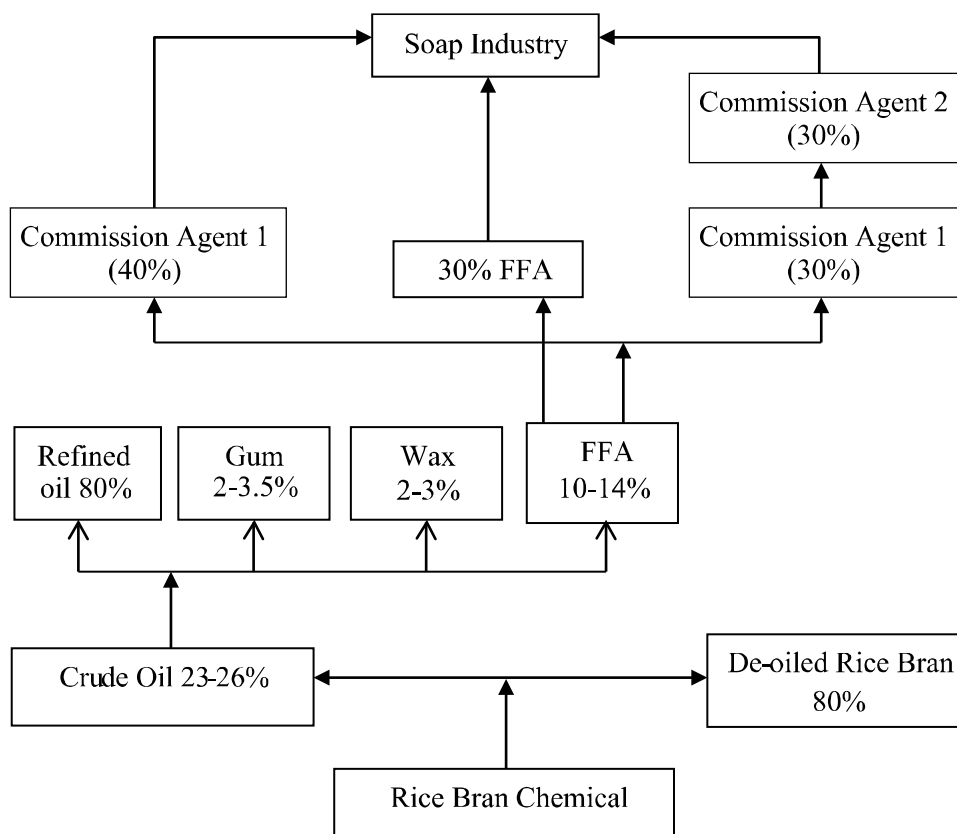
Volume Mapping of FFA Value Chain

Fig. 2. Flow diagram of product mapping with volume of FFA value chain.

Marketing cost of FFA

Marketing costs narrated the cost of performing various marketing functions which were needed to transfer a commodity from the place of production to the ultimate consumers. Mainly FFA was marketed in three ways where commission agents were found to be involved. Marketing costs for each kg of FFA were estimated to be Tk. 0.45, 1.99 and 2.06 for oil mill owner, commission agents and soap factories, respectively (Table 5).

Supply chains of the FFA marketing

Chain-I: Oil mill ————→ Soap factory

Chain-II: Oil mill ————→ Commission agent 1 ————→Soap factory

Chain-III: Oil mill ————→Commission agent 1————→Commission agents 2
————→Soap factory

Table 5. Total marketing cost of stakeholders and intermediaries involved in FFA marketing (Tk/kg)

Cost items	Oil mill	Commission agents 1	Commission agents 2	Soap factory
Transportation, loading and unloading	0.15	1.22	1.22	1.22
Drum fare	0.00	0.41	0.41	0.41
wages	0.00	0.17	0.17	0.17
Godown fare	0.15	0.00	0.00	0.12
Security	0.05	0.00	0.00	0.05
Electricity	0.05	0.00	0.00	0.05
Telephone	0.05	0.05	0.05	0.05
Personal expenses	0.00	0.15	0.15	0.00
Total	0.45	1.99	1.99	2.06

Marketing margin and profitability of FFA marketed

Marketing margin was the price of all utilities with activities and functions that were performed by the intermediaries (Kohls and Uhl, 2005). Marketing margin was the percentage of the final weighted average selling price taken by each stage of the marketing chain. The margin covered the costs that were involved in transferring produce from one stage to the next and provided a reasonable return to those actors in the marketing activities (Crawford, 1997). Kaplinsky and Morris (2000) reported that the value chain explained that it was needed to transfer a product in different channels of production to the final consumer.

Marketing margin under Chain-I, Chain-II and Chain-III were calculated at Tk.2.51/kg, Tk. 3.74/kg and Tk. 4.24/kg, respectively (Table 6). Marketing profit was found to be Tk. 1.30/kg and Tk. 1.60/kg in Chain-I and Chain-II, respectively. In chain-I, there was no marketing profit because the soap factory purchased FFA directly from the oil mill. Total marketing margin and profit were Tk.10.50/kg and Tk. 2.90/kg, respectively. From the above findings, a significant amount of money was earned due to many commission agents in the supply chain system from distributor to local market which was studied by BIFT, 2016. Consequently, value was changed in transportations. Van Der Vorst *et al.* (2014) also reported that the supply chain was predicted in each step for product quality that showed quality product availability and fewer losses of product to the end user.

Table 6. Marketing margin and marketing profit of FFA (Tk./kg)

Particulars	Chain-I	Chain-II	Chain-III	Total marketing margin and profit
Purchase price (PP)	58.00	58.00	58.00	-
Marketing cost (MC)	2.51	2.44	2.64	-
Sales price (SP)	60.51	61.74	62.24	-
Marketing margin (MM=SP-PP)	2.51	3.74	4.24	10.50
Marketing profit (MP=MM-MC)	0.00	1.30	1.60	2.90

Constraints to rice bran FFA production and marketing in soap factory

The industries were hard hit by frequent load shedding of electricity that increased the cost of production. Capacity building of engineers, mechanics and skilled technicians were other major constraints to production. More commission agents may also increase the marketing cost of FFA production and marketing in the value chain system. Sometimes the soap factory was encountered in difficult situations to collect the quality free fatty acid from the rice bran oil mill. It is urged to think that chemical analysis of rice bran FFA with specified proportion of properties that are needed to be rendered as further study in alternate use of imported palm fatty acid for soap production.

Prospects of FFA in soap factory

Two types of soaps were produced such as Chaka ball soap and Chaka laundry soap in Square Toiletries Ltd. Imported palm FFA was used in making Chaka ball soap and Chaka laundry soap. Square Toiletries Ltd. imported palm FFA acid from Malaysia at a price of Tk. 80/Kg but our country rice bran FFA is available at a price of Tk. 58/Kg. If the soap factory uses rice bran FFA, the production cost would be lower than the use of palm fatty acid in soap production all over the country. People would be benefitted by lower priced soap and more value addition was created for FFA. Besides this, Alam soap factory Ltd. also used the rice bran free fatty acid as an alternative of RBD palm stearin in making no. 1pocha soap and laundry soap, while RBD palm stearin was imported at a price of Tk. 85/kg.

Free fatty acids were non-volatile monocarboxylic compounds that were important constituents as base for laundry and toilet soaps were investigated by the researchers Berneckė and Maruška (2013). Singh and Singh (2009) studied that rice bran of its abundant free fatty acid with hydrolytic enzymes were used in the soap factories. Rajan and Krishna (2009) indicated that released free fatty acids from the extracted oil of rice bran were used in soap production.

Conclusions and Recommendations

Oil mill produced a handsome quantity of rice bran edible oil, DORB and FFA. Oil mill produced a large quantity of 7948 tonnes of edible oil, DORB (39600 tonnes) and FFA (1495 tonnes) and its edible oil reached 15.74% over crude oil. Financial analysis revealed that production of rice bran oil and FFA was profitable according to gross margin and net return. In value chain analysis, it was found that shorter chain incurred lower cost and longer chain increased the highest marketing cost. Total marketing profit was also noted as Tk. 2.90/kg in this value chain. Value addition of FFA was evidently signified in soap production. Rice bran edible oil mills should be given prioritized attention in order to produce more rice bran oil that limits in importing edible oil, palm fatty acid as well as RBD palm stearin to save foreign currency. Public and private sector enterpreneurs are needed to establish modern technology based several rice bran processing units in the country to increase the amount of edible oil production as well as increase the amount of by products as FFA, which is used as an ingredient for making soap that can save the huge amount of foreign currency and create employment generation significantly. Successful business development strategies are also required with necessary plan engineer, spare parts, skilled manpower, and availability of gas and electricity supply for utilizing FFA in soap factories. Further study regarding chemical analysis of rice bran FFA are needed for searching alternate use of imported palm fatty acid and RBD palm stearin for soap production.

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