

## Study on Financial Parameters of Rice Bran Edible Oil Processing

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### Abstract

This study was undertaken to identify the automatic and semi-automatic rice mill by-products, the technological process of processing rice bran oil and to analyze the financial parameters of rice bran edible oil processing to investigate the ways and means for proper economic utilization of the milled rice by products, specially the bran. Two rice mills at Gouripur, Mymensingh and one rice bran oil mill at Sherpur were visited and interviewed with carefully designed survey questionnaire for identification of milled rice by products and assessing financial status of oil mill. This study identifies rice bran, husk and broken rice as by-products and whole rice as main product of automatic and semi-automatic rice mills. In processing rice bran, edible oil is produced as the main product and de-oil rice bran, free fatty acid, gum, wax, splint earth are also produced as by-products. De-oiled rice bran is used in fish feed and Poultry feed mill, free fatty acid gum and wax are used in soap factory and splint earth is used in brick field as fuel. In the year of 2011, the industry processed 49,500 tons rice bran, purchased from different rice mills. Total input cost of the industry was Tk. 11,32,88,628 including the cost of bran and chemical used. The total cost of processing operation was Tk. 28,98,38,952 and revenue was Tk. 1,48,63,32,396. The oil mill earned a net profit margin of Tk. 6,36,07,163 and value addition of products was Tk. 3,54,46,115 with a benefit-cost ratio of 1.1. There is a huge unmet market demand of the products of the rice bran edible oil mill in the country and there is abundant volume of supply rice bran from the existing automatic and semi-automatic rice mills. This is high time to establish new rice bran edible oil mills in the country to reduce dependency on imported edible oil and to save foreign currency.

**Key words:** Rice bran, De-oiled rice bran, Value addition, Benefit-cost ratio.

### 1. Introduction

Rice is the main cereal crop in Bangladesh and its production in 2011-12 was about 34 million tons (BBS, 2012). In the process of milling, rice produces whole rice and by-products as rice husk, rice bran and broken rice. Generally, paddy contains 60-67.5% rice, 22% husk, 5-8% bran and 1-2.5% broken rice (BRR, 2009). The present volume of paddy produces about 22.7 million tons of whole rice, 6.8 million tons of husk, 1.7 million tons of rice bran and 0.68 million tons of broken rice.

Rice bran is obtained from the outer layers of the brown rice kernel during milling to produce polished rice through whiteners and polishers. Bran composition is largely dependent on the milling process. In modern rice mills, different kinds of bran are produced: coarse bran (from the first whitening step) fine bran (from second whitening step) and polish (from the polishing step). Polish consists of part of the endosperm and is often referred to as

meal. Rice bran contains 10-23% bran oil. Bran oil once stabilized and extracted is a high quality vegetable oil for cooking and eating. Rice oil is extracted from the germ and inner husk of rice. Rice bran oil (RBO) is popularly used in many countries as cooking oil due to its high smoke point and delicate flavor.

The conventional use of rice bran is as ingredient for animal feeds, in particular ruminants and poultry. In recent years, however, advances in stabilization techniques have been made which has led to new uses for bran and its derivatives, notably bran oil for cooking and waxes for cosmetic products, free fatty acid and gum for soap factory, splint earth as a fuel in brick field.

Rice is the staple food of Bangladesh. Huge amount of rice bran is produced in our country every year. Though there is plenty of rice bran, but the oil extraction technology is not developed properly like India, Japan, Korea, and China. Due to some

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constraints and lack of public awareness most of the rice bran produced in the country is still being exported to India. In recent time, a portion of rice bran is being used for producing edible oil in few industries of Bangladesh, Emerald oil and poultry industry at Sherpur is one of them.

Recent studies show that about half of the profit margins gained by a modern rice mill are from rice mill by-products. However, very limited studies have been carried out for efficient utilization of rice mill by-products (Gopala-Krishna *et al.*, 2001) studied on effect of refining of crude rice bran oil on the retention of oryzanol in the refined oil. M. M. Rahman (2009) studied on the prospect of rice bran oil production in Rangpur district. Mian Kamran Sharif (2009) studied on rice industrial by products management for oil extraction and value added products. Therefore, in-depth financial studies of milled rice by-products would have been contributed in efficient utilization for better economic return.

This study involves with the financial assessment of rice bran edible oil processing to investigate the ways and means for proper economic utilization of the by-product.

The objectives of the study were:

1. To identify the milled rice by-products of automatic and semi-automatic rice mills;
2. To identify and analyze financial parameters of rice bran edible oil processing; and
3. To identify and assess key problems and opportunities of rice bran edible oil processing.

## 2. Materials and Methods

### 2.1 Selection of rice and edible oil processing mills

Boshak automatic and semi-automatic rice mills at Gouripur and Emerald Oil and Poultry Industries Ltd. at Sheripara, Sherpur were selected for this study. In Emerald oil mill, rice bran is used to produce rice bran edible oil.

### 2.2 Survey questionnaire

Semi-structured questionnaires were prepared according to the objectives of the study with active consultation with key informants, experts from the

relevant fields and secondary information. A set of semi-structured questionnaires were developed to assess the selected rice bran oil mill and milled rice by-products. Furthermore, a check list was developed for KIs. The draft questionnaires and check list were pre-tested and necessary corrections, modification and alterations were made accordingly.

### 2.3 Data collection method

Data were collected by personal interview through semi-structured questionnaires and Key Informant Interview (KII). During interview each question was explained to the respondent clearly and tried to find out fact as much as possible.

### 2.4 Cost estimation and analysis

In this study economic profitability of rice bran edible oil processing was determined based on financial analysis considering the fixed costs, variable costs, input costs (purchase price of bran and chemical costs) and opportunity cost of running capital involved in rice bran handling and processing.

#### 2.4.1 Fixed costs

Fixed costs are the costs that are independent from the size of production. Fixed costs generally include: depreciation (D), interest on investment (I), taxes (T), insurance (In) and cost of housing or shelter (S). These are dependent on calendar year and are clearly independent of use.

**Depreciation:** Depreciation is estimated by the sinking fund method as follows:

$$D = V_n - V_{n+1} \quad (1)$$

$$V_n = (P - S) \left[ \frac{(1+i)^L - (1+i)^n}{(1+i)^L - 1} \right] + S$$

$$V_{n+1} = (P - S) \left[ \frac{(1+i)^L - (1+i)^{n+1}}{(1+i)^L - 1} \right] + S$$

Where,  $D$  = Depreciation, Tk./yr,  $P$  = Purchase price of machine, Tk.,  $S$  = Salvage value of machine, Tk.,  $L$  = Life of the machine in year, yr,  $i$  = Interest rate,  $n$  = Age of the machine at the beginning of the year in this study, salvage value is assumed as 10% of the purchase price.

Interest on investment of machinery: The interest on investment is usually included in operational cost; since money is used to buy a machine cannot be used for other productive enterprises. Using the following formula, interest on investment was determined:

$$\text{Interest on investment, } I = (P+S) / 2 \times i \quad (2)$$

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

**Taxes:** The cost of taxes was considered as 1.4% of purchase price of the machine and equipment.

$$\text{Taxes, } T = 1.4\% \text{ of } P \quad (3)$$

**Insurance:** The cost of insurance was considered 0.25% of purchase price of the machine and equipment.

$$\text{Insurance, } Ins. = 0.25\% \text{ of } P \quad (4)$$

Where,  $Ins.$  = Insurance rate,  $Tk./yr$ ,  $P$  = Purchase price of machine and equipment involved,  $Tk.$

$$\text{Total fixed cost of machinery} = (1 + 2 + 3 + 4) \quad (5)$$

**Opportunity cost of land:** The amount of money the rice bran edible oil processing mill has to pay for the land or the value one might get from the investment of the rice mill area. The leased amount of land used in this oil mill was considered as opportunity cost of land.

$$\text{Opportunity cost of land (amount of leasing)} = Tk./yr \quad (6)$$

**Depreciation of building:** The value declination of the building infrastructure with the passage of time is the depreciation cost for building. The depreciation cost of the building was estimated Sinking Fund method using equation (1), assuming the life of brick building 100 years and the metal roofed sheds 50 years.

$$\text{Depreciation cost of building was estimated in } Tk./yr \quad (7)$$

**Interest on investment of building:** The interest on investment is usually included in operational cost estimate, since money is used for infrastructure cannot be used for other productive enterprises. Interest on investment is taken as average value times 10% interest rate.

$$\text{Interest on investment of building, } I = (P+S) / 2 \times i \quad (8)$$

Where,  $P$  = Purchase price,  $S$  = Salvage value,  $i$  = Interest rate.

**Management cost:** In small industry, staff salary is negligible and owners themselves operate and maintain the industry. However, in small and medium industries monthly fixed salaried staffs are used for operating the industry. The amount of salary for the staffs was collected through survey.

$$\text{Staff salary as management cost} = Tk. /yr \quad (9)$$

$$\text{Total fixed cost per year, } FC = (5+6+7+8+9) \quad (10)$$

#### 2.4.2 Variable cost

The variable cost of rice bran processing in oil mill was reflected by the cost of labour, repair & maintenances, energy use of the machines and varied to a large extent in direct proportion to hours or days of use per year.

**Labour cost:** In semi-automatic and automatic rice mill, large numbers of temporary workers are employed, on contract basis for parboiling, drying, cleaning, milling, polishing, and bagging and storage operations.

$$\text{Labor cost (Tk./yr), } L = Tk./day \times \text{No. of labour required in a year} \quad (11)$$

**Repair and maintenance cost:** Repair costs are the expenditure, for parts and labour for (i) installing replacement parts after failure, and (ii) reconditioning of renewable parts as a result of wear.

Maintenance cost (adjusting for wear and tear, greasing, etc.) and cost of labour required for maintenance, installing and replacement parts are items to be included as R & M cost.

$$\text{Repair and maintenance cost per year, } R \& M = Tk./yr \quad (12)$$

**Electricity cost:** The cost of electricity was determined by asking the monthly electricity bill by the miller.

$$\text{Electricity cost (Tk. /yr)} = Tk./ \text{month} \times 12 \quad (13)$$

**Tax:** Normally the large mill owners pay their income tax per year. Tax is imposed to the rice mill owner on the basis of electricity cost.

$$\text{Tax as a cost} = Tk./yr \quad (14)$$

**Cost of lubricant:** The cost of lubricant was estimated through survey.

$$\text{Cost of lubricant} = \text{Tk./yr} \quad (15)$$

**Cost of gas used:** The cost of gas used was determined by asking the monthly gas bill by the oil industry.

$$\text{Cost of gas (Tk. /yr)} = \text{Tk./ month} \times 12 \quad (16)$$

$$\text{Total variable cost} = (11+12+13+14+15+16) \quad (17)$$

**Cost of chemical:** The cost of chemical was considered as part of annual operating cost and estimated through survey.

$$\text{Cost of chemical (Tk. /yr)} = \text{Tk./ month} \times 12 \quad (18)$$

**Annual operating cost:** Annual operating cost is the sum of the yearly total fixed costs and total variable costs.

$$\text{Annual operating cost (AOC, Tk./yr)} = (10+17+18) \quad (19)$$

**Running capital (RC):** Running capital was considered for three months operation including cost of input purchased (rice bran + cost of chemical), labour cost and stuff cost.

$$\text{Running capital, (Tk.)} = (\text{Input costs} + \text{Labour cost} + \text{Stuff cost}) \text{ for 3 months} \quad (20)$$

**Opportunity cost of running capital (OC):** Opportunity cost was calculated for a year by considering 18% interest on running capital.

$$\text{Opportunity cost of running capital, (Tk./yr)} = 18\% \text{ of rinning cost} \quad (21)$$

**Total cost of operation (TOC):** Total cost of operation was the sum of Annual operating cost and Opportunity cost.

$$\text{Total cost of operation (TOC)} = (19+21)$$

**Processing cost of rice bran oil:** It was the operating cost for producing 1 ton of edible oil in (Tk./ton).

Processing cost for producing 1 ton of rice bran edible oil (Tk. /ton)

$$= (\text{Total cost of operation per year} / \text{total amount of oil produced per year})$$

**Revenue:** Revenues 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 by-products.

$$\text{Revenues} = (Q \times P)$$

Where, Q = volume of product sold, kg and P = Selling price, Tk./kg.

**Value addition:** Value addition was calculated by deducting cost of inputs from revenues.

Value addition = revenues – cost of inputs (rice bran, chemicals)

**Net profit:** Net profit, was calculated by deducting total costs (including fixed cost, variable cost, opportunity cost) from value addition

Net Profit = Value addition – Fixed costs – variable costs – Opportunity cost of running capital

**Benefit-cost ratio:** Benefit-cost ratio is the ratio of total revenues to cost of bran purchased and total cost of operation.

Benefit-cost ratio = Total revenues/ (cost of bran + total cost of operation)

### 3. Results and Discussion

This study includes the present status of automatic and semi-automatic rice mills for identifying the milled rice by-products and the status of financial parameters of rice bran edible oil processing in a renowned oil mill at Bangladesh. This study also discusses about the problems and opportunities of processing of rice bran edible oil in detail. The installed capacity of this rice mill is 1300 ton per day. Existing products are parboiled fine rice, parboiled coarse rice and atap and by-products are husk, bran, broken rice and ash. Amount of rice milled in year 2011 was 17,420 tons. The amount of by-products such as husk, bran and broken rice produced by the automatic rice mill were 3658, 1219 and 233 tons (Table 1). The recovery of whole rice in automatic rice mill is higher in parboiled coarse and fine rice milling (67%) compared to atap rice (60%). Obviously, the broken rice recovery percentage is higher in atap rice (2.5%) compared to parboiled coarse and fine rice (1.33%). However, the recovery of rice bran was found in the range of 7.33-7.5% for both parboiled and atap rice. The recovery of husk was found about 21-22% (Table 2).

The installed capacity of this semi-automatic rice mill is 16 ton per 3 days. Existing products are Parboiled

fine, Parboiled coarse, Atap and Aromatic rice and by-products are husk, bran, broken rice and ash. Amount of milled rice in year 2011, was 1440 ton. The amount of by-products husk, bran and broken rice produced in year 2011, by the semi-automatic rice mill were 432, 72 and 9 tons (Table 1). The recovery of whole rice in semi-automatic rice is higher in parboiled rice (67.5%) compared to atap rice (60.5%), which is similar to the recovery of automatic rice mill. The rice bran recovery is found in the range of 5.6-6.3%, which is quite lower than the recovery rate of automatic rice mill. However, the husk recovery of semi-automatic rice mill was found quite higher (25-30%) compared to automatic rice mill (Table 2).

### 3.1 Rice bran edible oil mill

The researchers visited Emerald rice bran oil mill at Sherpur for the project purpose. It covers 1.22 ha of land. The researcher collected several financial data from the manager of the oil mill.

### 3.2 Financial parameters of rice bran oil mill

#### 3.2.1 Estimation of annual operating cost

For this study depreciation of machines, interest on investment of machines, taxes on machines, insurances, staff salary, opportunity cost of building and opportunity cost of land were considered as fixed cost items (Table 3). These items are depend out on calendar year and are clearly independent of use. The yearly fixed cost of rice bran edible oil processing was estimated as Tk. 6,83,02,101.

Table 1: Volume of by- products produced in automatic and semi-automatic rice mill

By-products	Automatic rice mill		Semi-automatic rice mill	
	Ton/yr		Ton/yr	
Husk	3658		432	
Bran	1219		72	
Broken rice	233		9	

Source: Field survey, 2011

Table 2: Recovery percentages in automatic and semi-automatic rice mill

Rice	Automatic rice mill				Semi-automatic rice mill			
	Whole rice (%)	Broken rice (%)	Rice bran (%)	Husk (%)	Whole rice (%)	Broken rice (%)	Rice bran (%)	Husk (%)
Parboiled (Coarse rice)	67	1.33	7.33	21	-	-	-	-
Parboiled (Fine rice)	66.5	1.34	7.33	21.3	67.5	1	5.6	25
Non Parboiled rice (Atap)	60	2.5	7.5	22	60.5	1	6.3	30

Source: Field survey, 2011

Table 3: Annual operating cost

Fixed cost		Variable cost		Chemical cost	
Items	Cost ( Tk./yr)	Items	Cost (Tk./yr)	Chemicals	Cost (Tk./yr)
Depreciation of machines	9,64,422	Labour cost	88,77,500	Hexane	1,35,87,750
Interest on investment on machines	1,63,35,000	Repair and maintenance cost	2,00,00,000	Citric acid	4,67,775
Taxes	25,20,000	Electricity cost	72,000	Phosphoric acid	43,43,625
Insurances	4,50,000	Income tax	12,00,000	Bleaching earth	3,06,90,000
Stuff salary	2,97,60,000	Gas bill	4,32,00,000	NaCl	5,79,521
Depreciation of building	22,680	Lubricant cost	3,50,00,000	Costic Soda	16,335
Interest on investment on building	1,81,50,000			Chemical used in laboratory	20,00,000
Opportunity cost of land	1,00,000				
Total fixed cost	6,83,02,101	Total variable cost	10,83,49,500	Total cost	6,04,68,781

Source: Field survey, 2011

Variable costs are those which vary with the amount of operational use of machines. For this study the cost of rice bran processing in oil mill was reflected by the cost of labour, repair & maintenance, electricity use, gas use, lubricant use and income tax. These costs are varied to a large extent in direct proportion to salvage paid as hours or days of use per year. The volume of rice bran processed in the edible oil mill in the year 2011 was 49500 ton. The yearly variable cost (Table 3) of rice bran edible oil processing was estimated as Tk. 10,83,49,500.

In different steps of processing rice bran oil several chemicals are used. Especially, Hexane is used for separation of de-oiled rice bran from crude rice bran oil. Citric acid and phosphoric acid are used for the degumming process in oil refining sector. Bleaching earth is used to reduce the color of bran oil and also used to separate the splint earth.

NaCl is used in boiler section and costic soda is used for the separation of Free Fatty Acid (FFA). A number of chemicals are also used in laboratory for testing purpose. Study estimated that for 1 ton of rice bran Hexane is required 1.5 kg at a price of 183 Tk./kg, Citric Acid is required 0.09 kg at a price of 10.5 Tk./kg, Phosphoric acid is required 0.45 kg at a price of 195 Tk./kg, Bleaching Earth is required 10 kg at a price of 62 Tk./kg, Activated carbon is required 1.69 kg at a price of 105 Tk./kg, Salt is required 1.05 kg at a price of 11.15 Tk./kg and Costic soda is required 0.01 kg at a price of 33 Tk./kg. Total yearly cost of chemicals was estimated as Tk. 6,04,68,781 (Table 3). Annual operating cost from fixed, variable and chemical cost was Tk. 23,71,20,382.

### 3.2.2 Estimation of total operating cost

#### Estimation of input cost

In year 2011, the oil mill purchased 44,055 ton of rice bran from automatic rice mill at a price of 22 Tk./kg, 4950 ton of rice bran from semi-automatic rice mill at a price of 20 Tk./kg, 495 ton of rice bran from other sources at a price of 8.5 Tk./kg (Table 4).

Table 4: Rice bran purchase price

Source of purchase	Cost (Tk./yr)
Automatic Rice Mill	96,92,10,000
Semi-automatic Rice Mill	9,90,00,000
Others sources (commission agents)	42,07,500

Source: Field survey, 2011

Total purchase price of rice bran was estimated as Tk. 107,24,17,500. Therefore, total input cost was estimated as Tk. 113,28,86,281 from the cost of rice bran and chemicals.

### Estimation of opportunity cost of running capital

Considering 3 months of operation of oil mill with running cost items as purchase price of rice bran, cost of chemical used, labour cost and stuff cost running capital is estimated as Tk. 29,28,80,945 with an 18% annual interest on running cost. Therefore, the annual opportunity cost of running capital was estimated as Tk. 5,27,18,570. The total annual cost of operation of rice bran edible oil mill was estimated as Tk. 28,98,38,952.

### 3.2.3 Estimation of operating cost of different products

The rice bran edible oil mill annually purchase 49,500 ton of rice bran from automatic, semi-automatic rice mill and from other sources. Rice bran is the main input for processing of rice bran edible oil. This study observed that during the processing of rice bran edible oil a good amount of de-oiled rice bran, FFA, wax, gum and splint earth are produced. These products have high demand in market. The amount produced and processing costs per ton of products are shown in Table 5. The processing cost per ton of rice bran was estimated as Tk. 5,855 and per ton of edible oil was Tk. 19,437 (Table 5).

### 3.2.4 Estimation of revenues

The products of rice bran edible oil mill are packed oil, loose oil, de-oiled rice bran, Fatty Acid, Wax, Gum and Splint earth. These products were sold at different price in year 2011. Packed oil is generally sold to the wholesaler, loose oil is sold to the different mustard oil mills, de-oiled rice bran is sold to the different poultry and fish feed mills. Fatty acid, wax, gum are sold in soap factories and Splint earth is sold as a fuel in different brick field and also sold as an ingredient of mosquito coil. The total revenue of the oil mill was estimated as Tk. 148,63,32,396 (Table 6).

Table 5: Processing cost of rice bran edible oil mill products

Products	Amount produced in year 2011 (ton)	Operating cost (Tk./yr)	Operating cost (Tk./ton)
Edible oil	7,948	15,44,84,161	19,437
DE-OILED RICE BRAN	39,600	11,58,19,645	2,925
FFA	1,495	1,68,97,611	11,303
Wax	329	20,52,060	6,237
Gum	332	3,38,648	1,020
Splint earth	808	3,15,113	390

Source: Field survey, 2011

Table 6: Selling price of different types of product

Items	Amount produced in the year 2011 (ton)	Selling price (Tk./kg)	Selling price (Tk./yr)
Packed oil	155	165 (Tk./liter)	2,81,04,396
Loose oil	7,793	98 (Tk./liter)	76,37,14,000
DE- OILED RICE BRAN	39,600	15	59,40,00,000
Fatty Acid	1,495	58	8,67,10,000
Wax	329	32	1,05,28,000
Gum	332	5	16,60,000
Splint earth	808	2	16,16,000
<b>Total revenue</b>			<b>148,63,32,396</b>

Source: Field survey, 2011

### 3.2.5 Value addition

The annual value addition of rice bran edible oil mill was estimated as the difference between the total revenues and total input costs and found Tk. 35,34,46,115.

### 3.2.6 Estimation of net profit

Net Profit is calculated by subtracting a industry's total cost of operation from value addition, thus showing what the industry has earned in a given period of time usually in 1 year. The annual net profit of the rice bran edible oil mill was estimated as Tk. 6,36,07,163.

### 3.2.7 Estimation of benefit cost ratio

The study estimated the benefit cost ratio of the rice bran edible oil mill as 1.1, which is the ratio of total revenue to the sum of total operating cost and cost of bran purchased i.e. total costs.

## 4. Conclusions

The study observed that rice bran, husk, broken rice and ash are produced in Automatic and Semi-automatic rice mills as by products. Among these by products rice bran has high demand in rice bran oil mills for producing rice bran edible oil. Rice mill owners are gaining a major share of their profit by selling the rice bran.

The Emerald Rice Bran Oil and Poultry Ind. Ltd., Sherpur is producing a good amount of edible oil and also a good amount of other valuable products such as de-oiled rice bran, FFA, gum, wax, splint earth. These products have very high demand in market especially de-oiled rice bran in fish feed and poultry feed mill, gum, wax and FFA in soap factories and splint earth in brick field as fuel. The profit of the rice bran edible oil mill is impressive with a benefit-cost ratio of 1.1. All financial parameters of the oil mill are found positive and the industry is found financially sustainable. The industry has emerged as an entity of value addition of rice bran as before it was only used for poultry and dairy feed.

There is a huge unmet market demand of the products of the rice bran edible oil mill in the country and there is abundant volume of supply rice bran from the existing automatic and semi-automatic rice mills. This is high time to establish new rice bran edible oil mills in the country to reduce dependency on imported edible oil and to save foreign currency. Non-interrupt supply of the gas to be ensured for the sake of sustainability of the industry. Capacity building of engineers, mechanics and skilled technicians is another major challenge of this industry and to be attended by creating proper training facilities by government and private sector initiative. 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 de-oiled rice bran, gum, FFA, splint earth and wax that would save huge amount of foreign currency and create employment significantly. The government should enact policies and regulations to ensure priority based continuous supply of gas for smooth running of the oil mill. The rice bran oil mill owners must strengthen public awareness programs to popularize their brand through electronic and mass media. Trade association should be established among the oil mill owners to strengthen the business environment related to credit recovery.

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