

Evaluation of a Traditional Rice Husking Mill

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Abstract

Rice milling process is an important post harvest operation. Present day most of the traditional husking mills like Engleberg huller are being replaced by automatic and semi automatic mill. The study was undertaken to identify the present status of Engleberg type rice husking mill in terms of capacity, technology, quality, milling losses; identify and analyze the financial performance, constraints; and recommend the priority interventions for updating the rice husking mill. The capacity of the mill was identified as 0.2 ton per hr and the capacity utilization was found as 20.83%. The products of the husking mill were identified as whole rice 62.5%, broken rice 7.5%, husk & bran 25%, and loss 5% respectively. The annual operating cost was estimated as Tk. 101,998 per year. The operating cost was estimated as Tk. 56.67 per hour and Tk. 283.35 per ton. The revenue was estimated as Tk. 225,000 per year and net margin was estimated as Tk. 341.67 per ton. The benefit-cost ratio was found to be 2.21 which indicate the business is very profitable. The return on investment was estimated at 1.21, which means that the capital will be returned within several years. Engleberg huller mills are facing some problems which must overcome for sustainability of this mill. The estimated financial performances of the husking mill were found impressive and the business seems to be sustainable. However, to compete with the quality rice produced form automatic and semi-automatic rice mills improved modern technologies to be adopted in the existing Engleberg type rice husking mills.

Key words: Engleberg, Capacity utilization, Operating cost, Revenue, Benefit-cost ratio.

1. Introduction

Rice is the staple food of the people of Bangladesh. In the year 2012-2013 Bangladesh produced about 34.2 million tons of rice from a total rice area of 10.59 million hectares (BBS, 2013). The huge quantity of paddy produces in the country is largely processed to clean rice by different types of mechanized rice mills, popularly known as Engleberg, semi-automatic and automatic rice mills, having different capacities spreading through the country. Milling is a crucial step in post-harvest processing of rice. The basic objective of a rice milling system is to remove the husk and the bran layers, and produce an edible, white rice kernel that is sufficiently milled and free of impurities. Most rice varieties are composed of roughly 20% rice hull, 11% bran layers, and 69% starchy endosperm, also referred to as the total milled rice. Total milled rice contains whole grains or head rice and broken. The by-products in rice milling are rice hull, rice germ and bran layers, and fine broken (Farouk and Zaman, 2002).

The rice growing countries, using the Engleberg hullers once, have gradually shifted to more sophisticated milling system, due to high breakage of paddy grain, resulting very poor rice recovery (53-55%), except Bangladesh and many African countries, where, even today, single pass mills are widely in operations and being established every year (Alam *et al.*, 2005). In many countries including India, Engleberg mills can no longer be licensed to operate or commercial mills. The rice milling sector in Bangladesh is undergoing a change. New automatic rice mills are being set up at a growing rate, raising competition for thousands of small and medium husking mills. Maximum paddy is still milled by Engleberg steel huller in Bangladesh and at least 2% rice is lost due to use of Engleberg steel hullers. Over the last decade, several hundred automatic and semi-automatic rice mills were established in various rice producing zones. In 2005, there were only 200 semi-automatic and automatic rice mills. The number has tripled to more than 600 now. In addition there are about 100000 traditional

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Engleberg type rice huller in the country (DOF, 2007). In Bangladesh, the Engleberg type steel rice hullers are still predominant in rice milling. At present, about 28% milling is done by Engleberg steel huller in Bangladesh and at least 2% rice is lost due to use of Engleberg steel hullers (Rahman, 2014). In order to reduce the milling losses, it is essential to know the causes and amount of losses in different milling operations. The millers need to be addressed about the causes and amount of losses so that they could improve the process to prevent the eminent losses which helps to attain food security in the country. Rice millers who are motivated for further improvement may be able to improve the technology to their existing management in the operations. In earlier many works had been done on rice husking mills especially on automatic, and semi-automatic mills and their demand are increasing day by day. However, the demand of Engleberg type husking mills in the country is yet to diminish. Because, in village level, farmers favor this type of husking mills depending on availability and easy access in their own community. So far, no meaningful initiative has been taken to analysis the traditional rice milling system in Bangladesh. Therefore, the study has been undertaken to identify and analyze the capacity, technology, quality, milling losses, financial performance and constraints of the Engleberg type rice husking mill. So that the technological changes in the milling sector and its advantages would be well understood and accordingly necessary measures can be taken to harness the benefits of this change.

The specific objectives of the study were as follows:

- To determine the capacity, technology, quality, recovery, and milling losses of an Engleberg type rice husking mill;
- To identify and analyze the financial performance of the rice husking mill; and
- To identify and analyze constraints to the rice husking mill.

2. Materials and Methods

Some Engleberg type traditional rice husking mills were selected purposively for the study and the rice mills were visited for the purpose collection of relevant information. A semi-structured questionnaire was prepared according to the

objectives of the study with active consultation with key informants, expert from the relevant fields and secondary information. Furthermore, a check list was developed for key informants. The draft questionnaire and the check list were pre-tested and necessary corrections, modification and alternations were made accordingly.

Performance evaluation

The required information was gathered by using the formulas as discussed below:

Capacity utilization: Expressed usually as percentage. It is the ratio between the operating hours per day to per year of a husking mill.

$$\text{Capacity utilization} = \frac{\text{Operating hours per day}}{\text{Operating hours per year}} \times 100$$

Husking efficiency: The percentage of total mass of milled rice (head and broken rice) recovered from the mass of the corresponding input paddy to the rice mill (husker or huller and whitener). It is also called total milling recovery.

$$\text{Husking efficiency (\%)} = \frac{\text{Weight of milled rice}}{\text{Weight of rough rice}} \times 100$$

Percentage head rice: The percentage of head rice recovered from the mass of the corresponding input paddy to the rice mill.

$$\text{Percentage head rice (\%)} = \frac{\text{Weight of head rice}}{\text{Weight of rough rice}} \times 100$$

Percentage broken rice: The percentage of broken rice recovered from the mass of the corresponding input paddy to the rice mill.

$$\text{Percentage broken rice (\%)} = \frac{\text{Weight of broken rice}}{\text{Weight of rough rice}} \times 100$$

Percent husk: The percentage of husk recovered from the mass of the corresponding input paddy to the rice mill.

$$\text{Per cent husk (\%)} = \frac{\text{Weight of husk}}{\text{Weight of rough rice}} \times 100$$

Percent milling loss: The percentage of weight of unhusked rough rice, stone, dust to the weight of input paddy.

$$\text{Per cent milling loss (\%)} = \frac{\text{Weight of unhusked rough rice + stone + dust}}{\text{Weight of rough rice}} \times 100$$

2.2 Cost determination and analysis

In this study, financial parameters of rice processing in husking rice mill were determined based on financial analyses considering the fixed and variable costs involved in milled rice processing.

- 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 measures the amount by which the value of a machine decreases with the passage of time whether used or not. In calculation of fixed cost, sinking fund method of depreciation was assumed and the following equations were used (Hunt, 1995):

$$D = V_n - V_{n+1}$$

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

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

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 was assumed as 10% of the purchase price. Estimated life assumed for huller and motor was 10 years and 15 years respectively.

• Interest on investment

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

$$I = \left(\frac{P + S}{2} \right) \times i \text{ Tk./yr}$$

- Tax, insurance and shelter costs are totally considered about 2% of purchase price of machinery.

- Variable costs are those, which vary with the amount of operational use of the machines. The cost of rice processing in rice mills was reflected by the cost of labor, repair & maintenances, electricity use of the machines and varied to a large extent in direct proportion to hours or days of use per year.
- Total annual operating cost was estimated as the sum of the yearly total fixed cost and total variable cost.

$$\text{AOC (Tk/yr)} = \text{Fixed cost (Tk/yr)} + \text{Variable cost (Tk/yr)}$$

- Revenue was calculated by multiplying the amount milled (Q) in ton per year with the milling charge per unit (P) in Tk. per ton and subsequently, by adding additional sources of income, such as revenues of selling the production waste of a product.

$$\text{Revenue (Tk/yr)} = (Q \times P) + \text{other sources of income}$$

- Net margin on a product is the net income per product. This was calculated by dividing the net income of the manufacturer by the total amount of milled rice (Q) in ton per year.

$$\text{Net margin (Tk/ton)} = \frac{\text{Revenue} - \text{Variable cost} - \text{Fixed cost}}{Q}$$

- Net income (Tk/yr) = revenues – fixed cost – variable cost
- Gross margin was calculated by deducting variable cost from revenue and dividing it by the total amount of milled rice Q (ton/yr).

$$\text{Gross margin (Tk/ton)} = \frac{\text{Revenue} - \text{Variable cost}}{Q}$$

- Benefit –cost ratio is the ratio of total revenues to the total cost of operation.

$$\text{Benefit - Cost ratio (BCR)} = \frac{\text{Total revenue}}{\text{Total cost of operation}}$$

- Calculating the return on investment (ROI) for each actor in the value chain shows how attractive the activity is relative to other potential uses of capital.

$$\text{Return on investment (ROI)} = \frac{\text{Net income}}{\text{Total cost}}$$

2.3 Milling process of Engleberg Husking Mill

Milling is a crucial step in post production of rice. The basic objective of a rice milling system is to remove the husk & bran and produce an edible form that is sufficiently milled and free of impurities. The rice should have a minimum of broken kernels. In this process, the parboiled clean rough rice produced traditionally at home is fed in a hopper of capacity 20-25 kg. Then it reaches to the cylinder housing, which have helical ribs, straight ribs, and sieves at the bottom side (Fig. 1). A straight edge or knife is inserted into the chamber to control the husking and polishing operation by adjusting the clearance

between the rotating cylinder and the knife. The cylinder rotates at a speed of 800-900 rpm by an electric motor of 30 hp with a flat belt and pulley drive. Feed rate of huller is controlled by a slide gate at the bottom of the feed hopper. Milled rice and husk are found from outlets. Generally two passes have been done through the huller. The mixture of paddy, dehusked rice, husk, and bran is fed again to get more milled and polished rice. At last, the mixture of milled rice, husk, bran are separated by using manually kula, sieve etc. The whole rice and broken rice are also separated by using these devices.

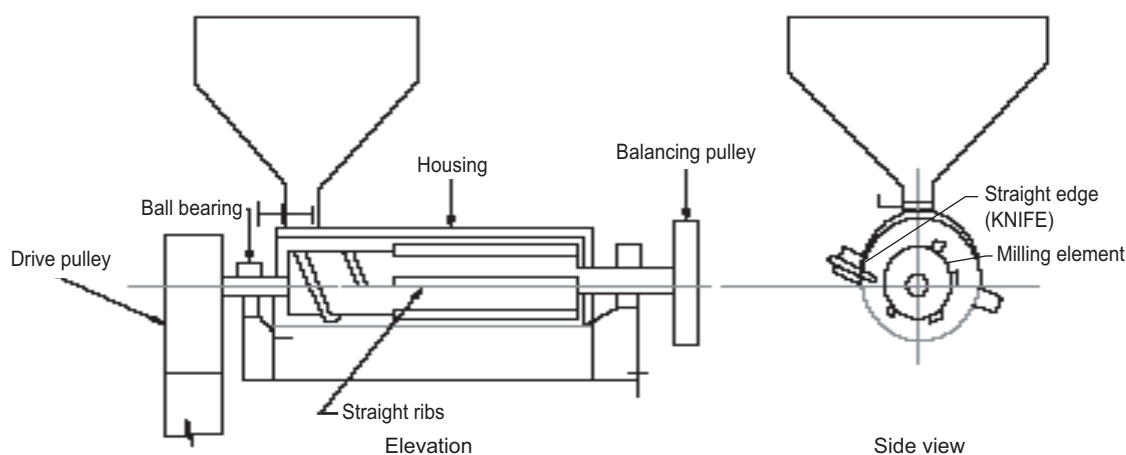


Fig. 1: Engleberg Rice Huller (section)

3. Results and Discussion

The study found 40 kg of paddy produced 25-30 kg of milled rice which included 62.5% whole rice and 7.5% broken rice. The husking process also produced 25% to 33% of husk and bran (10 -13 kg), and incurred a loss of 5% to 7% (2-3kg). The losses include non-husked paddy, stone, dust, spilled loss etc. The husking efficiency was found 70%. The capacity utilization of the husking rice mill was about 20.83%. The results show typical recovery and losses in traditional Engleberg type husking rice mills. Compared to recovery of head rice in automatic and semi-automatic rice mills using modern machinery such as, rubber roll huller, rice polisher, separator, color sorter, fine polisher (silky machine) etc. the recovery of whole rice was at least 2% less. Moreover, the whole rice contains certain percent of broken rice along with head rice as

customers at market accept as edible rice. The bran produced from milling process of husking rice mills cannot be used for edible oil production and have less market value compared to rice bran produced from automatic and semi-automatic rice mills. Therefore, the improvement of this type of Engleberg type husking rice mills is needed to harness maximum benefits from it.

In this study the purchase price of huller and motor were Tk. 20,000 and Tk. 38,000 respectively. The ages of both the machines were 5 years. The depreciation for huller was calculated as Tk. 1,814 per year and for motor as Tk. 1,675 per year. The interest on investment for the huller and the motor were calculated as Tk. 1,210 and Tk. 2,299 per year, respectively. The miller did not pay any taxes and there was no insurance for the mill. So, cost of tax and insurance were omitted. The miller paid a rent

for land and building that was Tk. 5,000 per year. Therefore, the total fixed cost was calculated as Tk. 11,998 per year (Table 1). The variable costs for labor repair & maintenance and electricity costs were estimated as Tk. 36,000, Tk. 18,000, and Tk. 36,000 per year, respectively. The total variable cost was estimated as Tk. 90,000 per year. The annual operating cost was found Tk. 101,998 per year; the operating time was found 5 hr per day and 30 days in each month and annual outturn found 360 ton per hour.

The financial performance of the Engleberg type husking rice mill showed very slim net margin (Table 1) that indicated the entrepreneur sustaining his endeavour marginally. The husking rice mill

operated only 5 hours a day that is; the capacity of the mill was not utilized. Electric load shading, frequent break-down of the machine components, low quality of milled rice, inadequate supply of paddy in off seasons were the main causes. In recent time, automatic and semi-automatic rice mills are producing good quality polished rice which has demand in the market. The price difference between milled rice of husking rice mill and automatic rice mill is within Tk. 2 per kg. As a result the consumers are mostly tempted to purchase good quality rice with that little bit of higher price. To cope with this competition the traditional Engleberg type husking rice mills must adopt at least one step ahead improved technology.

Table 1: Financial performance of the Engleberg type husking mill

Items	Amounts
Total fixed cost	Tk. 11,998 per yr
Total variable cost	Tk. 90,000 per yr
Annual operating cost	Tk. 101,998 per yr
Operating cost	Tk. 56.67 per hr; Tk. 283.35 per ton
Revenue	Tk. 225,000 per yr
Gross margin	Tk. 375 per ton
Net margin	Tk. 341.67 per ton
Benefit-cost ratio	2.21
Return on investment	1.21

Table 2: Priority constraints and intervention for updating the rice husking mill

Constraints	Solution	Service provider
• Irregular power supply and high cost of electricity	• Provision for non interrupted power supply at reduced cost of electricity	• PDB, PBS
• Inadequate operation, R&M skill at rice mill level	• Provision for training on operation, R&M of rice mill operators and technicians	• PTI, VTI apprenticeship at rice mills
• Inadequate supply of paddy in off season	• Continuous supply of paddy throughout the year by attracting farmers with quality rice milling through improved milling technology	• Farmers' level
• Unavailability of spare parts and high cost	• Provision for availability of spare parts and reducing cost by reducing tax and vat	• Local manufacturer, dealer, Government
• Lack of Govt. policy	• Improved Govt. policy	• Policy makers, consultants
• Low milling capacity	• Improved milling capacity	• Research institutes, manufacturer
• Inadequate bank loan	• Sufficient bank loan should be provided	• Bank

4. Conclusions

At present about 100000 traditional rice hullers are operating in Bangladesh and about 28% of the total rough rice produced are milled by Engleberg huller. In future, this type of milling option may reduce to around 20% and sustain in the milling arena because of its accessibility, convenience and traditional taste of the rural population. The study indicates that the capacity utilization of the mill was too low thereby the net profit margin found was also low. However, the benefit-cost ratio and the return on investment were impressive. Proper entrepreneurial and managerial capacity building of the entrepreneurs may sustain the technology in the foreseeable future with significant profit margin. The losses of at least 2% of the whole rice and the bran in this rice milling process indicates that technological improvement is needed in terms of loss saving and capacity enhancement. This may further sustain the traditional rice milling technology in the rural areas. The husking mill faces some problems such as discontinuous supply of paddy throughout the year, irregular power supply, cost of electricity, inadequate bank credit, non-availability of spare parts and inadequate government policies. Adequate business development services are to be ensured through public and private initiatives to resolve the problems.

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