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An Economic Assessment of Different Threshing Methods for Rice in Bangladesh

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Abstract

Threshing is one of the most important post harvest operation of grains. Along with Traditional threshing, mechanical threshing methods such as, Pedal threshing, Open-drum power threshing and Power threshing are being used in Bangladesh. In this study different cost, capacities and ratios of the threshing methods were calculated and compared along with different economic and financial indicators to appraise financial profitability of these methods. Data were collected from a sample of 50 farmers of Barshanta village of Atrai Upazila under Naogaon District. Mean values of this data were used for various calculations in this study. The operating cost of Pedal threshing (30.173 Tk/hr) was found lower and followed by Power threshing (53.5 Tk/hr), Traditional threshing (84.67 Tk/hr) and Open-drum power threshing (122.09Tk/hr). The throughput capacity of Open-drum power threshing (1158.40 kg/hr) was found significantly higher in compare to other threshing methods and Traditional threshing (74.94 kg/hr) method appeared as lowest. The throughput cost of Power threshing (0.073 Tk/kg) and Pedal threshing (0.089 Tk/kg) were found almost same and appeared as economic. The throughput cost of Open-drum power threshing (0.112 Tk/kg) was found close to those throughputs cost and was significantly lower than Traditional threshing. The Benefit-Cost Ratio of Power threshing (1.4) was found highest followed by Pedal threshing (1.325), Open-drum power threshing (1.228) and Traditional threshing (1.02). Gross Margin of Traditional threshing (63.05 Tk/hr) was found significantly greater and followed by Power threshing (35.96 Tk/hr), Open-drum power threshing (35.5 Tk/hr) and Pedal threshing (15.16 Tk/hr). Whereas, Net Margin of Open-drum power threshing (27.92 Tk/hr) was found highest and Traditional threshing (2.13 Tk/hr) was lowest. The substitution proposition by partial budget analysis showed clear superiority of Open-drum power threshing over other threshing methods, and incurred net gains. Considering various costs ratios and financial indicators along with present socio-economic status and facilities available to farmers, Open-drum power threshing and Power threshing may have been considered as most promising threshing method for the farmers of Bangladesh.

Key Words: Threshing, Gross margin, Net margin, Partial budgeting

1. Introduction

Post harvest activities of cereals in Bangladesh are mostly traditional and labour intensive. Among these activities threshing is the first and the major post-harvest operation of grains. The removal or separation of grains from the panicles of the stalks is called threshing. Traditional threshing is the combination of beating and treading. In beating 84.86 percent threshing was completed in 25 percent time and 15.14 percent treading was completed another 75 percent of time (Baqui and Islam, 1994). In hand beating small bundles are beaten on Drum and Wooden Logs. In treading, thin layer of harvested stalks is spread over the threshing floor and animals are allowed to walk over it. The small volume of paddy bundles is threshed by the farmer immediately. But in case of large quantity they stack the paddy bundles for several days and gradually complete the threshing. Late threshing of stacked materials causes both qualitative and quantitative losses due to warm and moist environment inside the stack. In recent time

few local manufacturers such as Alim, Rahman, Ishakhan, Janata, Farida, Mahbub, Bhaibhai Engineering are producing engine operated open-drum and closed-drum threshers along side of manually operated pedal threshers, and it become popular among the farmers.

Traditional threshing consumes more time than other mechanical threshing methods. Traditional threshing of paddy also causes a grain loss as high as 7 percent (Zami, 2000). Karim and Rashid (1981) mentioned that about 3 percent paddy were lost during mechanical threshing in Aus season. Similar study was undertaken by Qusem et al. (1985) and Saha et. al. (2004) in Bangladesh. They suggested that improved method of threshing to reduce this loss and threshing cost in great extent. At a very conservative estimate of 3 percent the amount that can be saved by using mechanical threshing is about 1.2 million metric tons of rice annually, which is worth of Taka 21600 millions. This saved amount of grain would be very beneficial for improving chronic shortage of food.

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Since the Traditional threshing is laborious and time consuming, farmers become inclined to partial mechanized to mechanized threshing techniques.

Hence, replacement options for traditional threshing need to be explored urgently. But, the farmers are not aware of the financial and economic implications of this change. In view of the urgent need for proper understanding of the situation, a study has to be carried out to appraise the financial and economic impacts of different threshing methods in Bangladesh, with particular reference to the substitution of Traditional Threshing by mechanical one.

2. Materials and Methods

2.1 Study Site

The study was conducted in Barshanta village of Atrai Upazila under Naogaon district. The selected village is situated in the North-East part of the Atrai Upazila and having a distance about 7 km from Upazila headquarters. This site was selected because of availability of different type threshers and near from researchers study and working place.

2.2 Threshing Methods and Materials Used

Existing threshing methods both traditional and mechanised are considered in this study. The common methods are: traditional threshing (beating and animal treading), pedal threshing, open-drum power threshing and power threshing. The threshers used in this area are most common models of Bangladesh and represent overall Bangladesh conditions.

2.3 Data Collection and Analysis

From the selected village, 136 farm families who had at least one thresher and cultivable land were

selected and constituted as the population of the study. Among them 35 percent of the farm families were selected as the sample of study using table of random number. An Interview Schedule (IS) was prepared for the data collection. Necessary corrections, addition and alternations of IS were made after pretest using 10 percent (sample) farm families which were selected by Stratified Random Sampling Method (Table1).

Then final IS was used for data collection from the selected farmers with the help friends and local leaders during 30 August to 10 September 1999. After completion of data collection the interview schedule was compiled, tabulated and analysed according to the objectives of the study. Local units were converted into standard units. The responses to the questions in the interview schedules were transferred to a master sheet to facilitate tabulation. Mean data were used in various calculation in accordance with the need of the study.

2.4 Operating Cost of Different Threshing Methods

The operating costs for different threshing methods were calculated on the basis of collected data of one year. However, inflation rate was not considered in this study. For calculation of operating cost of animal treading, appreciation cost was considered instead of depreciation, because with the passage of time selling price of animal increases. Cost items and calculation procedures of different threshing methods are presented in Table 2.

Where, Purchase price (P), Salvage value (S), Working life (L), Average working hours per year (WH), Interest rate (i), Maintenance cost (M), Housing (H), Veterinary charge (V) and Insurance, taxes and Shelters etc (ITS, 0.3% of P) were considered as fixed cost items. On the other hand,

Table 1. Population and Sample Size of the Study

Name of the threshing method	Population of farm families	Selected farm families (35%)	Farmers from selected families comprising sample	Reserve sample for pretest (10% of sample size)
Traditional threshing	20	7	7	1
Pedal threshing	88	31	31	3
Open-drum power threshing	25	9	9	1
Power threshing	3	3	3	1
Total	136	50	50	6

Table 2. Cost items and calculation procedures of different threshing methods

Traditional threshing (TT)	Pedal threshing (PAT)	Open-drum power threshing (OPT)	Power threshing (PT)
Calculations: For manual threshing	Calculations:	Calculations: For machine and engine	Calculations:
Depreciation, $D = \frac{P-S}{L}$	Depreciation, $D = \frac{P-S}{L}$	Depreciation, $D = \frac{P-S}{L}$	Depreciation, $D = \frac{P-S}{L}$
Interest, $I = \frac{(p+S)}{2} \times i$	Interest, $I = \frac{(p+S)}{2} \times i$	Interest, $I = \frac{(p+S)}{2} \times i$	Interest, $I = \frac{(p+S)}{2} \times i$
Fixed cost/h. (FC ₁) = D + I	Fixed cost/h. (FC) = D + I Variable cost (VC) per hour = (R & M + La)	Fixed cost/h. (FC) = D + I VC ₁ = (R & M) + La VC ₂ (engine) = (R & M) + La + F + O	Fixed cost/h. (FC) = D + I + ITS VC = (R & M) + La + F + O
For animal	Operating cost/h.	Variable Cost/h. = VC₁ + VC₂	Operating cost/h. = (FC + VC)
Appreciation, $A = \frac{S-P}{L}$	= (FC + VC)	Operating cost/h. = (FC + VC)	
Interest, $I = \frac{(p+S)}{2} \times i$			
Fixed cost/h. (FC ₂) = I + H + M + V FC = FC ₁ + FC ₂			
Variable cost (VC) /h. = La			
Operating cost			
Per hr. = (FC + VC)			

Daily labour rate (La), Rapier and maintenance cost (R&M), Oil cost (O) and Fuel cost (F) were considered as variable cost items.

2.5 Methods of Economic Analysis

2.5.1 Calculation Procedure for Gross Margin (GM) and Net Margin (NM)

The Gross Margin (GM) of an enterprise is its enterprise output (revenue) less its variable costs and the Net Margin (NM) is the enterprise Gross Margin less its fixed costs. Mean values of Gross Margin and Net Margin of 50 respondents were used for interpretation of result.

Gross output = [Units] x [Hiring rate per unit]
Gross output (TT) = Output + manure + milk production
Gross Margin = [Gross out put] – [Total variable cost]
Net Margin = [Gross Margin] – [Fixed costs]

2.5.2 Partial Budget (PB)

Partial Budgeting is a marginal analysis which attempts to determine the changes in inputs, outputs, costs, revenues and profits associated with a proposed changes action, where this action does not affect the overall structure and performance of the enterprise. In other words, it looks at the marginal or partial changes. The result of the Partial Budget is to show the change in net income above variable expenses. Partial Budget only includes those revenue and expenses items that will actually change as a result of the alternative action. The effect of a Partial Budget is that it compares the costs of change with the benefits of change by examining the impact of that change as net income (Table 3). Hence, the Partial Budget technique becomes a major decision making tools, allowing the user to assess the implications of alternative courses of action.

Table 3. Partial Budget Calculation

COSTS OF CHANGE	BENEFITS OF CHANGE
GM Lost: Expected GM of the existing system.	Extra GM: Expected GM of the alternative system.
Extra fixed costs: Estimated new fixed cost.	Fixed costs saved: Estimated reduction of fixed costs.
Total Costs (X)	Total Benefits (Y)
Net Gain (Y > X)	Net Loss (X > Y)

Source: Alam, M.M. (1997)

3. Results and Discussion

3.1 Operating Cost, Throughput Capacity and Throughput Cost of Different Threshing Methods

After through calculation of operating costs, with appropriate assumptions and considerations the results are shown in the Table 4. The operating cost of Traditional threshing, Pedal threshing, Open-drum power threshing and Power Threshing were found 84.6, 30.173, 122.09 and 53.50 Tk/h, respectively.

The operating cost of Pedal threshing is lower in compare to other threshing methods and operating cost of an Open-drum power threshing is greater than that of all the threshing methods. Throughput capacity of an Open-drum power threshing (1158.40 kg/h) is significantly higher in compare to other threshing methods and Traditional threshing (74.94 kg/h) appears as the lowest. Thus, Traditional threshing requires more time for threshing operations. Throughput costs of Power

threshing and Pedal threshing are almost same and appear economic. The Throughput cost of an Open-drum power threshing is almost similar to these throughput costs and significantly lower than that of Traditional threshing.

Time economy in operation is one of the important objective of mechanization as turnaround period between two successive crops is limited. In irrigated areas having two cropping seasons, harvesting and cleaning of first crop is very close to the land preparation of the second cropping season. In this situation, the operations need to be done very quickly in order to catch up with the planting season. But Traditional threshing and Pedal threshing require more time and physical labour. Therefore, from the point of time requirement, comfort, throughput cost and capacity, Power threshing and Open-drum power threshing might appear as better option for the farmers.

Table 4. Operating cost, Throughput capacity, Throughput cost, Gross Margin and Net Margin of different threshing methods

Items	Operating cost (Tk/h)	Throughput capacity (kg/h)	Throughput cost (Tk/kg)	Benefit -Cost Ratio (B/C)	Gross Margin (Tk/h)	Net Margin (Tk/h)
Traditional threshing	84.6	74.94	1.136	1.02	63.05	2.13
Pedal threshing	30.173	338.33	0.089	1.325	15.16	9.82
Open-drum power threshing	122.09	1158.40	0.112	1.228	35.50	27.92
Power threshing	53.50	733.33	0.073	1.4	35.96	22.5

3.2 Benefit-Cost Ratio

It can be seen from Table 4 that the Benefit-Cost ratio of Power threshing (1.4) is slightly greater than that of Pedal threshing (1.325), Open-drum power threshing (1.228) and much higher than Traditional threshing (1.02). This method is economically suitable for the farmers, but its initial investment is much higher in compare to the other methods. Large majority of the farmers can not afford to invest this huge amount of money. On the other hand, Open-drum power thresher has demanded almost half that initial investment of Power threshing. Again, the engine used in Open-drum power threshing can be used in other agricultural operations, which further reduced the cost of operation of this method.

3.3 Gross Margin and Net Margin for Different Threshing Methods

The calculated Gross Margin and Net Margin of different threshing methods are shown in the Table 4. It can be seen from Table 4 that Gross Margin of the Traditional threshing (63.05 Tk/h) is significantly greater in compare to other methods. The Gross Margins of Open-drum power threshing (35.5 Tk/h) and Power threshing (35.96 Tk/h) are almost similar and the Gross Margin of Pedal threshing (15.16 Tk/h) is the lowest. As the output is different for the methods, the difference in Gross Margin is because of difference in the variable costs. Net Margin of Open-drum power threshing (27.92 Tk/h) is significantly higher in compare to other methods (Table 4). Net Margin of Traditional threshing (2.13 Tk/h) appears smaller in comparison to other methods at large extent.

The timeliness factor is not considered in calculating Gross Margin and Net Margin of these threshing methods. Through, the Gross Margin of Traditional threshing appears impressive in compare to other threshing methods, but the fixed cost of the method has been found much higher that lead the Net Margin to a minimum. When timeliness of operating is taken into account, this method might not be found suitable for Bangladesh Agriculture. The throughput capacity of Open-drum

power threshing is significantly higher in compare to other threshing methods along with impressive Net Margin. Therefore, when timelines of operation is considered the Open-drum power threshing might appear as the most suitable threshing method for the farmers.

3.4 Partial Budget (PB)

The Gross Margin and Fixed cost data of different threshing methods obtained from previous calculation (Table 4) have been used in Partial Budget format and the results are presented in Table 5. It can be seen from Table 5 that for all different threshing methods, the substitution of Traditional threshing by Pedal threshing, Open-drum power threshing and Power threshing have ended with net gains but Open-drum power threshing appears as most impressive one. The inclusion of timeliness of operation may also increase the net gain figures of Open-drum power threshing, especially in case of large holdings.

Again substitution of Open-drum power threshing by Power threshing has ended with net loss. The substitution proposition by partial budget analysis shows that the Open-drum power threshing is the most suitable threshing technique, which could replace the existing threshing methods.

Partial Budget provides an effective means to assess the likely effect of future policy or changes in part of the farm system. This analysis considers all the financial and economic elements of a method thus, appears as the most reliable instrument for replacement decision. Almost 95 percent of the farm holdings of Bangladesh belong to small to medium farm category and they can not afford to invest large amount of money for machinery or a technique, though it is technically sound and economically beneficial. Considering various financial indicators as appear in previous section along with present socio-economic status and infrastructural facilities available to the farmers, Open-drum power threshing might be considered as the most promising threshing method for the farmers of Bangladesh.

Table 5. Substitution proposition by Partial Budget

	Pedal threshing	Open-drum power threshing	Power threshing
Traditional threshing	Net gain 7.7 Tk/ h	Net gain 25.8 Tk/ h	Net gain 19.36 Tk/ h
Pedal threshing		Net gain 18.10 Tk/ h	Net gain 11.66 Tk/ h
Open-drum power threshing			Net loss 6.44 Tk/h

4. Conclusions

- i) The Operating cost of Pedal threshing was found lowest and followed by Power thrashing, Traditional thrashing and Open-drum power threshing. Similarly, Throughput cost of Power threshing was found lowest and followed by Pedal threshing, Open-drum power threshing and Traditional threshing. In contrast, Throughput capacity of Open-drum power threshing was found significantly higher and followed by Power threshing, Pedal threshing and Traditional threshing. Time economy in present day agricultural operation is of great importance as cropping intensity is increasing and turn around period between successive crops is decreasing. Operation and throughput costs economy, throughput capacity become important issue is machine selection. Therefore, from the point of timeliness of threshing operation, capacity, comfort etc. Power threshing and Open-drum power threshing might appear as better option for the farmers.
- ii) Benefit-Cost Ratio of Power threshing was found slightly better than Pedal threshing and Open-drum power threshing and Traditional threshing appeared lowest. Thus, indicating the economic suitability of semi-mechanized and mechanized threshing methods.
- iii) In Gross Margin and Net Margin analysis Open-drum power threshing appeared as the best method followed by Power threshing and Pedal threshing. The Gross Margin of Traditional threshing appeared impressive in compared to other threshing methods but higher fixed cost incurred by the method lead the Net Margin to a minimum. In this contest, Open-drum power threshing and Power threshing might appear as suitable threshing methods for the farmers.
- iv) The substitution proposition by Partial Budget analysis clearly showed the economic profitability of Open-drum power threshing over all the threshing methods. Considering

the timeliness of operation, capacities, costs, margins, comfortability and economic capability of farmer Open-drum power threshing might be recommended for the farmers of Bangladesh.

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