Drying of Paddy in Wet Season by Mechanical Dryer for Improving Farmers Income*

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1. INTRODUCTION

Although Bangladesh is about to attain foodgrain self sufficiency, there is a threat from post harvest loss which accounts for a significant proportion of harvest. (Akteruzzaman, 2003). Of the three types of rice (Aus, Aman and Boro) grown by the farmers, Boro has become the main rice crop which occupies about 50 per cent of total rice production in Bangladesh. Unfortunately, the harvesting time of Boro (mid April to mid June) falls in the rainy season which severely causes problems of drying of the harvested paddy. Boro paddy requires moisture remedial measures at a faster rate to avoid loss during subsequent handling and storage. In most cases, lack of drying facilities compels the small farmers to sell their wet paddy immediately after harvest at a very low price.

Because of insufficient drying, rice grains get broken during husking by rice huller and if stored, pest infestation occurs which reduces the quality of seed/grains and thereby affects market price. In addition, shortage of drying space in the homestead also causes insufficient drying of grain and post harvest loss. Insufficient drying also induces post harvest loss of grains and degrade quality of rice which decreases farmers' income from rice production. Introduction of modern and scientific power operated drying machine can substantially minimize the enormous post-harvest losses ensuring quality of rice. During the rainy season, the prices of paddy decrease and rice price increases. In this period, quick drying of paddy using mechanical dryer and selling husked rice ensures additional benefit particularly to those farmers who need immediate cash income.

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Keeping in view the above issues Rangpur-Dinajpur Rural Services (RDRS) initiated mechanical dryer project with the financial assistance from the Research and Extension on Farm Power Issue (REFPI) project and technical assistance from Bangladesh Agricultural University, Mymensingh, Bangladesh Rice Research Institute (BRRI) and the University of Agriculture and Forestry, Vietnam (UAFV). The main purpose of the project was to familiarize the dryer machine to the farmers and to examine the performance of different types of dryer and find out the most appropriate technology from socio-economic and technical point of view in the context of Bangladesh. It is argued that if dryer facilities can be made available to the farmers there is possibility of improving farmers' income from rice production. However, the type of mechanical dryer suitable for the small farmers of Bangladesh is a matter of thorough investigation. This study was undertaken with the following specific objectives:

(i) to investigate the market price variation of Boro paddy and rice over time and the benefit derived by the poor farmers from the devices of mechanical dryer.

(ii) to analyze and compare financial profitability of different types of dryers from the point of view of the investors in dryers.

2. METHODOLOGY

Boro harvesting season of 2002 was considered for conducting this study. RDRS installed three types of dryer in the mainland of Lalmonirhat as well as in Char areas of Kurigram district in mid May 2002. The names of the three types of dryer are: (i) Flat Bed Dryer (FBD) (ii) Alim Batch Dryer (ABD) and (iii) STR-1 Dryer. The main characteristics of these devices are described in Table 1. One FBD was installed in Tushbhander Federation of Kaliganj Thana of Lalmonirhat. One ABD was installed in Mohendranagar Federation of Lalmonirhat Sadar thana in the village of Singadar and three STR- 1 dryers were installed in different areas of Rowmari thana of Kurigram district.

Two sets of questionnaires were developed, one for collecting information from farmers (users of dryers) and another for collecting physical, technical and cost-return data of the different types of dryers from the operators of the dryer. In total 100 farmers who used dryer services were interviewed by using the developed questionnaire from May to August 2002.

Table 1: Purchase cost and capacity of different types of sample dryer

Specification/Capacities	Unit	Flatbed dryer	Alim batch dryer	STR-1 dryer
Capacity				
ϖ Per batch	Quintal	40	3.2	4
ϖ Per day	Batch	1	4	2
Drying time/batch	Hour	8	3	5
Fuel used	-	Rice husk	Wood	wood
Fan operated by	-	Diesel	Diesel	Electricity
Sample households	No.	12	28	60
Purchase cost	Taka	135,000	135,000	7000

Moreover, secondary data were collected from different organizations such as BRRI, RDRS, and BAU/ REFPI project office. The collected data were compiled, tabulated and analyzed in accordance with the objectives of the study. In addition to tabular method, the project appraisal technique was followed to find out the profitability of mechanical dryer from owner point of view.

3. PRICE VARAITION OVER TIME AND BENEFIT DERIVED BY THE DRYER USER

3.1 Quantity and Prices of Boro Paddy Harvested and Sold over Time

The quantities of Boro paddy harvested under weather conditions is presented in Table 2. It was found that more than 20 percent of the Boro paddy was harvested during the rainy weather when drying emerged as an acute problem. Interestingly, it was observed that about 60 percent of the B*oro* paddy was harvested during the period of 2nd week of May to 4th week of May in the studied households of which only about 8 percent (313 quintal) were dried using the mechanical dryers (Table 2).

The total amounts of Boro paddy and rice sold were respectively 730 quintals and 116 quintals during the 2nd week of May to 4th week of August. It is evident that one-fourth of the harvested paddy was sold after immediate harvesting of Boro paddy during the month of May and almost every household sold paddy at home. Overall one third of the marketed Boro paddy was sold at home and the remaining amount was sold at market places.

The prices of Boro paddy were Taka 525 per quintal in the rainy day and Taka 563 in the sunny day during the 3rd week of May and these prices were found Taka 650 and Taka 725 respectively during the end of July (Table 3). The prices of paddy were 7.24 percent higher in the sunny day than in the rainy day during the 3rd week of May while the variation was observed 11.54 percent during the 4th week of July

between rainy and sunny day (Table 3). The prices of paddy were 25 to 30 percent higher over the period of time irrespective of rainy and sunny day.

Table 2: Quantity of Boro paddy harvested and sold under different weather condtions over the wet season 2002

Time of Harvested	Quantity harvested (quintal			Percent of total		
	Rainy Weather	Sunshine Weather	Total	Rainy Weather	Sunshine Weather	Total
1st week of May	32	176	208	15.38	84.62	4.94
2nd week of May	233	827	1060 (97)	21.99	78.01	25.17 (1.12)
3rd week of May	212	1014	1226 (112)	17.32	82.68	29.11 (4.08)
4th week of May	343	1110	1453 (104)	23.62	76.38	34.48 (2.47)
1st week of June	42	218	260	16.18	83.82	6.16
2nd week of June	0	6	6	0	100	0.14
Total harvested	862	335	4213 (313)	20.48	79.52	100.00 (7.67)
Total sold	-	-	729.60	-	-	17.32

Note: Figure in the parenthesis indicate the amount and percentage of paddy dried by mechanical dryers in the studied households.

It was observed that the average price of rice increased by3.29 per cent in the rainy day compared to the price in sunny day. The average prices were Taka 1255 per quintal in the rainy day and Taka 1215 on sunshine day and the highest difference (5.20 percent) was observed in 4th week of June when the prices were respectively Taka 1275 and Taka 1212 per quintal (Table 3). In the case of paddy, situation was reverse. Thus farmers were getting higher returns from sale of paddy by using the mechanical dryer.

3.2 Micro View of the Prices of Boro Paddy and Rice over Time and Locations

An investigation of the prices of Boro paddy and rice were done together considering the area, period of time and point of time in this study. It was found that the price of Boro paddy at Mohendranagar was the highest (Taka 670) due to the nearness of this area to district headquarters (Table 4). The prices of Boro paddy in Kaligonj (Taka 630) largely differed with that of Mohendranagar due to

distant location of this area from the district headquarters. Kurigram being a remote and backward area, lacked easy communication with district headquarters. As a result, any commodity can not gain easy access in or out for marketing. Thus prices of any commodity are much higher in this area and the price of Boro rice also showed the similar trend (Table 5).

Table 3: Selling price of Boro paddy and rice over time and weather in the study areas

Time of sold	Price of Boro paddy (tk./			Price of boro paddy (Tk./quintal		
	Rainy day	Sunny day	% higher in sunny day	Sunny day	Sunny day	% higher in rainy
3rd week of May	525	563	7.24	-	-	-
4th week of May	550	600	9.09 1150		11953.91	
1st week of June	575	663	15.30	1200	1250	4.17
2nd week of June	588	650	10.54	1225	1250	2.04
3rd week of June	588	655	11.39	1225	1262	3.02
4th week of June	593	663	11.80	1212	1275	5.20
1st week of July	625	713	14.08	1225	1275	3.92
2nd week of July	625	713	14.08	1225	1262	2.04
3rd week of July	638	725	13.64	1225	1250	3.07
4th week of July	650	725	11.54	1237	1275	3.47
Average	596	667	11.91	1213	1255	3.29

Source: Field Survey (Wet season, 2002)

An attempt was made to observe the amount of paddy sold within a certain period. It was observed that only 14 percent of paddy was sold within 7 days while 31 percent within 30 days, 38 percent within 60 days and the rest 17 percent was sold within 90 days of harvesting paddy. The prices of both paddy and rice had an upward trend (Tables 4 and 5) with the passage of time. The price of per quintal Boro paddy was Taka 563 within 7 days and it increased to Taka 750 within 90 days and in case of rice, the corresponding prices were Taka 960 and Taka 1240 respectively. The prices of both rice and paddy increased by about 30 percent with the passage of time. It was also found that the Boro paddy prices decreased with the occurrence of consecutive rainy days while the price of Boro rice increased substantially. Evidence showed that the Boro paddy price decreased by about 7 per cent while the rice prices increased by about 6 percent (Table 4 and Table 5).

Table 4: Price of Boro paddy by location, period and point of time during the wet season of 2002

Location	Price per quintal (Tk.)	Period of Time	Qty sold (%)	Price per quintal (Tk.)	Point of Time*	Price per quintal (Tk.)
Kaligonj	630	Within 7 days	14	563	1st rainy day	675
Mohendranagar	670	Within 30 days	31	625	2nd rainy day	655
Kurigram	663	Within 60 days	38	695	3rd rainy day	638
All	655	Within 90 days	17	750	4th rainy day	630

* Data generated from Tarakanda of Fulpur in Mymensingh during 18-25 July 2002.

Table 5: Price of rice by location, period and point of time during the wet season in 2002

Location	Price per quintal (Tk.)	Period of Time	Price per quintal (Tk.)	Point of time*	Price per quintal (Tk.)
Kaligonj	1085	Within 7 days	960	1st rainy day	1200
Mohendranagar	1143	Within 30 days	1053	2nd rainy day	1230
Kurigram	1133	Within 60 days	1155	3rd rainy day	1255
All	1120	Within 90 days	1240	4th rainy day	1268

* Data generated from Tarakanda of Fulpur in Mymensingh during 18-25 July 2002.

3.3 Benefit Accrued to the Users of Mechanical Dryer

In this section an attempt has been made to impute the cost and return from drying paddy. Normally the price of paddy decreased on consecutive rainy day. All the costs were computed and presented in Table 6. It was found that after imputation of all the processing costs the benefit derived from such paddy market was about Taka 81.00 per quintal in addition of post-harvest losses. For example, if a petty rice trader buys one quintal of paddy in the rainy day at Taka 675 and then he processes the paddy such as parboiling, drying, milling and carrying etc., then all the costs stood at Taka 775 (Table 6). It was assumed that one quintal of paddy would be converted to 67.50 kilogram of husked rice which can be sold at the rate of Taka 12.68 per kilogram, that is Taka 1268 per quintal. Thus, the total return from one quintal of processed paddy would amount to Taka 865. Hence, a total of Taka 81 will be the net return/benefit from one quintal of paddy. In this way, a dryer could be used for such kind of business motive which was found very

common in Vietnam market (Hien, 1999). If the loss of post-harvest operation can be reduced, the derivable benefit will be more than the estimated benefit value. The small and marginal farmers can take it as a business motive.

Table 6: Imputation of benefit derived from Dryer as alternative source of income to the farmer

Cost items	Cost in Taka	Percent of total
Purchased price of paddy in rainy day (Taka per quintal)	675.00	87.02
Parboiling cost	25.00	3.27
Cost of drying	37.50	4.83
Cost of milling	25.00	3.27
Carrying cost	12.50	1.61
A. Total cost	775.00	100.00
B. Return from selling rice @0.675x100 kg = 67.5 kg x 12.68	856.00	
Total gain from per quintal paddy in addition to reducing post harvest loss	81.00	

Source: Field Survey (Wet season, 2002)

4. RETURN ON INVESTMENT TO MECHANICAL DRYER OWNERS

The aim of this section is to analyze what happens to financial profitability under different types of dryer from the view point of investors. The sensitivity analysis also was worked out in this section to examine the change of profitability with the changed circumstances. The gross cost and gross benefit of the mechanical dryer were calculated to see the return on investment in mechanical dryer operation.

4.1 Measuring Gross Costs

Cost items were classified into two major groups e.g. capital cost and operational and maintenance cost. There together equaled total cost. The capital cost consists of the purchase cost of different types of dryer which varied with their characteristics and discussed earlier in Table 2. Operation and maintenance cost varied with the type of FBD, ABD and STR-1 dryer machines. The operation and maintenance cost consists of costs of diesel, cost of husk, carrying cost, cost of electricity, cost of charcoal, cost of firing wood, and casual labor cost. All the costs were calculated during the period of dryer operation in the year of 2002. Table 7 demonstrates the per quintal paddy operation cost of drying under

different types of dryer which were Taka 27.30, Taka 32.12 and Taka 29.25 respectively for FBD, ABD and STR-1. The cost of FBD was lower than that of the STR-1 and ABD. The cost of ABD was the highest for drying paddy in the wet season. In the case of FBD, the cost of charcoal/wood and husk constituted about 47 percent of the total cost while the costs of diesel was about 5 percent higher in ABD. The lower cost resulted from economic use of the higher capacity utilization. Electricity was used only for STR-1 but diesel was used for both FBD and ABD. So, the average cost of STR-1 was moderately higher than FBD cost.

Table 7: Operation and maintenance cost of different types of dryer practiced for drying *Boro* paddy in the study areas

Cost items	Flat Bed Dryer		Alim Batch Dryer		STR-1	
	Cost per quintal (Tk)	% of total cost	Cost per quintal (Tk)	% of total cost	Cost per quintal (Tk)	% of total cost
Cost of charcoal/ Firing wood	7.83	28.66	9.38	29.18	8.38	28.63
Cost of husk	4.93	18.04	3.75	11.67	3.75	12.82
Cost of diesel	6.00	21.98	8.50	26.47	0	0
Labor cost	7.00	25.64	7.88	24.51	6.50	22.22
Cost of carrying	1.55	5.68	2.63	8.17	1.63	5.56
Cost of electricity	0	0	0	0	9.00	30.77
Total operating cost	27.3	100.00	32.13	100.00	29.26	100.00

Source: Field Survey (Wet season, 2002)

4.2 Measuring Gross Benefits

The formula used for calculating gross benefit was the benefit derived from collected charge (Quantity of dried paddy in quintal x charge collected per quintal for drying Boro paddy) + reduced post-harvest losses + grain saved + increased return for quality improvement. Though this formula was considered but due to lack of data it overlooked the benefit derived from reduced post-harvest loss, grain saved and increased return for quality improvement. Thus the amount of paddy to be dried by the respective dryer multiplied by per unit fixed charge has been considered. The gross benefit of the FBD was found to be Taka 60,000 (Taka 37.50 x 1600 quintals), and Taka 19,200 (Taka 37.50x 512 quintals) and Taka 11,200 (Taka 35.00 x 320 quintals) were found to be the gross benefit for ABD and STR-1 dryer respectively. In addition, 10 percent of the investment cost was considered as salvage value which was added to the 5th years benefit.

4.3 Financial Analysis of the Mechanical Dryers

The financial analysis in this study was computed from the viewpoint of owner of mechanical dryer. Discounted measures of project worth were used for financial analysis. The discounted measures commonly used in agricultural project analysis are (i) Benefit-Cost Ratio (BCR), (ii) Net Present Value (NPV) and (iii) Internal Rate of Return (IRR). The formal mathematical statements of the discounted measures of project worth are suggested by Gittinger (1994). This appraisal, however, is based on the following assumptions:

(a) All the mechanical rice dryer FBD, ABD and STR-1 were purchased in cash.
(b) The life span of the FBD, ABD and STR-1 dryers were considered 5 years.
(c) Production technology was assumed to remain unchanged throughout the project life.
(d) Prices of all inputs and outputs were assumed to remain constant through out the project life.
(e) Discount factor of 15% was assumed for calculating BCR, NPV, as this seemed to be the opportunity cost of capital under the existing condition of Bangladesh economy.

The summary results of financial analysis of the three different types of mechanical dryers are presented in Table 8. It clearly shows that investment on STR-1 dryer was highly profitable while the investments on FBD and ABD were not profitable in the existing condition. The result showed that the BCR for STR-1 dryer was 1.06 that is higher than unity while the BCR of FBD and ABD were respectively 0.87 and 0.43.

The NPV of the STR-1 in existing condition was Taka 2,306 while for the other two types of dryer it was negative indicating the loss of the FBD and ABD respectively. The positive NPV indicates that STR-1 is considered financially viable and IRR of the STR-1 dryer was also greater than the normal bank rate. The average IRR was 40.29 percent while the IRR of other two types of dryer were negative. In view of these circumstances, the financial analysis showed that STR-1 dryer was highly profitable from the viewpoint of individual investments.

Table 8. BCR, NPV at 15 percent discount factor and IRR of different dryers

Dryer type	Existing condition			Remodeling		
	BCR	NPV (Taka)	IRR (%)	BCR	NPV (Taka)	IRR (%)
STR-1	1.06	2,306	40.29	1.01	295	18.03
Flat Bed Dryer	0.87	-30,229	-0.50	1.06	11,137	24.78
Alim Batch dryer	0.43	-93,516	-33.21	0.69	-32,647	-16.21

4.4 Sensitivity Analysis of the Different Types of Dryers

The evaluations of financial analysis as stated in left hand side in Table 8 have been done based on certain assumptions as stated earlier. The local workshop owners and engineers stated that the prices of the FBD and ABD could be reduced to 50 percent (about Taka 70,000) after remodeling the dryers but the flow of income would remain constant during the life cycle. It is possible because the former prices actually did not reflect the purchase price which was taken as research and development cost of the dryers. In case of STR-1 dryer, if the drying period reduced 30 days instead of 40 days due to fine weather. The result of sensitivity analysis shows how the investment decision changes with the changes in the value of any variable in the discounted cash flow analysis. Dillon and Hardeker (1993) also argued that the problem of uncertainty was another knotty problem for which there was no easy solution. In Bangladesh, the price of cost items is increasing day by day. Only the vital factors such as price of the dryers and weather were considered in this study for the sensitivity analysis.

The results of the sensitivity analysis showed that the BCR of the FBD increased to 1.06 and NPV increased to Taka 11,137 and was observed 24.78 percent which were very promising. The BCR, NPV and IRR of the ABD were respectively 0.69, Taka -32,647 and –16.21 per cent, that is, still increasing losses (Table 8). In case of the STR-1, the BCR, NPV and IRR decreased to 1.01, Taka 295 and 18.03 percent, that is, it could still earn a marginal profit. Thus, the study suggested that STR-1 dryer could be used for the household level due to its modest capacity and the FBD dryer could be suggested for the commercial rice husking mills for its larger capacity while there was a possibility of making the ABD profitable when it could be used for drying high valued seed.

5. CONCLUSIONS

Natural or sun drying is solely dependent on weather condition, so the timeliness of work is hard to be achieved. As mentioned in the introduction, drying becomes more problematic for Bangladesh farmers during Boro harvesting season due to

continuous rainfall and preoccupation of farmers for planting the next crop. So artificial drying is very necessary during peak season not only to lessen the burden of farmers but also to prevent the grain deterioration, which will greatly affect the income of farmers. Therefore, FBD, ABD and STR-1 dryer machines were the reasonable alternative methods of sun drying.

Based on the above findings the following conclusions could be drawn:

1) A large quantity of Boro paddy is harvested and sold during the peak period of wet season. Thus, the higher demand for mechanical dryer is observed during that period to ensure fair price to the farmers.

2) The price of Boro paddy varies from place to place depending on variation in weather condition. Higher price (7 to 12 percent) was observed at market than at home and 10-12 per cent higher price was observed at sunny day compared to rainy day. Thus, the farmers could rely on the mechanical dryer for securing fair price of paddy.

3) The price of rice increased by 10 percent in subsequent rainy day while the price of paddy decreased by 8 percent under the same environment so, the dryer could help farmers for earning additional income by taking it as a business venture.

4) Rice husk can also be used, as a cheap fuel for dryer which can eventually reduce the operational cost of a dryer.

5) Finally, the study strongly recommends for rapid extension of appropriate designed dryer through government and non-government initiatives.

References

Akteruzzaman, M. (2003): "Socio-economic aspects of mechanical dryer for Drying Paddy in Wet Season at RDRS sites in Rangpur". Workshop Paper presented at RDRS, Rangpur, Bangladesh.

Dillion, J. L. and Hardaker (1993): Farm Management Research for Small Farmer Development, FAO, Rome.

Gittinger, J.P. (1994): Economic Analysis of Agricultural Projects. John Hopkins University Press, Baltimore.

Parvin, J. (2003): An Economic Study on the Use of Mechanical Dryer for Drying paddy in Wet Season at RDRS Sites in Bangladesh, Unpublished M. S. Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Phan Hieu Hien (1999): A systematic approach to promote dryer as a major measure of quality assurance for rice grain, Workshop Paper, Held at University of Agriculture and Forestry, Vietnam.

RDRS (2001): Community based integrated technology investigation for drying of paddy in wet season, A Project Proposal, RDRS, Rangpur.