Business Rationale for Investment on Power Operated Maize Sheller in Bangladesh

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ABSTRACT

A study was carried out to investigate the investment of a selected agro-machinery power operated Maize Sheller in the course of mechanization of Bangladesh. The analysis considers different types of Maize Sheller, and inter-regional differences in agro-economic factors that influence the business rationale for investment. Maize Shellers are increasingly needed to serve demand from poultry sector because manual shelling is very laborious. Comparing with manual shelling, results indicate that power operated Maize Shellers look like a wise investment (5 – 8 acres for 25% internal rate of return or IRR). However, it makes economic sense to operate shellers at higher capacities, and along with the high capital cost (Tk[1] 18,000 – 22,000) to save large numbers of labours to farmers and maize traders. Therefore, power operated Maize Sheller can able to overcome the shortage of expensive labour during peak harvesting season.

Keywords: Maize, power-operated, sheller, investment, wages, break-even

1. INTRODUCTION

1.1 Growing Use of Agro-machinery in Bangladesh Agriculture

The growth in agricultural productivity is essential to promote broad-based economic growth and reduce rural poverty. Productivity growth is based largely on application of technology and information. Investment in agricultural machinery and technology has been critically important to growth performance in agriculture generally, and is likely to become increasingly important for Bangladesh (Albu et al., 2006).

Last couple of decades, the traditional animal-draught power in agriculture is becoming shortage which is due to increase in cost of cattle rearing in Bangladesh (Hatch, 2005). Therefore, farmers used to rear cattle only for meat/milk purpose or else sell cattle before starting the rainy season due to unavailability of cattle feed. On the other hand, labours shortage has been occurred in rural area because the young generation is not willing to engage in agriculture and the shifting of local labours or little-educated people to other available jobs to avoid inconsistent income from seasonal agricultural works. The land owners usually hire labour locally or temporary available labours from other regions with high price. So, the use of agro-machinery is increasing day by day which is relevant and

[1] US$ 1 = Tk 70 (Bangladesh Taka)

necessary in Bangladesh agriculture due to shortage of animal-draught power and the expensive limited labours.

1.2 Rationale for Selection of Power Operated Maize Sheller

The agricultural tillage and irrigation practices are already mechanized in many districts of Bangladesh where about 33% and 40% of total cultivable land (19.84 million acres) are being used with more than 350,000 power tillers and about 1 million different types of power driven pumps (Anon, 2004; BBS, 1999). At the same time, more than 200,000 threshers including both manual and power operated are used for paddy threshing in Bangladesh (Anon, 2004). With increasing rate of paddy thresher's use, maize shellers are also becoming popular currently among farmers although there is no statistics available of maize shellers. However, increasing use of maize shellers in Bangladesh is due to farmer's interest in maize cultivation. Currently, 0.25% of net cropped area is under maize cultivation (BBS, 2004). During 2001-02, maize cultivated area in Bangladesh has increased about 350% from 2000-01 rapidly (Table 1). This was due to less cost of production compared to other crops (paddy, wheat, oilseeds, etc.) and huge market demand from growing poultry sector.

Table 1. Maize cultivation in Bangladesh

Year	Cultivated area	Production
	'000 acre	'000 M.ton
1995-1996	7	3
1999-2000	8	4
2000-2001	11	10
2001-2002	49	64
2002-2003	50	27

Source: BBS, 2004

Initially, farmers used to shell maize grain from corn cob with hand operated sheller. While power operated maize shellers were available in local market during 2001-02, farmers started to use this machine which can save more time and labours in maize shelling besides existing hand operated maize shelling machine. The selected agro-machine of this study is power operated Maize Sheller as it can replace hand operated maize sheller. The power-operated Maize Sheller is especially designed for threshing maize corn and a wide variety of machines are manufactured in local workshops around Bangladesh. Some manufacturers follow designs published by Bangladesh Agricultural Research Institute (BARI) model. However, there is no literature available on break-even analysis of power operated Maize Sheller with considering inter-regional wage rate variation and IRR variation in the perspective of Bangladesh.

1.3 Purpose of the Study

This short study sets out to analyze the business rationale for smallholder farmers to invest in specific type of agro-machinery (power operated Maize Sheller) in Bangladesh. The analysis considers different types and models of agro-machinery especially for power operated Maize Sheller, and inter-regional differences in agro-economic factors that influence the business rationale for investment.

The study aims to provide specific information on cost-effectiveness of power operated Maize Sheller for investment by farmers, producers, investors and R&D organizations in future. The study calculates rates of return for the investment in this selected machinery and compares this with the cost of borrowing to see whether there is a strong case for investment. Since the opportunities to borrow and costs of doing so are still very inconsistent in Bangladesh, the study also looks at the minimum viable acreage needed to justify investments depending on different interest rate regimes or opportunity costs.

2. METHODOLOGY

2.1 Field Methodology: How the Field Work was done / Data Collected

The field survey was done to collect information on selected power operated Maize e Sheller from farmers and different stakeholders in selected regions of Bangladesh (Bogra, Comilla, Dinajpur, Jessore, Kustia, Dhaka, Sylhet and Mymensingh districts). For this purpose, we developed one questionnaire for farmers and rental service providers to collect the information on types and models, advantageous locations, incurred capital costs, running costs items, expected economic life, usage operating hours or acres, costs savings in terms of labours and other factors. To find the farmers who are using the selected agro-machines, we communicated with agro-machinery manufacturers, repairing workshops, local farmers, research organizations and Department of Agricultural Extension (DAE) in the selected regions. Another questionnaire was made for agro-machine producers or manufacturers to collect information on size, capacity, power requirement, produced numbers, supplied regions and other relevant information related to selected agro-machine. This information helps us to do crosscheck the collected field information of agro-machine from farmers. We also visited government and private financial institutions in selected regions to collect information about financial supports to farmers and manufacturers in investing on agro-machine.

2.2 Financial Analysis Method

The business rationale for investing in agro-machinery or power operated Maize Sheller depends mainly on three factors:

- The capital cost, and the performance characteristics of the technology (C)
- The alternative costs (mainly labour) for which the agro-machinery is substituting (L)
- The scale of production (i.e. capacity utilisation) (S)

This study examines variations in capital cost, and performance characteristics (C), by comparing different types of agro-machinery. It looks at variations in substituted costs (L), by considering inter-regional differences in rural wage rates. And it examines scale of production (S) or capacity utilisation by considering the annual acreages of crop for which the agro-machines are put to use.

A conventional way to assess the investment opportunities is to calculate the internal rates of return (IRR) generated by investments as these factors vary. In mathematical terms, we would examine IRR as a function of variations in C, L and S.

However, land-holdings in Bangladesh are very small (mean <2 acres, median <1 acre) according to BBS (2004), the third factor [S] dominates the analysis of IRR. We could have

arbitrarily selected a range of different land-holding sizes, and calculated the IRR for each machine – but this would not produce very useful results, and would have taken a huge amount of time.

Instead we thought it would be more useful to examine what minimum sizes of land-holdings are required to make investments yield a selected range of returns. The selected values for internal rate of return (IRR) are derived by considering the different borrowing or loan opportunities available to farmers / investors. These include the opportunity costs for farmers who invest savings or remittances from family members.

In mathematical terms, therefore, this study is slightly unusual in examining S as a function of variations in IRR, C and L which is derived from break-even concept used for agro-machinery as reported by Bainer et al. (1987) and Hunt (1995). The break-even production area (S) was calculated as below:

$$S = 0.80 \times \left(\frac{C}{GB} \right) \times \left(IRR + \frac{1}{EL} \right) \quad [1]$$

$$GB = \left(L + VOB \right) - RC \quad [2]$$

where, C = Capital cost, Tk; GB = Gross benefit Tk/acre; EL = Economic life, years; VOB = Values of other benefits (reduced in processing loss, crop damage risk, cost of labour logistics), Tk/acre; RC = Running costs, Tk/acre.

The exact difference in results depends on the interest rate and period of depreciation. However, for the calculations in this study, reducing the figures by 20% gives a result that is more than sufficiently accurate for our purposes.

3. BACKGROUND FINDINGS

3.1 Locations: Rationale for Selection of Regions

For the selection of regions, we consulted regional research organizations, the department of agricultural extension, local private institutions and literature about current usage patterns of Maize Sheller (BBS, 1999; Hatch, 2005; ITDG, 2003). Since it was a short-term investigation, we selected eight regions initially for the field work which cover almost all the typical crops and agricultural practices used in Bangladesh. During the field survey (December 2005 – January 2006), we were able to find 15 owners/users of power operated Maize Sheller, among which 2, 6, 4 and 3 interviewees were found in Bogra, Dinajpur, Kustia and Mymensingh districts, respectively. However, we were unable to collect information from four regions (Jessore, Sylhet, Comilla and Dhaka) because of unavailability of selected agro-machine users. The locations of regions in Bangladesh map are shown in Figure 1.

Figure1. Locations of surveyed regions in Bangladesh.

3.2 Land Holding Patterns

Table 2 illustrates inter-regional differences in the areas of maize cultivated land that fall in to various sizes of land-holding categories. It also shows that there is a good opportunity of using power operated Maize Sheller in Bogra, Dinajpur, Kustia and Mymensingh regions.

Table 2. Land holdings and maize cultivated area of different regions

Size of Land Holding:		**< 1 acre**	**1 - 2.5 acres**	**2.5 - 7.5 acres**	**> 7.50 acres**
Bogra					
Number of land holdings	335,000	52%	32%	15%	2%
Maize crop acres	82 acres	34%	35%	18%	12%
Comilla					
Number of land holdings	483,000	60%	31%	9%	0%
Maize crop acres	12 acres	75%	17%	8%	0%
Dinajpur					
Number of land holdings	271,000	36%	32%	27%	5%
Maize crop acres	528 acres	6%	28%	51%	16%
Kustia					
Number of land holdings	166,000	53%	29%	16%	2%
Maize crop acres	326 acres	23%	29%	39%	9%
Mymensingh					
Number of land holdings	767,000	14%	31%	39%	16%
Maize crop acres	131 acres	5%	25%	61%	8%
Sylhet					
Number of land holdings	700,000	9%	21%	43%	27%
Maize crop acres	11 acres	0%	18%	82%	0%

Source: BBS, 1999

3.3 Labour / Wage Rates

Wage rates for manual labour vary from region to region, and rise to peaks in the main periods of high labour demand during the crop harvest time. Usually, harvesting periods of maize and *Boro* rice (a winter or dry season rice crop) match each other during Apr-May. During other times, wages are 10 – 30 % below the peak-season rates. The approximate daily wage rates of male labour during the harvesting season of corn are found to be Tk 120, Tk 140, Tk 120, Tk 80, Tk 110, Tk 100, Tk 120 and Tk 120 in Bogra, Comilla, Dhaka, Dinajpur, Jessore, Kustia, Mymensingh and Sylhet, respectively. It is important to note that inter-regional variations in wage rates are also caused by type of crops cultivation, mentality of farmers or labours, and whether the crop season starts early or late in that region.

A major effect of these inter-regional variations is to cause migration of labours from North-Western part of Bangladesh (Dinajpur, Rangpur) to North-Eastern (Sylhet) and South-Eastern part (Comilla) through Dhaka.

The daily wage rate of female labours is usually Tk 20/- less than that of male labours where female labour is commonly employed in rice planting, reaping, post-harvest operations (threshing, winnowing, drying) and manual shelling of maize especially in the northern region of Bangladesh (Bogra, Dinajpur, Rangpur, etc.).

Wage rates are similar whether labour is used for machine operations or for simple manual work. However the field survey revealed significant variation in wage rates between farmers even in the same district. This is thought to be due to differences in relationships, attitudes and competing labour opportunities in particular villages. For the purposes of the calculations in this study, we therefore gathered information from farmers about the costs per acre of the agro-activities which are being substituted by use of the agro-machine.

3.4 Costs of Finance / Borrowing for Capital Investment

The local agro-machines manufacturers are generally reluctant to provide credit (e.g. payment by instalments) due to poor history of farmers defaulting. Some times, manufactures accept 50% down-payment from well known customers.

Government banks: Farmers can borrow up to Tk 14,500 per acre per year against land titles or others items under a crop-loan scheme at 8% interest from Bangladesh Krishi Bank and Janata Bank. However, interviews with farmers suggest that they are reluctant to go to government banks due to various formalities.

Private financial institutions: In principle ASA (Association for Social Advancement) lends up to Tk 100,000 for one year at 12.5% interest rate; BRAC (Bangladesh Rural Advancement Community) lends up to Tk 20,000 through group-lending arrangements, at 15% interest rate. However, use of this lending for agro-machinery investment is not common, in part because borrowers must repay immediately in 12 instalments over the course of a year. So far, ASA and BRAC have such type of credit programmes to the people who engage in bakery, garment, chanachur (crispy) making, fish/fruit/vegetable selling or processing, cattle/goat husbandry, handcrafts, pottery, etc. in rural and urban areas.

However, the above practices are accessible all over Bangladesh since the mentioned government and private institutions are available in remote areas.

3. POWER OPERATED MAIZE SHELLER FINDINGS

3.1 Types and Models

Typically, power operated Maize Sheller (Figure 2) comprise of a closed metal drum structure driven by a 12 hp diesel engine. Corn grains are removed from cob due to its rubbing action between pinions and corns. The smaller size machines used in Bogra were driven by 6-8 hp diesel engines. A special case was found in Mymensingh where 1.5 hp motor was used. The weight of the typical one is varied from 125 to 150 kg depending on raw materials used to make. Due to its heavy weight, it has two wheels for movement with the help of human or other vehicle means.

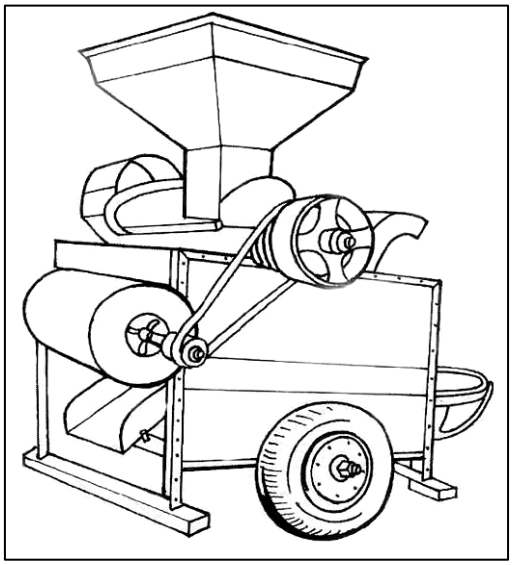

Figure 2. Power operated Maize Sheller.

The low cost maize sheller used in Mymensingh is one-by-one corn-cob feeding to threshing drum. On the other hand, expensive maize sheller have hopper and from there corn-cob moves downwards to threshing drum. Maize sheller produced by regional manufacturers and present selling price of their product (excluding cost of prime mover) are: Tk 21,000 for 4,000 kg/hr capacity from Uttaran Engg. (Dinajpur), Tk 15,000 for 1,200 kg/hr capacity from Rahman Engg. (Kustia), Tk 23,000 for 2,800 kg/hr capacity from Liton Engg. (Chuadanga), and Tk 8,000-10,000 for 300 kg/hr capacity from Comilla Cooperative Karkhana, based on information provided by manufacturers.

3.2 Advantageous Locations for Use

The field survey revealed that the power operated Maize Sheller is commonly used in Bogra, Dinajpur, Kustia and Mymensingh where maize has been grown for at least 5-10 years. This was due to the demand for this crop in these regions although people of Bangladesh are still not habituated to eat maize. Farmers supply maize to growing number of poultry farms where

smashed maize grains are used as poultry feed. So, maize cultivation is a good business since the production cost of maize is relatively lower than that of wheat or other cereal crops. Therefore, many farmers who traditionally cultivate wheat or rice in Kustia, Dinajpur and Mymensingh are now showing interest to grow to maize. And this practice recently has started in other regions, such as, Bogra and Comilla.

3.3 Patterns of Use (Crops, Seasons)

Generally, maize sheller is used during maize harvesting period (May/Jun). Due to speciality of maize sheller, farmers used this machine only for maize shelling. The average operating use in our survey was found to be 103 hours/year serving 58 acres/year which included farmers' own-land and land covered by rental service. It also indicates about 2 machine-hours are needed to shell one acre production.

In Dinajpur, the annual average operating use is found to be 103 acres or 75 hours. This was due to bigger rental area (sometimes 300 ac) served by the farmer, and lower operational hour was due to the using of expensive higher capacity of machines (4,000 kg per hour capacity). On the other hand, low capacity machines in Bogra showed higher serviced hours (176 hours/year) with serving only 29 acres/year.

However, farmers expressed that the maize growing area is going to increasing since production costs of maize are lower than other crops (wheat, rice, etc.). For providing rental service, maize sheller owners typically charge Tk 8-10 per maund or 37 kg of shelled maize (i.e. Tk 700 – 800 per acre).

3.4 Capital Costs

Capital cost of maize shellers ranges widely due to size and facility of machine. This cost varied from Tk 8,000 to Tk 17,000. The capacity of maize shellers used in Dinajpur, Kustia and Mymensingh is above 2,000 kg /hour.

The delivery costs were reported Tk 100 to Tk 500 for big size machines depending on the distance needed to travel from the available neighbouring manufactures. For total capital costs, we counted 20% of engine cost and 3% of capital cost for shelter although there is no custom to pay tax and insurance in Bangladesh (Bainer et al., 1987; Hunt, 1995; Smith and Wilkes, 1976). After discussing with farmers, we assume that 20% of annual operation time (for irrigation, tilling and other purposes) of the engine is used for maize shelling.

Anticipate lifetime of the maize sheller ranges from 8 - 10 years on average. Most farmers expected to use their maize sheller almost 10 years with availability of parts and repair-service in the local workshop. However, rental service farmers described lower operational life. It seems reasonable to assume full depreciation over 8 years. For purposes of the investment analysis, we looked at two different sizes of maize sheller as shown in Table 3 where model A is smaller size and model B is larger size with higher capacity.

Table 3. Capital costs of Maize Sheller

Category/Model	A	B
Capacity, kg/hour	2,000	4,000
Manufacturers	Rahman Engg. (Kustia)	Uttaran Engg. (Dinajpur)
Capital Costs, Tk	18,500	21,500
Economic life time, years	8	8

3.5 Operating Costs per Acre

The operating or running costs of Maize Shellers varied from Tk 50 to Tk 150 per hour. This figure was found to be low in Bogra due to small size machine. It includes repairing of machine and engine, fuel, oil and labour wages. Parts that frequently fail or need replacing are bearings, belts and pinion teeth. Reported running costs are high in Dinajpur, Kustia and Mymensingh because farmers provide rental service for 50 to 300 acres and it caused increased repairing services (from Tk 200 to Tk 3,000 each season) and other items. Operating costs for different categories are presented in Table 4.

Table 4. Operating Costs of Maize Sheller

Category / Model	A	B
Running Cost, Tk/hour	76	160
Hours / acre	2.2	1
Running Cost, Tk/acre	165	160

3.6 Cost Reductions per Acre

The economic benefits of using maize sheller come from replacing the labour costs involved in manual shelling (Figure 3). It was not a problem for farmer or owners of maize shellers to estimate labour required for shelling one acre of maize cobs because they were accustomed to hand-operated shellers in the past. Farmers reported that it takes 15 - 20 person-days to manually shell an acre of maize at 30 kg per hour. Using 15 person-days, we calculate substituted labour costs (Table 5).

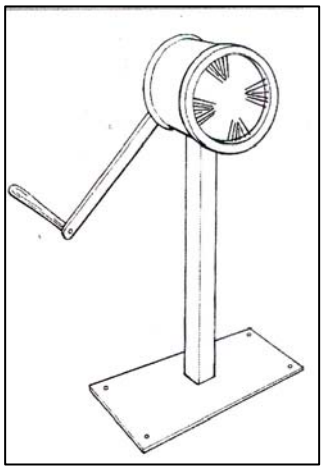

Figure 3. Hand operated Maize Sheller.

Table 5. Substituted Labour Costs for Manual Shelling

Districts	Labour cost
	Tk/acre
Bogra	1,800
Comilla	2,100
Dhaka	1,800
Dinajpur	1,200
Jessore	1,650
Kustia	1,500
Mymensingh	1,800
Sylhet	1,800

3.7 Other Factors (Risks and Non-financial Benefits)

There is no major risk in investing in maize sheller. Farmers and maize sheller manufacturers both opined that the demand for maize shellers is increasing due to increase of maize growing area to serve maize as poultry feed. It makes impact on manufacturers who used to fabricate maize sheller.

Almost all farmers mentioned that they can save time and labour by using maize sheller during maize harvesting seasons. At the same time, they can reduce the crop damage due to rain and can also reduce mental stress involved in finding extra labours during busy harvesting and planting time. It encourages farmers to cultivate more maize on their land.

4. RESULTS AND DISCUSSION

The results of the financial analysis are shown in Table 6. They are shown in terms of both the minimum annual acreage of cultivation, and the minimum hours of operation, needed to achieve internal rates of return (IRR) of 10%, 25% and 40% in each district.

Table 6. Break even production area for power Maize Sheller

Maize Sheller Category	**A**			**B**		
Capital Costs	Tk 18,400			Tk 21,900		
Operating Cost	Tk 167 /acre			Tk 160 /acre		
Output	2.2 hours/acre			1.0 hours/acre		
To achieve IRR of:	**10%**	**25%**	**40%**	**10%**	**25%**	**40%**
Minimum acreage serviced						
Bogra, Dhaka, Mymensingh and Sylhet	2.0	3.4	4.7	2.4	4.0	5.6
Comilla	1.7	2.9	4.0	2.0	3.4	4.7
Dinajpur	3.2	5.3	7.5	3.8	6.3	8.8
Jessore	2.2	3.7	5.2	2.6	4.4	6.2
Kustia	2.5	4.1	5.8	2.9	4.9	6.9
Minimum hours of operation						
Bogra, Dhaka, Mymensingh and Sylhet	4	7	10	2	4	6
Comilla	4	6	9	2	3	5
Dinajpur	7	12	16	4	6	9
Jessore	5	8	11	3	4	6
Kustia	5	9	13	3	5	7

The calculations show inter-regional variations in wage rates because some differences in break even production areas. However, the investment rationale is also rather dependent on the required IRR. In order to enable investment, it reveals that break even areas influence an access to available credits at reasonable rates.

According to this analysis, the annual acreages required to achieve these internal returns are moderately high by Bangladeshi standards (i.e. average land holding size is < 2 acres). For example, 4 - 6 acres of cultivated land would be needed to generate internal returns of 25% a year in most districts for B-type of machine (Table 6). The operating costs and returns on two different models are fairly similar for given acreages. Not surprisingly, given the high capital costs, maize shellers are only owned by the large farmers and by traders. Among the 15 interviewed farmers using them, the area of crops for which the machine was used annually ranged from 20 to 300 acres, with an average of 71 acres. However, it can be understood from Table 2 that farmers in 2.5-7.5 acres and >7.5 acres categories are able to invest on power operated maize shellers as per certain IRR and category of machine.

The results expressed in hours also gives an idea of the scale of operation needed to make the maize sheller a good investment for a rental service business. Note that a rental service business would need higher hours of operation than these results show (e.g. by a factor of perhaps 50%) which covers additional management and logistical costs not included in this analysis. This explains why rental services were found to be already well established with rental charges of Tk 300 – 400 per acre of maize crop. This looks like a reasonably competitive rate to recoup investment in capital and running costs.

5. CONCLUSIONS

This study was conducted to analyse the business rationale for small-holder investment in specific type of agro-machinery in Bangladesh. The analysis considers both different types and models of agro-machinery, and inter-regional differences in agro-economic factors that influence the business rationale for investment. Maize shellers are increasingly needed to serve demand from poultry sector. Because manual shelling is so laborious, only moderate production is needed to create reasonable investment returns (5 – 8 acres for 25% IRR). However, it makes economic sense to operate shellers at higher capacities, and along with the high capital cost (Tk 18,000 – 22,000), this makes this agro-machine preserve for large farmers and maize traders. The technology is, however, well suited to rental service operation, and field data suggests this is already happening (Tk 700 – 900 per acre). Power operated Maize shellers are not good investment for small-holders if they do not use it in rental service business. However, more widespread availability of maize shellers among traders and large farmers should push the rental cost down closer toward the running costs (less than Tk 200 per acre). In so doing, we can hope the method used in this study can be followed to determine the business rational investment for power operated Maize Sheller with considering different agro-economic factors in other developing countries around the world.

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