BIDS Policy Brief
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Productivity and Efficiency of Rice Mills in Bangladesh: Economic, Social and Food Security Implications[1]

This Policy Brief analyzes different rice milling technologies having economic, social and food security implications in terms of their productivity and efficiency to understand the behaviour of rice mills in Bangladesh.

1. Introduction

With rapid structural transformation, the relative contribution of agriculture to GDP has declined substantially over time in Bangladesh although the absolute output of rice, the main staple, has increased from about 12 million to over 34 million metric tons during the last four decades. For human consumption, paddy must first be processed to remove the husk (outer shell of paddy) and bran (inner coating over the kernel) to produce clean rice. This means that with rising output of paddy the demand for milling (to dehusk and remove bran) has also been rising rapidly. As such, rice milling has emerged as a major agro-processing industry in the country.

Over the years, the technology for processing paddy into rice has changed significantly from manual methods to fully automated ones in keeping with higher levels of output and the demand for faster processing. The traditional manual method is the use of *dheki* (in which the pestle is iron tipped and fixed to a foot-operated long and thick pole), the mortar being a lined hole in the ground. The *dheki* has now been replaced with more mechanized methods. The mechanized means come under a variety of machines operated by diesel or electrically driven motors along with various separating tools for rice from husk and bran at different stages of operation. There is also pre-milling parboiling which may or may not be integrated with actual milling. An array of rather small, practically portable husking machines also exist which are used by the villagers.

Thus, in terms of technology, there exists the traditional *dheki* which is not yet fully out of the scene while, at the other extreme, there are large automatic rice mills that uses sophisticated and modern technologies. It must, however, be realized that the productivity, technical efficiency, and scale economies of these technologies are vastly different. The operation of rice mills of different vintages has diverse implications for rice consumption, trading, employment generation and its gender implications, land use, energy

[1] This policy brief is based on the study, *Productivity and Efficiency of Rice Mills in Bangladesh: Economic, Social and Food Security Implications,* carried out by M. Asaduzzaman, Nazneen Ahmed, Moogdho M. Mahzab, M. Ahiduzzaman and M.Abdur Rahim under the Policy Research and Strategy Support Program (PRSSP) being implemented by BIDS with support from IFPRI and USAID.

(diesel and electricity) consumption, and in terms of other economic and social dimensions.

In recent years, the large automatic rice mill owners have often been blamed for their alleged oligopolistic behavior and manipulation of market prices of rice in their favor. On the other hand, there are arguments that the size of operation of large automatic rice mills demands that they ensure steady and large scale supplies of paddy as well as ensure their storage for stable operation of the mills. Naturally, their operational behavior and efficiency would be different from those of the small scale operators. This study brings out the differential operational behavior, determinants of efficiency, economic and social impacts as well as implications for food security by type of processing technology of rice.

Table 1: Number of licensed rice mills in different divisions of Bangladesh, 2011

Divisions	Husking	Major	Auto	Total
Rajshahi	5,242	2	48	5,292
Rangpur	6,361	20	110	6,491
Dhaka	2,430	64	105	2,599
Khulna	1,932	21	14	1,967
Chittagong	307	11	74	392
Sylhet	51	0	10	61
Barisal	24	13	0	37
Total	16,347	131	361	16,839

Source: Ministry of Food.

2. Rice Milling and Food Security

Rice, being the country's staple food, requires special attention for its milling, especially in terms of productivity and quality of output. Higher productivity and quality obviously have important implications for better supply and hence for food security. Technical efficiency in milling and the technology in use are major factors behind productivity and hence need investigation to understand the productivity behavior over time. A highly automated and fast technology in milling means that these units must ensure steady supply of the principal raw material, paddy. Furthermore, as the government provides a floor price for paddy and rice and the procurement under the Public Food Distribution System (PFDS) is often made from the rice mills, the larger ones have an advantage in supplying more than the others and it is also administratively easier for the relevant agencies to procure from the larger units. Highly automated and large rice mills are fewer in number and under the present situation these units can exert both some monopsony power in purchasing paddy and monopoly power in selling rice in the market. They can, it is often alleged, easily destabilize the rice market which is detrimental to ensuring food security, especially for the poor households. It is important therefore to understand their stock (of paddy and rice) behavior and its proximate determinants for effectively stabilizing the rice market.

There is yet another aspect of food security which relates to the quality of milling and the clean rice that comes out of the mills. In Bangladesh, several grades are used to mark the quality of milled rice. As these gradations are mostly related

to the extent of removal of husk and bran, the cleaner the rice looks, the higher the price it fetches in the market. On the other hand, highly polished rice has less nutritional elements (such as vitamin B) as these are reduced or eliminated from the kernel. Thus the dheki-processed rice is often sought by the health-conscious people often at premium prices. This shows that the nature of processing and milling has implications for the nutritional aspects of food security.

In addition, technological changes and the productivity of rice milling have important implications for employment, particularly female employment. In the case of dheki, rice processing is almost an exclusive female domain of activity. With mechanized means in mills, women are still employed but more in parboiling and drying activities while the scope of females working in large automated mills is very limited. For portable hullers, women labor appears to be almost nonexistent.

Available studies in Bangladesh and elsewhere mostly concentrate on energy consumption, capacity utilization, efficiencies in terms of rice recovery rate (from paddy), and other aspects of efficiency and social impacts of different types of rice milling. These studies can broadly be classified under three categories. One category focuses on the types of technologies involved in rice milling. The second category attempts to analyze the characteristics of milling while the third category examines the efficiency of input use. The efficiency analysis is mostly done in physical terms such as energy consumption per unit of output, and economic efficiency. Such studies are, however, few in number and do not provide a comprehensive view of efficiency of various types of rice mills covering social and economic implications and thus implications for food security.

This policy brief summarizes the results of a study undertaken by the present authors to analyze different rice milling technologies to understand behavior of the milling firms and entities having economic, social and food security implications.

3. Methodological Note

Rice mills can be defined in many ways. In broad terms, four major groups of rice mills can be differentiated in Bangladesh. The "auto mills" are mostly dependent on automated machineries, where the presence of automatic drier, polisher and color sorter can be found. The 'semi-auto mills' use rubber rollers like the auto mills but they might not have automatic drier; rather they opt for sun-drying. The third group is the most widely used traditional mills, popularly known as "chatal" which uses the Engelberg steel roller processing. Finally, the stationary and mobile hullers are used for small scale paddy processing. It may be added here that the exact number of rice mills in the country is somewhat difficult to estimate. While information is available on licensed rice mills which are mostly mechanized, there is hardly any data related to the hullers.

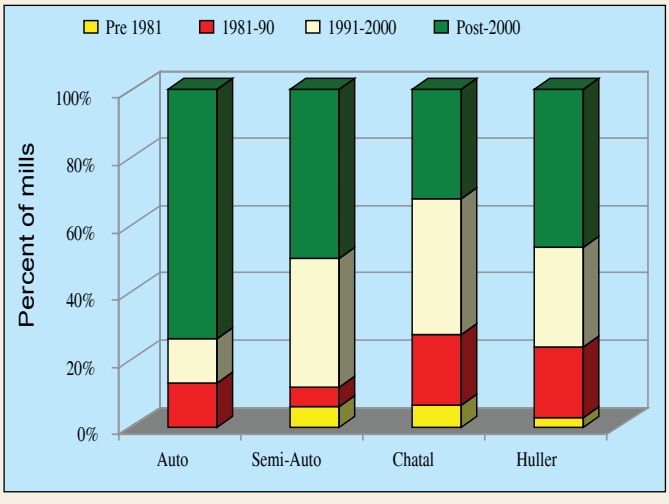
The results are based on both primary and secondary information. The primary data have been collected from all types of mills and enterprises with the help of structured questionnaires. Two separate questionnaires are used for collecting information on hullers and modern (including chatals) rice mills. The distribution of different categories of rice mills in the sample was based on estimated numbers of different categories of rice mills using available information. In total, 402 rice mills from 11 districts have been surveyed in the study. Out of the surveyed rice mills, 24 are mobile hullers (6 percent), 127 are stationary huller (32 percent), 145 are husking (36 percent), 68 are semi-automatic (17 percent), and 38 are automatic rice mill (9 percent). In addition, focus group discussions (FGDs) and case studies have been conducted to supplement the survey results.

4. Major Results and Policy Implications

The analysis highlights several major findings and conclusions which are as follows:

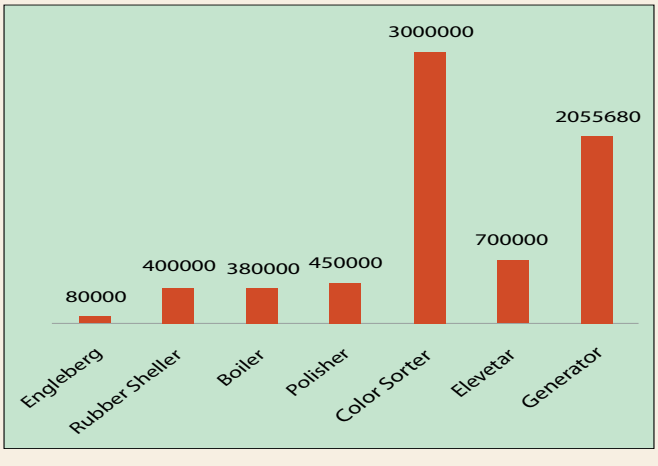
- Significant structural changes are taking place in rice milling in the country. The traditional *dheki* milling system has increasingly been replaced by modern and mechanized mills, some of which are fully automatic.
- About 60 percent of the rice mills are licensed by the local government authority. Only a few auto mills are operating under the Company Law. Most of the other mills operate without any formal license.
- Out of the 38 surveyed auto mills, 25 are established after 2005, indicating that the auto mills technology is a more recent phenomenon.
- The rice mills mostly process parboiled rice which ranges from 75 percent to 97 percent of the total rice processed by different mills.
- Auto rice mills use different types of machineries, some of which are costly. The rubber sheller, the hall mark of auto rice mills, on average cost five times more than the steel sheller (used in Engelberg plants or chatals). As such, the auto mills have to incur an initial investment which is nearly 13 times higher than similar investments in semi auto mills and 127 times of that of an average Engelberg mill (chatal).

Figure 1: Year of establishment of surveyed rice mills



Source: Study Survey.

Figure 2: Average value of capital machineries in rice mills (in Taka)



Source: Study Survey.

- Although the initial investment for an auto mill is much higher than similar investments in other rice milling technologies, the gross revenue is also higher in these mills. As the auto mills are less dependent on weather for drying and other operations, their operations are less risky and the related process is less prone to stoppage. On the other hand, as the drying space (or land) needed in semi auto or traditional mills involve opportunity cost of land, inclusion of its opportunity cost narrows the gaps between the investments in traditional and auto mills.

Table 2: Capital, output and gross revenue of rice mills
(Annual average)

Mill Category	Current value of machines (000 Tk.)	Output of rice (Maund)	Gross revenue (000 Tk.)
Auto	20,724	205,559	121,788
Semi Auto	1,494	47,981	24,635
Chatal	163	17,715	9,334
Huller	40	5,500	…

Source: Study Survey.

- As the auto mills are less dependent on natural weather for drying and other operations of the mill, their operations are less risky. They can operate even during the rainy season. In addition to the sophisticated machines used in auto mills, the fact that they can operate round the year, result in higher productivity in auto mills compared with the productivity in traditional mills. In a running week, an auto mill can mill 6,394 maunds (256 metric tons) of rice. In comparison, a semi auto mill can mill up to 1,516 maunds of rice, which is less than one-fourth of the capacity in auto mills.

- The employment structure of auto mills differs significantly from traditional mills. The number of permanent staff in automatic mills is nearly twice that in chatals and 60 percent more than in semi-auto mills. The difference is also reflected in the capital-labor ratio (value of capital/cost of labor). The ratio is 4.4 for auto rice mills, which is 3 times that in semi-auto mills and more than 17 times that for chatals.

- About 38 percent of the labor force in rice mills is women. They are employed mostly in drying and cleaning part of the process. But they are also, though in a limited way, involved in the milling and polishing part of the process which are generally thought to be men's jobs.

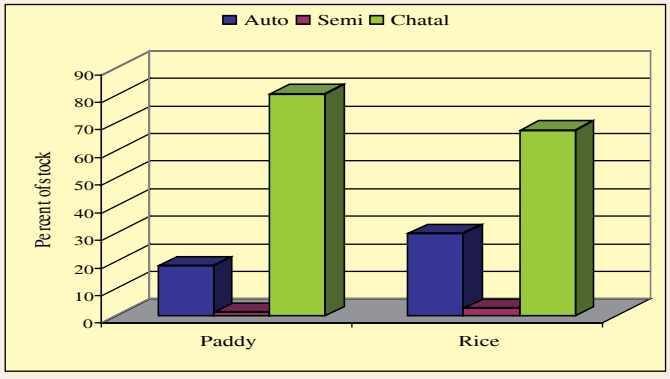
Box 1: Stock Behavior of Rice Mills

Regarding the stock behavior of the mills, mixed results are reported. It is found that the hullers still account for the bulk (estimated at around 60 percent) of the total processed rice in the country. But as these are itinerant ones, they do not store any paddy or rice. Of the rest, automatic rice mills account for about 20 percent of the total processed rice, while chatals account for 78 percent. In this respect, the auto mills probably have some oligopolistic power. Also, when the levels of stock are considered, auto mills account for an estimated 18 percent of paddy and 30 percent of total rice stocks (at the beginning of the reference year), while the chatals account for 80 percent and 67 percent of the stocks of paddy and rice respectively (Figure 3). This indicates very limited price leadership behavior, if any, by the auto mills. But the average stock of chatals is only one-tenth and one-twentieth for paddy and rice respectively compared with the auto mills (Figure 4).

Source: Study Survey.

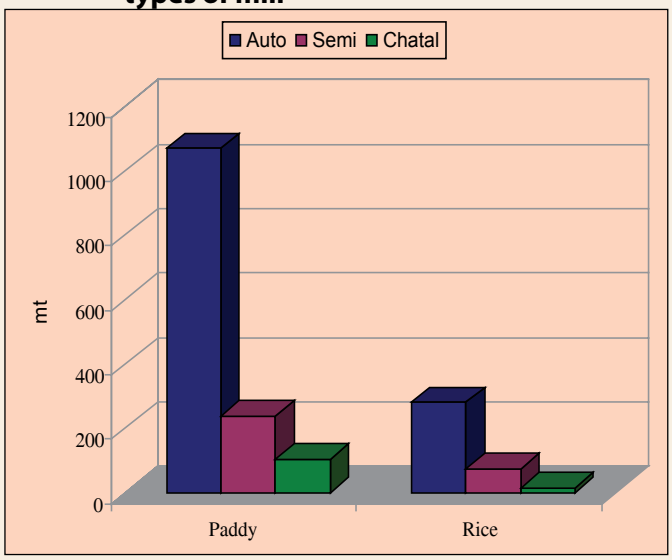
- This indicates that while in aggregate the auto rice mills have only limited monopolistic power, at any given point in time their average stocks are relatively high probably giving them a price leadership role. But given that the processing capacity of a chatal is only one-twelfth of that of an auto mill, auto mills need to keep adequate stocks of paddy for ensuring the smooth running of the mills. It may also be noted that the rice stocks are only around a quarter of the paddy stocks for these mills. Thus, although there seems to exist some scope for the auto mills to behave in a monopolistic manner, the chances appear to be much less in reality.

Figure 3: Opening stocks of paddy and rice by types of mill



Source: Study Survey.

Figure 4: Average stocks of paddy and rice by types of mill



Source: Study Survey.

- Econometric analysis used in analyzing the characteristics and productivity of different types of mills provides the following major results: (i) the volume of paddy milled is a major factor in the case of value addition. In this respect, the auto mills have an advantage over semi auto mills and traditional mills; (ii) for all categories of mills, labor has positive relationship with overall output. Capital also has a positive relationship except in the case of semi auto mills; (iii) while average productivity is higher in auto rice mills, the relative efficiency shows that traditional chatals and semi auto mills are doing better than the auto mills. Given the cost structure of the auto mills, not all auto mills can run the production process efficiently from the very beginning. It usually takes a good amount of time for them to increase the average score of efficiency. On the other hand, semi auto and traditional mills which are less capital intensive can optimize the production process within a short time even with limited resources. Table 3 shows that semi auto and traditional mills are doing better than auto mills in terms of average efficiency score.

Table 3: Efficiency scores of different mills

Category	Mean	Standard deviation	Minimum	Maximum
Auto Mill	0.57	0.30	0.13	0.99
Semi Auto Mill	0.76	0.18	0.18	0.99
Traditional Mill	0.77	0.15	0.24	0.94

Source: Study Survey.

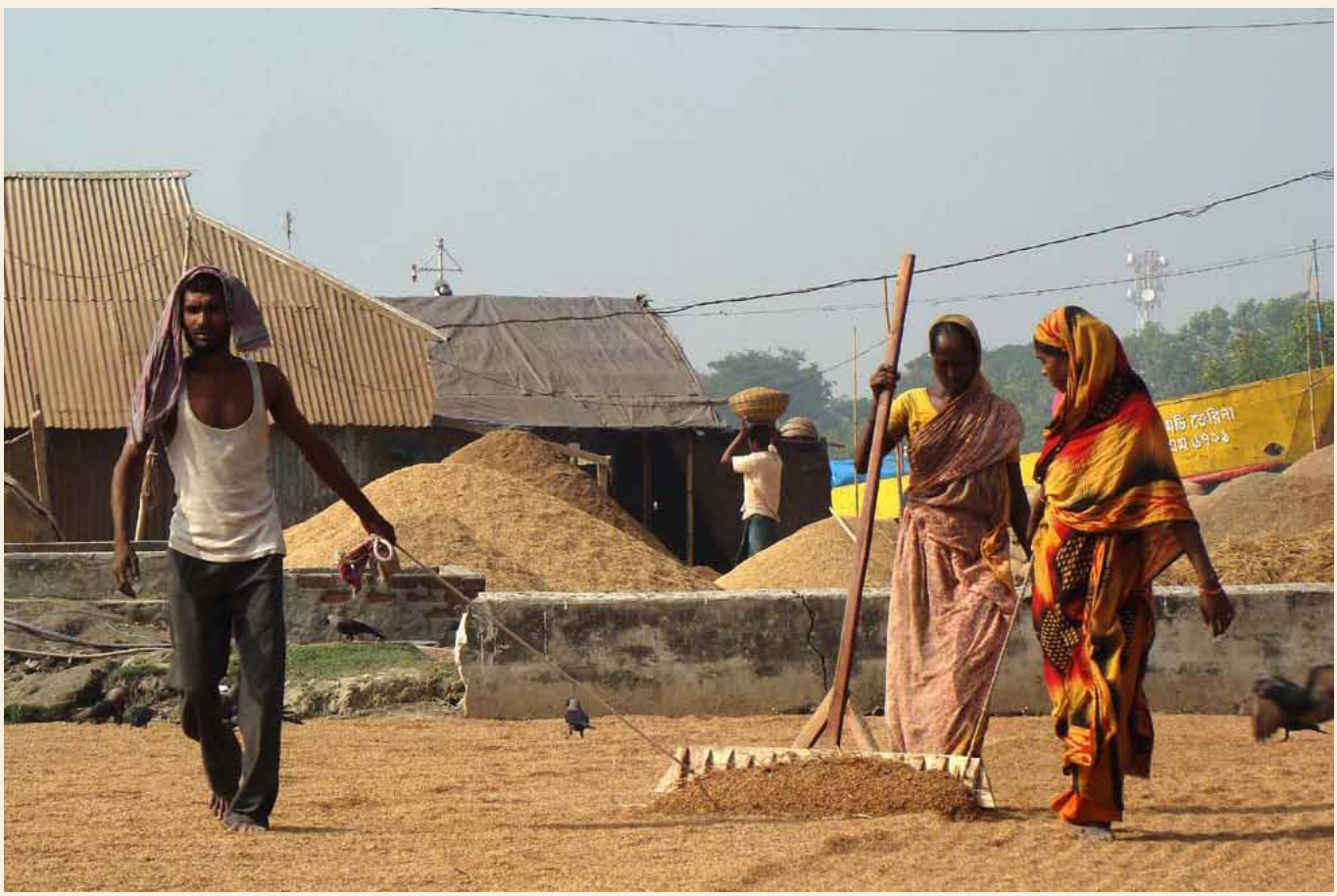
- In terms of food security, the increase in the number of auto rice mills probably ensures a better supply of rice throughout the year covering different parts of the country. However, the shift from traditional milling system to auto mills implies increased demand for formal loans, permanent workers, and large-sized land requirement.

- Another concern related to food security is the use of color sorter machine by the auto mills to weed out discolored kernels and polisher used to make rice whiter. As the white rice thus produced has less nutritional value, one implication of increase in the number of auto mills is to promote the use of less nutritional types of rice.

The following policy implications may be drawn from the study results.

- The changing structure of rice milling technologies needs to be matched with food security concerns emerging out of these changes. For example, the use of color sorters and polishers could be discouraged by appropriate policies (e.g. imposing higher duties on import of such machineries) along with encouraging the auto mills to produce rice with better nutritional value. This will also improve the efficiency of the auto mills by promoting higher value for money in their operation.

- The high level of investment (along with higher processing capacity) by the owners of auto mills together with the necessity of keeping high average stocks of paddy tends to give these mill owners some leverage to exercise market power and gain price leadership. On the other hand, given that the



auto mills neither account for an overwhelming proportion of processed rice nor of the total stocks, these together may tend to limit their capacity to deliberately influence much the market price of rice. As such, the policies should focus more on removing the mismatch between the supply and demand for paddy at different points of time and in different locations, reducing transportation costs and discouraging unnecessary use of polishing and colour sorting machines which increase the cost of rice processing and thus the price of supplied rice in the market.

- Prudent government initiatives are required to ensure that the auto rice mills are able to maintain regular flows of paddy to utilize their capacity without exercising their potential capacity and market power to influence market prices. In this respect, timely procurement of rice by the government under the PFDS can play an important role. Moreover, open market sale of rice by the government and raising awareness among the people regarding the lower nutritional value of white polished rice could be used to promote food and nutrition security. Similarly, to discourage the production and consumption of polished rice, the government may consider procuring only non-polished rice or may give a premium price to such varieties.

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