CHAPTER – V
OPERATIONAL PROCESSES OF RICE MILLS

5.1. Introduction

Of the various agro-processing industries, rice milling is of greatest importance both in terms of capital involvement and labour employment. The basic raw material of the industry is paddy. Paddy is boiled, then dried and poured into the machines, which crush the paddy and extract rice. It, therefore, involves a lengthy processing before the paddy in the field can be brought on to the kitchen for human consumption. Not only the length, but there are also several technological levels in the processing of paddy. The entire gamut encompasses cottage dhenkis (wooden husking instruments) worked traditionally by women at home to large mechanized rice mill-cum-oil extraction plants. All these layers exist, sharing the same economic space in this informal sector industry. Hence, in this chapter we will briefly go through all these operations to understand their labour, space and capital requirements so that we can explore deeper into the informal nature of this particular industrial activity.

Roughly one-half of the world population, including virtually all of South, East and Southeast Asia, is wholly dependent upon rice as a staple food; 95 percent of the world's rice crop is consumed by humans. The cultivated rice plant, Oryza sativa, is an annual grass of the Gramineae family. It grows to about 1.2 metre (four feet) in height. The leaves are long and flattened, and its panicle, or inflorescence, is made up of spikelets bearing flowers that produce the fruit, or grain.

The origin of rice culture has been traced to India in about 3000 BC. Rice culture gradually spread westward and was introduced to southern Europe in medieval times. With the exception of the type called upland rice, the plant is grown on submerged land in the coastal plains, tidal deltas, and river basins of tropical, semitropical, and temperate regions. The seeds are sown in prepared beds, and when the seedlings are 25 to 50 days old, they are transplanted to a field that has been enclosed by levees and submerged under 5 to 10 cm (2 to 4 inches) of water, remaining submerged during the growing season.

5.2. Operational Steps

The harvested rice kernel, known as paddy, or rough rice, is enclosed by the hull or husk (Figure 5.1). Milling usually removes both the hull and bran layers of the kernel, and a coating of glucose and talc is sometimes applied to give the kernel a glossy finish. Rice that
THE OUTER LAYERS AND INTERNAL STRUCTURE OF A RICE GRAIN

- Endosperm
  - Aleurone cell layer
  - Endosperm cells with starch granules

- Germ (embryo)
  - Plumule
  - Scutellum
  - Redicle

- Apex (awn)
- Lemma
- Hull
- Bran
  - Nucellar tissue
  - Seed coat (testa)
- Pericarp


Figure 5.1
is processed to remove only the husks is called brown rice and contains about 8 percent protein and small amounts of fats. It is a good source of nutrients like thiamine, niacin, riboflavin, iron, and calcium. Parboiled white rice is processed before milling to retain most of the nutrients, and enriched rice has iron and B vitamins added to it. The by-products of milling, including bran and rice polish (finely powdered bran and starch resulting from polishing), are used as livestock feed. Broken rice is used in brewing, distilling, and in the manufacture of starch and rice flour. Hulls are used for fuel, packing material, industrial grinding, fertilizer manufacture, and in the manufacture of an industrial chemical called furfural. The straw is used for feeding livestock, as bedding or mats, roof thatching, as packing material, and for making broom straws.

Paddy has three separate portions: (a) embryo; (b) inner portion or endo-sperm; and (c) outer portion or bran. The inner portion of the paddy is made up of carbohydrate. Paddy contains protein (6-9 per cent), Vitamin B (especially B₁) etc. Generally we take two types of rice: (i) sun dried rice; and (ii) parboiled rice. Sun-dried rice loses its vitamin contents during the period of milling and is considered to be harmful for health. The Health Department of the Government of India suggests consumption of only the parboiled rice.

The rice milling industry is a continuous process. The milling processes and the products at the end of each different process are described below. The four main parts of the rice kernel are the hull, bran, germ and endosperm. The purpose of milling rice is to separate the outer portions from the inner endosperm with a minimum breakage. The various steps followed in rice milling given in *Encyclopaedia of Science and Technology* (1985) are illustrated below in a flow chart.
Figure 5.2: Flow Chart for the Processing of Rice

Rough or Paddy Rice → Rough Cleaning Equipment → Drying

→ Separating and Grading Equipment → Stones

→ Aspirators

→ Rubber Rolls

→ Scourers or Debranners

→ Polishers

→ Aspirator

→ Grading System

→ Milled Rice

→ Rice 2nd Heads

→ Rice 1st Heads

→ Coating

→ Coating Drum

→ Coated Milled Rice

→ Uncoated Milled Rice

Source: 'Encyclopaedia of Science and Technology' (1985), Vol. 11
5.2.1. Processing Inside a Rice Mill
The conversion of paddy into rice is the main activity of the rice mills. In the early days of the rice milling industry, people used hand-pounding system for the processing of paddy. From that time till date several methods of paddy processing have been introduced. The Paddy Processing Research Centre in Kharagpur is still engaged in the research of developing improved means of paddy processing.

5.2.2. Methods of Processing
Paddy parboiling is the oldest Indian method of processing which is able to retain all the nutrient qualities of paddy. Various methods are practiced for the processing of parboiled rice.

5.2.2.1 Batch Method
It is the oldest method of paddy processing throughout the state of West Bengal. Even in the Burdwan district about 80 per cent of the mills use this method for processing operation.

Raw paddy is purchased or collected from the agricultural fields directly from the farmers or indirectly (from brokers).

- At first paddy is given to washing for a short period of time to remove dirt.
- Then the paddy is parboiled in several *handis* (pots) at a temperature of about 50°C. About three quintals of paddy can be parboiled in one *handi*.
- After parboiling, the paddy is dewatered and given for soaking into a tank filled with cold water. Such a tank is called *houze*.
- After 24 hours this paddy is boiled again in *handis* at the same temperature mentioned above.
- When boiling operation is over, the paddy is spreaded for sun drying in the adjacent courtyard.

Paddy usually takes between 7 and 8 hours to dry up completely depending on the ambient temperature and humidity condition. In monsoon months paddy takes longer period to dry than the rest of the year.
The second phase of paddy processing is carried out by several machines. Of them, 'huller' is the oldest machine, which at present is used by only husking mills. Most of the rice mills in Burdwan now use 'shellers'. The shellers are of two types - disc sheller and rubber-roll sheller. Rubber roll shellers have a great use in Burdwan. The rubber-roll sheller system consists of four sets of machinery: sheller, paddy separator, fanning, and polisher.

In the second phase:

- The sheller breaks the paddy into rice. In this process some of the paddy remains unbreakable.
- The paddy is brought into the paddy separator, which separates rice from paddy.
- From here the unbroken paddy returns to the sheller again whereas the rice goes to the fanning. The machine removes the husk from the rice.
- Finally, the polisher smoothens the rice and recovers a large quantity of rice bran, which has a great demand for making edible oil.

During the period of entire processing operation, the elevator plays an important role in the transportation of paddy and rice from one place within the parts of the machine to another. The elevator is usually run by electricity.

Rice processed by batch method is of milky white colour and such rice can be preserved for a long period of time. Therefore, it has a great demand among the Bengalees who take rice as their staple diet. Some non-Bengalees do not like the particular flavour of rice produced in this way. Rice mills sometimes use 0.05 per cent sodium chromate during the parboiling operation to make the rice whiter and marketable.

5.2.2.2 Parboiling Method

This method is essentially an improvement on the batch method. In this method, a larger amount of paddy can be processed into rice in a short time. Thus, the milling capacity is higher than that of the batch method. In this case the handis are of bigger size. The paddy containing capacity of a single handi is about 36 quintals. After parboiling operation the paddy is soaked in cold water only for about 12 hours. The paddy needs only five hours for sun drying because in this method the moisture content of paddy becomes 35 per cent, while in the batch method paddy retains 40-45 per cent of moisture. The quality of rice does not
differ from that made by the previous method. The batch method is now being replaced by the parboiling method all over West Bengal.

5.2.2.3 Pressure Parboiling Method

The Paddy Processing Research Centre in Tamil Nadu is engaged in research on the various methods of paddy processing to get higher yields of good quality parboiled rice with minimum loss during processing. Pressure parboiling method reduces the cost as well as the time required for parboiling.

The pressure parboiling method is a further improvement of parboiling method. Here the *handis* act like pressure cookers, feeding pressure and steam to the paddy. This procedure eliminates the need of soaking in cold water. After washing, paddy is parboiled at 70°C and steamed at a pressure of 40 PSI (pressure per square inch). This operation reduces the drying time considerably. The kernel moisture of the pressure-parboiled paddy is only 23 per cent at the most. The paddy can also be dried through mechanical drier using hot air generated with the help of oil-fired furnaces or husk-fired furnaces. At present it is mostly run by electricity

**Advantages of Mechanical Drying**

- Mechanical drying prevents losses to birds, uneven drying of paddy, and dependence on the sun.
- Mechanical drying of paddy is known to improve the overall productivity of milling operations and milling characteristics of paddy.
- Labour requirement is small in comparison to *chatal* - based mills (those with sun-drying yard only).
- By using mechanical dryer, milling operation can be continued even during the rainy season.

**Disadvantages of Mechanical Drying**

The use of mechanical dryer in Burdwan was very limited till 1987. However, after 1987 most of the rice mills of the city have been using mechanical dryer along with sun-drying yard, that is a mixed (dryer and *chatal*) technology. Some new rice mills have been set up based only on mechanical dryer. The two main disadvantages of it are:

- the higher initial capital investment required because of the higher cost of drier,
- higher running cost because of corrosion of blades, and
- the lack of space in rice mills for the setting up of a dryer.
PLATE 5: HUSKING MILL (HULLER)

PLATE 6: HANDIES FOR PRESSURE AND PARBOILING OF PADDY
Yet, the mills tend to mix both technologies because sun drying of paddy before hand requires a short run in the drier. Also, in dry season, the yard can be put to use.

**Advantages of Pressure Parboiling Method**

There was a general feeling that pressure parboiling involved a higher consumption of steam. However, this notion was clearly proven to be incorrect by a series of experiments that in most methods of parboiling there was really a good deal of saving in steam cost.

- Pressure parboiling is a very elastic process and can be easily modified to suit the variety of paddy being processed; and
- This process gives a good out turn of rice and good quality of bran, which is a source of vegetable oil.

**Disadvantages**

Despite the advantages of pressure parboiling method, it can be said that:

- rice processed in this way can not be taken as staple diet; and
- due to heavy pressure the colour of the rice becomes reddish and such rice cannot be boiled into water.

Rice produced in this way can then be used only for making puffed rice.

5.3. **Hand Pounding or Husking Pedal System**

The age-old practice of converting paddy into rice was the hand pounding or husking pedal system. Hand pounding of rice known as *dhenki* is used in village homes by women. In such case workers are employed for this purpose, they are allowed to retain bran and a portion of rice in addition to some cash. This is, therefore, a type of cottage industry providing rural employment (Sen, 1966) especially to women.

Hand pounding or husking pedal system of converting paddy into rice has been practiced for hundred of years. Though this system has lost much of its importance, it still exists in rural areas of the district. The reasons behind the gradual decay of the system are: low input-output ratio, extremely hard manual labour requirement, and stiff competition from husking mills and rice mills providing cheaper processes of production. The hand-pound rice industry began to receive stiff competition from husking mills and rice mills from the early years of the last century. The most important factor in the gradual easing out of hand pounding was
the non-availability of labour for such heavy jobs and the introduction of machines in agro-processing industries. In an agriculturally prosperous district like Burdwan, where there are jobs in the field all the year-round, the decay was more rapid than in some other backward districts. Now, in Burdwan, hand pounding of rice is usually done on special festive or religious occasions and has acquired a socio-cultural significance in rural areas.

5.4. Husking Mill and Rice Mill

Development of processing machinery in England, Germany and other European countries gave a new dimension to the paddy processing industry of Burdwan. In the first decade of the last century husking mills and rice mills began to operate in Burdwan region along with other agriculturally rich districts like 24 Parganas and Hooghly in West Bengal.

The differences between a husking mill and a rice mill are firstly, the rice mills, compared to the husking mills have more hullers (hull is synonymous to husk for the term for the outer layer of the rice grain). Secondly, rice mills have boiler plants to boil the paddy and a drying yard for sun-drying of the boiled paddy, whereas the husking mills have no such boiler plant and sun-drying yards. Husking mills crush or fabricate the boiled and dried paddy of the consumers against a certain commission amount, which is better known as bani. This is reminiscent of the putting out system prevalent in pre-industrial societies. The rice mills on the other hand perform all these functions at their own cost and trade with their products. Thirdly, the rice mills have a storehouse for storing both paddy as raw materials and rice as the finished product, and often arrange to sell their rice in various markets. The husking mills return the finished rice to the supplier of paddy. Usually, farmers use the husking mills to process the rice meant for domestic consumption and sell any surplus in the local market. Thus, the rice mills represent capitalistic mode of production, whereas the husking mills reveal a pre-capitalist nature. However, both are essentially informal industries.

The modus operandi of both the rice mills and husking mills are the same that is the fabrication of paddy into rice. The operational processes of the machinery used in both types of mills are also the same. In rural areas single huller machines, commonly called husking machines, are generally used. This type of machine generally employs 2 to 3 persons. Its capacity is 0.6 to 1 metric ton of paddy per hour (Sen, 1966). However, the difference lies in the intricacy and elaborateness as well as production capacity of the huller machines of rice.
mills and husking mills. The finished output too varies greatly, consequently resulting in 2 clearly differentiated markets.

5.5. Paddy Processing in Husking Mill

The purpose of both the rice mills and husking mills are the same but there is a significant difference in polishing of rice and bran is not removed from the processed rice. This rice is consumed only by rural classes. Husking mills serve an important role in agro-processing in rural areas and was often the only form of manufacturing in the agricultural areas of Burdwan. As they use lower levels of technology, they are less capital intensive and can be easily set up by an entrepreneur.

The processing machinery in husking mill is somewhat crude. As a result, there is variation in fineness and colour of rice. Above all, the husking mills only fabricate the boiled and dried paddy brought to them by the customer (can be the grower or consumer). For this service, they take a service charge or commission. Before bringing it to the husking mill, the paddy should go through certain procedures.

They are given which is discussed in detail in chapter VIII (p. 227).

All the finished products and by-products in the husking mills go back to the customers. The husking mill owner is nothing but a jobbing miller. However, the system is so that it reminds one of pre-industrial revolution systems, that is, a non-capitalistic production system. In fact, similar production relations still exist in the handloom sector in some cases in India. It also shows the lesser specialization of production activity in rural areas.

5.6. Rice Milling in Early Days

In early days of rice milling, the capacity of mills was not as much as today's modern rice mills. At that time, in the absence of electricity, steam engines and boilers were operated by husk, coal and firewood as fuel. The only by-product obtained from the milling industry at that stage of development was bran. Though imported machinery was used, the rice milling industry remained labour-intensive industry. Even today it is so, the only exception being totally dryer based mills. To keep pace with changes in time and developments in technology, certain changes have been made in the operational processes of the rice milling industry. Previously, the industry was a seasonal one and its operations would remain
suspended during the monsoons. According to a senior rice miller and a senior executive member of Burdwan District Rice Mill Owners' Association, at that time it was customary to suspend the milling operation on the day of Rathayatra (in the Bengalee month of Asharh - June-July) and to re-open on the Bijaya-Dashami (in the Bengalee month of Ashwin - September-October) day every year. The reasons given by them for such suspensions of work were: First, due to rain, sun-drying system through drying yard would not be possible. Secondly, the quality of rice produced during rainy season fell with serious impacts on the price and profitability. Finally, in the rainy season the casual labourers working in rice mills used to go back to their fields for cultivation work. Clearly, with the provision of year-round work made possible by mechanization, the industry is gradually adopting more capitalistic nature in terms of having captive labour.

Before the innovation and introduction of modernized machines and appliances, the input-output ratio in the rice mills was low. According to this old rice miller, before the introduction of modern machinery the quality of rice was much better than it is at present. This is because all the layers of rice are now being used for other purposes as by-products, leading to a lowering of nutritional value of the rice. At that time sun drying of boiled paddy used to take a longer period and the moisture content of the rice was low. This statement can be verified if one carefully studies the present moisture content rates of rice produced in husking mills and in modernized rice mills. The moisture content in husking mill rice is 14 per cent whereas the same in rice produced by a modern rice mill is 16 per cent. The basic difference in the rice produced by the two is in the appearance, the rice mill rice being more acceptable to urban consumers. There is in fact still a tendency among traditional customers to prefer husking mill rice.

5.7. Introduction of Modern Machinery

The development of improved machinery by Schulz Company of Germany led to some dramatic changes in the operational processes of rice mills. In India, these modern machineries were introduced in some rice mills after World War II leading to a much increased production capacity of the rice mills from those years onwards. However, the procedure for processing of paddy more or less remained unchanged, though for the first time a separator-cum-polisher machine was introduced to separate rice from bran. This addition of the new improved processing system resulted in the reduction of broken rice content to a
considerable extent and thus helped to reduce the cost of production on the one hand and increased the input-output ratio on the other.

5.7.1. Huller
The huller system of operation still continues and the production capacity of the mills depends upon the capacity or size of hullers that it can afford to use. The machinery, driven by electricity or diesel oil motor of 5 hp to 20 hp, consists of two grooved horizontal cylinders set side by side in an outer casing. These cylinders revolve at a high speed of up to 1000 rpm (revolutions per minute). One of the cylinders receives the paddy while the other discharges it after the removal of the husk. A steel blade set in the outer case against which the cylinder revolves effects the actual husking. The blade is adjustable according to the size of the paddy and degree of hulling required. The product has to pass again through another type of huller for polishing.

The huller type of rice mills usually has a number of hullers. When paddy is converted into rice in a single huller, there is a greater percentage of broken rice. This may be uneconomical and so paddy is hulled in one huller and the resultant husked rice containing a good proportion of paddy is passed through other hullers, which are so adjusted as to mill the rice with least breakage. The huller type of mill generally employs ten persons. In this type of rice mills it is not easy to regulate the degree of removal of bran and the bran gets mixed up with powdered husk. The bran if used as cattle feed lead to digestive disturbances of animals (Sen, 1966). This type of huller system continued up to 1968.

5.7.2. Replacement of Huller System by Sheller-cum-Polisher-cum-Separator System
In 1968 the Government of India made some changes and modifications to the Rice Milling Industry (Regulation) Act, 1958. In this amended act, instruction was given to the rice mills (Gazetteer of India, 1967) to replace the earlier huller system of operation by the modern system of milling, that is, sheller-cum-polisher-cum-separator system. By this means, the government also directed the rice mills to extract rice bran from the rice as it has some industrial value. The reasons for replacement of the earlier huller system by modernized sheller-cum-polisher-cum-separator system, as stated in the amended Act of 1968 are as follows:

- These hullers were scattered all over the countryside far away from important markets and in many cases, were run along with other power driven plants like
flour, oil, dal mills or pumping sets etc. without securing requisite permits or license under the Act.

- Most of the rice mills with hullers were antiquated and used outmoded technology. As a result the out-turn of rice from outmoded hullers was much lower than that from Sheller-cum-Polisher type of mills. As such, use of hullers decreased the availability of rice.

As a result, it was ensured that rice mills both existing and new ones were equipped with modern technology. Moreover, the removal of bran, popularly known as 'polishing' of rice after its recovery from paddy, was also proposed to be covered by the term 'milling rice' which hitherto would be covered by the recovery of rice from paddy. (Gazetteer of India, 1967)

**Sheller**

In sheller-type mills, the dehusking is done by grinding the paddy between two stone discs, which resemble the stone *chakki*, polishing of the husked rice is done by automatic core polishers. Polishing is done to improve the appearance of the rice; polished rice also means better quality and fetches a higher price. The cleaning, dehusking, winnowing, polishing and sieving are automatically performed one after another in continuous process and the different products like rice, husk and broken rice etc. are separately delivered. A sheller type of mill with the single sheller generally employs about 10 persons apart from casual labourers. Recovery of rice is 69 per cent to 70 per cent.

In the huller type of mills dehusking and polishing being combined in the same process, the polishing cannot be controlled to the same degree as in sheller-type of mills operating with a core polisher (Sen, 1966).

5.8. **Governments' Role in Modernization of Rice Mills**

- In the year 1958 the Government of India enacted for the first time, the Rice Milling Industry (Regulation) Act, 1958 for the country. In this act, among many others, some provisions were also made for the development of organizational and operational aspects of the rice mills and use of their by-products.
In 1968 the Government of India made some changes and modifications to the Rice Milling Industry (Regulation) Act, 1958, under the caption Amending Act 29 of 1968 of the Rice Milling Industry (Regulation) Act, 1958. The amended act required the rice mills to replace the earlier huller system of operation by the modern system of milling that is Sheller-cum-Polisher-cum-Separator System. The government also directed the rice mills, by this amending act of 29 of 1968, to extract rice bran from the rice as it has some industrial value.

- The Government of India also agreed to pay subsidy to the existing or new mills, if they introduced modernized system of milling. This gave impetus to the millers and all existing rice mills availed themselves of this opportunity to modernize the mills.
- The introduction of modernized system under the encouragement of the state brought a radical change in the milling process and this system has been still continuing.
- 'Kedar' boiler, an indigenous product that was much in use in the rice mills in the 1950s and 60s have been banned by the government as the boilers had some technical snags.

**Turn-Key Project**

A latest innovation in the rice milling industry is the Turn-Key Project. This project has been introduced in some provinces of India, such as Punjab and Andhra Pradesh etc. Under the system, raw paddy is poured into the milling process and the boiling or parboiling is done automatically and drying is also done automatically by Rotary-drying Process. After properly drying, paddy is transferred to grinding machines by a conveyor belt system for its grinding. After grinding, the husk, rice and bran are separated automatically.

This system has many advantages in its operational process.

- It does not require any drying yard;
- It also requires lesser number of workers to operate;
- Minimum time is required for conversion of paddy into rice;
- Further, the working of the mill is not hampered at all in the period when climate becomes adverse;
- It has also very little environment pollution effect;
- Under this system safety and security are more ensured as it is an automatic process;
- This system also has the distinctive advantage of bulk production at a time.
The Turn-Key Project machinery, which previously would be imported from Japan and Phillipines, are now being produced in India by some manufacturing concerns, such as Oswal Group of Industries.

Though Turn-Key Projects became popular in Punjab and Andhra, there has been very little progress in this regard in the rice milling industry not only in the district of Burdwan but also in West Bengal. The various factors believed to be responsible for the phenomenon are:

Firstly, it is not a fact that the rice millers in West Bengal are not aware of the system. The reverse is rather true. Nevertheless, they did not go far as it required some technical know-how, which was not readily available in the district.

Secondly, involvement of fixed capital requirement under Turn Key Project is much more than the present Sheller-cum-Polisher-cum-Separator system and it is not possible for the millers in the district to provide such huge amount of capital at a time.

Thirdly, this project requires minimum workers for its operations, hence it is apprehended that any move to introduce Turn Key Project will not be favoured by the labour union.

Fourthly, the quality of rice produced under Turn-Key Project is also not conducive to the consumers.

Lastly, Turn Key Projects being capital intensive by nature run counter to the philosophy of small-scale industrial units to which sector the rice milling industry as a whole belongs.

Recently, however, two Turn-Key Projects have been undertaken in the district. In view of the various limitations of the system it remains to be seen how the rice milling industry in the district with surplus agricultural labour reacts to this new system.

5.9. Rice Mill Machinery Manufacturing in India

The modern machinery for rice mills is now manufactured in India and are also readily available. The well-known concerns producing machinery for the rice mills in the country are Dandekar-Schulz collaboration, Kiran brand machines made by Kiran Engineering works, Batala Gurucharan Industrial Works at Mainpuri, Texmaco near Calcutta, Binny Industries group at Bangalore, Oswal Industries group at Bombay etc.
Production of rice mill machinery in India played an important role in promoting modernization of the process. It also meant lesser initial capital investment and better servicing facilities thereby facilitating entry into this sector.

5.10. Advantages of Modernization

Introduction of modernized plant in the rice mills has brought some improvements in the milling process.

- With the introduction of rubber roll shelling system, the production capacity of the mills has increased to a large extent.
- Mechanical drying of high moisture-paddy can prevent the quantitative and qualitative losses occurring in traditional method of harvesting.
- Replacement of traditional system of parboiling (under which paddy takes 24-36 hours) by the improved one (which takes only 4-6 hours) results parboiled rice free from any off-flavour and its nutrient is infused into the kernel.
- Important advantage of modern machinery is that they can be run by electricity or diesel;
- Further, being an automatic process, machines require less labour and comparatively less fuel reducing substantially the cost of production;
- Mechanization has improved the quality and quantity of the products;
- Machines have reduced the percentage of broken rice to a significant extent and thus modernization of plant has increased the input-output ratio in the rice mills;
- Use of modern machinery has also brought more safety and security to the labourers engaged in the rice milling process; and finally
- It has also reduced the incidence of environmental pollution.

Another indirect advantage has been the enhancement in the operating time of the mills. Now the rice milling process is not suspended even in the rainy season. However, at the same time it must be mentioned that machines have reduced the role and status of women workers, and have made the production process more capitalistic thus introducing elements of formal sector.
5.11. Existing Processing Techniques in Burdwan

The Rice mills of Burdwan city and surrounding areas commonly use either pressure or parboiling method for paddy processing excepting Barddhaman Rice Mill (using batch method). In some mills both methods are used. For example, a mill may be specialized in producing *bhater chal*, following parboiling method. In case of a sudden increase in demand for *murir chal*, that very mill can produce *murir chal* for a short period along with *bhater chal*. Between the 2 methods, parboiling method requires more time than pressure method.

Examples of rice mills based on only mechanical dryer are the Ma Tara Rice Mill (on Tejganj Bypass) and Dutta Modern Rice mill (in Lakuddi in the outskirts of Burdwan municipal area), New Madan Mohan Rice mill (on Bypass) of Burdwan city. Example of rice mixed type rice mills are Shanti Rice Mill, Shib Shankar Rice Mill, Nitya Kali Rice Mill, Sree Shankar Rice Mill, Shree Ram Rice Mill, Bardhamaneswar Rice Mill, Shambhu Nath Rice Mill, Sarbamangola Rice Mill, Roy Trading Rice Mill, Agarwal Rice Mill etc. Many owners have combined the traditional method with modern techniques, and use them according to seasonal variations.

5.12. Summary

We have described in this chapter the different operational processes in rice milling industry starting from age-old paddy converting practice like hand pounding or husking pedal system or *dhenki* and passing through husking mill and huller system ultimately reaching to modern sophisticated sheller-cum-polisher-cum-separator system. This improvement in operational processes of rice milling is an indication of technological development in our country in general and Burdwan region in particular.

To keep pace with the changing demands of society, the mode of rice fabrication also changed. In the early days *dhenki* was popular because in rural India, the demand for rice production was only to meet the requirement of a family. That is, rice production was meant for subsistence and at a subsistence level. In other words, scale of production was limited and there was in most cases no excess production for marketing. The next rice fabricating machinery to come into being was the husking mill, which depended on pre-capitalistic modes of production relations. The production of rice in husking machine is rather faster than that in the *dhenki*. As the mills are operated by electricity, they can process larger amounts of paddy creating surplus production for marketing. Such technological improvements can
happen only when the production of paddy improves above the subsistence level. These husking mills mainly deal with *bani milling* (on the basis of certain commissions to be kept by the mill-owner). Naturally, profit levels in husking mills too are lower than those in rice mills. The owner of husking mills could make significant gains only when a good number of customers brought large quantities of paddy for such *bani milling*.

The similarities between *dhenki* operators and husking mill owners are that both of them are not under a banner of union. This total absence of unionization indicates their completely informal nature, but the popularity of husking mills somehow decreased in Burdwan region during the post-1958 period with the advent of the huller system of operation. Consequently the production capacity of the rice mills increased to a great extent from these years onwards. The quality and quantity of rice further improved with the replacement of huller system by sheller-cum-polisher-cum separator system. At the same time, major changes began to take place in rural Burdwan, leading to great improvements in paddy production. In response, rice-fabricating units become more commercialized and capital oriented surpassing their subsistence and feudal nature. The nature of ownership also changed at this time and quite a few *Ugrakhatriya* families either sold off or leased out their mills. Here we see the correlation between operating and processing on the one hand and social and economic changes on the other.

With the passage of time, the methods of paddy processing also began to change within the rice mill itself. From the oldest batch method, processing changed to parboiling method and eventually to pressure parboiling method. The traditional practice of drying of paddy on the *chatal* under the sun became obsolete in most cases (many newly established rice mills do not even have a *chatal*). In that case the use of mechanical dryer was introduced which changed the seasonal nature of the rice milling industry helping to continue the rice milling operation all the year round. This changing methodology also increased the production capacity of the rice mills carrying this industry another step ahead towards formality.

Thus, the basic differences between the traditional and modern techniques of rice milling in Burdwan region are as follows: in the case of former, capital investment is negligible, production capacity is very low, in most cases no surplus for marketing is left, lack of unionization, small physical area, greater dependence on physical elements of climate leading to seasonality, fewer number of byproducts, and favourable representation of women
in production work. In case of rice mills, capital investment is very high, production capacity is also very high, finished product is entirely meant for sale in the market, strong unionization of mill workers, larger ground area, lesser dependence on physical elements of climate (greater use of mechanical dryer for drying paddy during rainy season), larger number of byproducts, and almost a complete male domination among workers, women being relegated to only unskilled chatal work.