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## Economics of paddy processing industry in India: a case of Karnataka

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### ABSTRACT

With the growth of demand for food crops, especially the rice and quality product, the need for improved technology of paddy processing industry has been realised. This improvement of technology saves post-harvesting losses to some extent. However, the viability of the industry depends on the economics of paddy processing done by different mills. With the help of 92 sample mills (67 modern and 25 traditional), the conversion ratio of rice was found to be 63 percent and 58.7 percent by the modern and traditional mills respectively. Though, the net profit accrued by the modern mills was found to be lesser than the traditional mills, the former is beneficial and preferred than the latter, on the ground of economies of scale and quality of production.

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### 1. Introduction

In India, rice is the staple food for more than 50 percent of the country's population (Joshi, 2004; Saunders, *et al.*, 1980). According to NABARD (2010), 65 percent of India's population is living on rice. At present, India has the largest share of its land area under rice cultivation, and become second largest producer of rice in the world, 21 percent of global rice production, next to China (Joshi, 2004; Nayak, 1996). Rice contributes about 43 percent of total food grain production and 46 percent of total cereal production in the country, and continues to play a vital role in the national food grain supply chain (Mondal, *et al.*, 2011). However, the country is still facing shortage of food supply, and seemingly a man-created phenomenon in terms of marketing network, storage and infrastructure (Iqbal and Merwe, 2010). According to Joshi (2004), it is estimated that about 10 percent of the food grains

produced in India is lost in processing and storage. Further, he estimated that about 9 percent of paddy is lost due to the use of old and out-dated methods of drying and milling, improper and unscientific methods of storage, transport and handling. Karnataka is one of the leading paddy producing states in the country, and the efficient paddy processing industry helps in post-harvest loss to some extent in agricultural sector in the state. The major problem in the rice processing industry in the state is that about half of the entire paddy production is processed by inefficient traditional huller mills, leading to considerable post-harvest loss (Singha, 2012). Why is it so and what are the economics of paddy processing units in the State are the researchable issues at this juncture.

The paddy processing activity in Karnataka can be broadly classified into two categories, viz. traditional method and modern method. However, the paddy processing units of the traditional huller type are often considered inefficient when compared to the modern mills. In this regard, a number of studies in the past have indicated that the overall supply of rice could be augmented substantially through modernisation of existing traditional rice processing techniques. However, the number of traditional mills is still larger than the modern ones in the state (Singha, 2012). With this notion, the present study is the modest attempt to analyse the paddy processing industry or hulling and milling ratios of paddy through different processing methods in Karnataka. However, the specific objectives of the study are given below:

- a. To estimate conversion ratios of paddy to rice by different mills (modern and traditional) in the state.
- b. To analyse the economics of paddy processing industries in the state by the modern and traditional mills.
- c. To understand the quantity and value of by-products produced by different mills.

## 2. Materials and methods

The present study is based on both primary data collected from the 92 mills through stratified sampling. The year 2009-10 is considered as the year of reference. However, data pertaining to 2007-08 and 2008-09 have also been collected to validate yearly growth trends and economics of milling ratios in the state. The primary data of ninety-two (92) rice mills (25 traditional mills and 67 modern mills) were collected from the three districts of Karnataka — Mandya, Davanagere and Tumkur, based on the concentration of rice mills and area under paddy cultivation. The districts of Mandya and Davanagere have relatively more number of modern rice mills as well as area of paddy production in the state, and the sample of modern mills are collected from these two districts. It was also found that these districts do not have hullers (traditional mills). While, the sample of traditional mills of 25 units were collected from Tumkur district, as a large number of hullers (traditional) mills are being operated (based on informal sources) and the paddy cultivation in the district is also very high in the state. Also, in the present study, of the traditional rice mills, only the huller units were surveyed as the *sheller* and *huller-cum-sheller* units are limited in number in the district and even in the state. Moreover, they are found to be custom-hiring units and processed non-parboiled paddy only. In the case of modern mills, all the sample units were found to be operated under the owner-cum-trader category and produced non-parboiled rice. The sample of 67 modern mills were collected from three type of mills- Phase I with 7 units, Phase II with 24 units, and Phase III with 36 units.

### 2.1. Rice milling industry in Karnataka

Broadly, in this present study, two processing or milling techniques — traditional (Huller) and mechanical methods (Modern) — will be studied. Modern mill again has three different types- Phase I, Phase II and Phase III (technology and cost increases as level/phase of mill upgrades from phase I to II and III). Up-gradation of milling unit is an improvement of technology in the sector. During the milling of rice, husk and bran are obtained as by-products. The quality of rice and husk produced depends upon the type/technology of mill. In the case of single huller (traditional) mills, husk is obtained in a fine broken state and is always mixed with bran and broken rice. As traditional rice milling industry is come under the unorganised sector, proper and accurate information on traditional rice mills (hullers) was not available with the Government of Karnataka (Singha, 2012).

#### 2.1.1. Rice milling ratio and differences

For analysis, the paddy which is processed by different milling units has been categorised into two kinds: **raw rice** (processed as raw i.e. without boiling/heating treatment of paddy) called *non-parboiled*, and **rice** (processed after boiling/water heating treatment to the paddy) called *parboiled rice*. Also, in terms of grades/qualities, final output — *polished rice* is categorised as: 1) **Grade A** (Basmati Rice and Superfine quality), 2) **Common Rice** (Non-Basmati Rice or *Grade B*) by the purchasing agencies and both can either be raw (non-parboiled) or parboiled

(Kapur, 2003). However, for the present study, the classification of *Common* and *Grade A* is not made on the basis of Basmati and Non-Basmati quality, as it is categorised by the millers for their convenience on the basis of the overall quality of the rice produced (Singha, 2012).

It is obvious that there are considerable differences in the milling ratios with respect to the different phases. The milling ratio of modern type of mills especially the Phase III type of mills was comparatively higher than other types of mills, has certain advantages over the other mills because primarily it involves many more stages in paddy processing. To compare milling ratios, Table 1 summarises the different phases of mills. Though milling ratio of parboiled rice was better than non-parboiled rice (Nayak, 1996; Lele, 1970), the present study focuses on the non-parboiled rice only.

**Table 1**

Milling Ratios of Modern and Traditional Rice Mills		(Qty. in '000 Qtl).			
Type of Unit	Particulars	2007-08	2008-09	2009-10	Average
Phase I	Paddy Processed	549.7	557.9	574.7	560.8
	Fine Rice	336.5	341.3	351.6	343.1
	Out-Turn Ratio (%)	61.2	61.2	61.2	61.2
Phase II	Paddy Processed	889.6	895.5	944.6	909.9
	Fine Rice	564.7	563.8	601.8	576.7
	Out-Turn Ratio (%)	63.5	63.0	63.7	63.4
Phase III	Paddy Processed	1604.6	1722.7	1818.4	1715.2
	Fine Rice	1017.1	1093.0	1155.5	1088.5
	Out-Turn Ratio (%)	63.4	63.4	63.5	63.5
All Modern (I+II+III phases)	Paddy Processed	3043.9	3176.1	3337.7	3185.9
	Fine Rice	1918.3	1998.0	2108.8	2008.4
	Out-Turn Ratio (%)	63.0	62.9	63.2	63.0
Hullers (Traditional)	Paddy Processed	228.3	375.3	238.6	280.7
	Fine Rice	133.7	221.1	139.6	164.8
	Out Turn Ratio	58.6	58.9	58.5	58.7
All (Modern and Huller)	Paddy Processed	3272.2	3551.3	3576.3	3466.6
	Fine Rice	2052.0	2219.1	2248.5	2173.2
	Out-Turn Ratio (%)	62.7	62.5	62.9	62.7

Source: Survey

From the Table 1, one can infer that the average milling ratio of paddy (paddy to rice conversion ratio) in Karnataka is 62.7 percent (together modern and traditional) in the three years study period (2007-08 to 2009-10). In the case of modern mills (all three phases together), the average conversion ratio is found to be 63 percent. Of the modern mills, the average conversion ratios of Phase I, Phase II and Phase III are found to be 61.2 percent, 63.4 percent and 63.5 percent respectively during the same period. However, for the traditional mills, it turns out to be 58.7 percent. This implies that the modern mills are better than the traditional mills in terms of milling ratio of paddy in the country. However, the question remains here is – why do not people upgrade their traditional mills into more sophisticated modern mills? Still, traditional rice mills dominate the rice milling industry in the rural areas of Karnataka. This question can be answered by analysing cost and benefits of paddy processing units in detail.

### 3. Economics of paddy processing industry

The basic economics of paddy processing remains with out-turn ratios and quality of output of the mills. In this modern age, modern technology has shaped the fortunes of many rice-growing countries in the world. The study of the economic aspects of the rice milling industry may help in understanding the economic viability and profitability of this industry in the state. It gives a broad idea of economic aspects of the rice milling industry including market incidentals, cost of processing rice in the different types of mills and the different types of the rice produced. By treating the paddy processing units as strict business units, we will arrive at a conclusion on the

economics of paddy processing in the huller units and in the modern rice mills in the different phases of development.

### 3.1. Market incidentals of mills

The market incidental of paddy processing by modern rice mills is presented in the Table 2. It is obvious that the market incidentals in the modern rice mills under the owner-cum-trader category were considerably higher than that of traditional rice mills. However, in case of custom hiring category of huller units, there was no market incidental because, the farmers hulled their paddy by paying custom charges and the mill owners get only custom charges. Even the customers of the huller units, viz. the farmers who bring the paddy to convert it into rice, often help in the tasks of loading/unloading and feeding of paddy/rice in huller machines. Hence, costs like transportation, handling, storage, drying costs, packing, weight-loss, etc., do not arise for huller units. Therefore, we do not compare traditional and modern mill in this regard.

The three years' average market incidental of modern mills is found to be Rs 8.75 per quintal of paddy processed (Table 2). In 2009-10 the highest market incidental of Rs 9.58 per quintal paddy processed was incurred and the lowest at Rs 7.78 per quintal was recorded in 2007-08. Of the different components of market incidentals, transport charges were highest at Rs 2.08 per quintal of paddy processed. At the bottom, average storage charge incurred in the three years average was Rs 0.78 per quintal of paddy processed. From the present study, the varieties comparison of market incidental of different quality of rice, like *Grade A* and *Common* rice, was not made, as the processing activities and charges of these categories remain more or less the same. Intuitively, over the years, the cost of market incidentals has been increasing and differed for the different phases.

**Table 2**  
Market Incidentals Incurred by Modern Rice Mills (All)

Year	2007-08	2008-09	2009-10	Average
Handling/Cleaning/ Packing (Rs./Qtl)	1.07	1.77	1.77	1.53
Packing Material (Rs./Qtl)	1.67	1.98	2.09	1.91
Drying Labour/Material Charges (Rs./Qtl)	0.00	0.00	0.00	0.00
Weight loss (Rs./Qtl)	1.69	1.65	1.67	1.67
Transportation (Rs./Qtl)	1.85	2.08	2.31	2.08
Storages Charges (Rs./Qtl)	0.70	0.73	0.90	0.78
Other Specify (Rs./Qtl)	0.81	0.67	0.87	0.78
Total (Rs./Qtl)	7.78	8.88	9.59	8.75

Source: Survey

### 3.2. Processing cost of modern and traditional rice mills

The processing cost of rice in modern rice mills is presented in the Table 3. The processing cost of milling consists of fixed and variable/direct costs. According to Shwetha, *et al.* (2011), the total processing cost per quintal of paddy amounted to Rs 127.00 per quintal for traditional mills and Rs 196.40 for modern units in the five years from 2005-06 to 2009-10 in Davangere district of Karnataka. However, in this study, under the fixed cost, major components like, insurance, depreciation charges and administrative charges are included. Depreciation charges may vary considerably according to the age of machine used, even the two mills using same technology. In addition, this component is more significant for the modern mills than the traditional ones because the modern mills use advanced technology involving huge investment (Lele, 1970). Fixed cost estimation excludes investment on machines (seed cost) for the present study. However, the variable cost consists of labour cost, electricity (especially for modern mills), packaging charges, maintenance and storage charges, etc. This cost varies as production changes (increase or decrease). As mentioned above, the study concentrated on non-parboiled rice so fuel charges of modern mills for parboiling of paddy were not included. However, the same (fuel charges) was included in the case of traditional mills, and clubbed with electricity charges because sometimes they run on diesel as well.

The present study found out that the three years' average cost (2007-08 to 2009-10) of paddy processing by modern mills (phase I, II and III) is Rs 68.49 per quintal (excluding seed capital). Of which, Rs 45.09 was attributed to variable costs and the remaining Rs 23.41 for fixed cost. The average total cost of paddy processed (combine three

phases) was Rs 65.05 per quintal in 2007-08 and rose to Rs 67.66 in 2008-09, and further increased to Rs 72.76 per quintal of paddy processed in 2009-10. The detail cost structure of modern rice mills is given in Table 3.

**Table 3**

Average Cost of Paddy Processing by Modern Rice Mills (Owner cum trader)

Type of Rice Produced Year	Non-Parboiled			Average
	2007-08	2008-09	2009-10	
<b>Variable Cost (A)</b>				
Labour Cost (Rs/Qtl)	17.07	18.76	20.66	18.83
Electricity charges (Rs/Qtl)	14.49	14.37	15.07	14.64
Fuel Charge/Parboiling (Rs/Qtl)	0.00	0.00	0.00	0.00
a. Petrol/Diesel (Rs/Qtl)	0.00	0.00	0.00	0.00
b. Firewood (Rs/Qtl)	0.00	0.00	0.00	0.00
c. Bio Mass (Rs/Qtl)	0.00	0.00	0.00	0.00
Packing Material Cost (Rs/Qtl)	0.86	1.12	1.27	1.08
Maintenance/Repair Cost (Rs/Qtl)	4.15	4.46	5.05	4.55
Storage Cost Specify (Rs/Qtl.)	0.86	0.88	0.98	0.91
Other Cost Specify (Rs/Qtl)	4.92	4.93	5.34	5.07
Sub-total	42.37	44.53	48.37	45.09
<b>Fixed Cost (B)</b>				
Insurance (Rs/Qtl)	1.31	1.40	1.49	1.40
Depreciation (Rs/Qtl)	16.01	15.45	16.18	15.88
Adm. Expense (Rs/Qtl)	2.74	3.43	3.71	3.30
Other Specify (Rs/Qtl)	2.63	2.84	3.01	2.83
<b>Sub-total</b>	22.69	23.13	24.39	23.41
<b>Total (A+B)</b>	65.05	67.66	72.76	68.49

Source: Survey

The fixed cost was slightly increasing from Rs 22.69 per quintal of paddy processed in 2007-08 to Rs 23.13 in 2008-09 and Rs. 24.39 per quintal in 2009-10. Finally, three years' average of this cost was Rs 23.41 per quintal of paddy processed. However, the variable cost was increasing more rapidly than the fixed cost like the increase in price of materials and labour charges. The variable cost per quintal of paddy processed was found to be Rs 42.37 in 2007-08. It went up to Rs 44.53 in 2008-09 and even further to Rs 48.37 per quintal of paddy processed. Three years' average variable cost was found to be Rs 45.09 per quintal of paddy processed for the modern rice mills. For comparison with the modern rice mills, it was necessary to consider the processing costs borne by the traditional rice mills, viz. the huller units. The detail cost of paddy processing in traditional mills is shown in Table 4. As mentioned above, the present study of traditional mills also concentrates on the non-parboiled rice and the custom hiring basis mills that are also been included.

From Table 4, it is clear that the cost of paddy processing in traditional mills was lesser than in modern mills. The cost of machines was also much lesser compared to the modern mills. As a result, the depreciation charges and insurance cost reduced drastically compared to modern mills. The three years average cost turned out to be Rs 15.12 per quintal of paddy processed. We also witnessed that the cost of paddy processing in this mills was increasing year after year from Rs 12.66 per quintal in 2007-08 to Rs 15.08 per quintal in 2008-09, and further rose to Rs 17.61 per quintal. As these mills were run under the custom hiring basis and mostly run by self-labour, the labour cost got dramatically dropped to Rs 4.02 per quintal of paddy processed, and the electricity charge became the highest cost component in this mill type at the cost of Rs 5.48 per quintal. When we break the total cost of

paddy processed into two parts, only Rs 2.58 per quintal was attributed to fixed cost and Rs 12.64 to variable cost. Similarly, these two sub-costs (fixed and variable) were also increasing year after year from 2007-08 to 2009-10.

Compared to the modern rice mills, the cost of paddy processing in the traditional mills (hullers) was almost five times less. Similarly, the labour cost was also five times lesser than the modern mills because the traditional mills were run on custom hiring basis and labour involvement was not much significant. Besides, the machine was of low cost and the cost of insurance cost was also dramatically low.

**Table 4**

Cost of Paddy Processing by Traditional Mills (Hullers) on Custom Hiring basis.

Year (Non-parboiled)	2007-08	2008-09	2009-10	Average
<b>Variable Cost (A)</b>				
Labour Cost (Rs/Qtl)	3.28	4.02	4.76	4.02
Electricity/fuel charges (Rs/Qtl)	4.32	5.71	6.41	5.48
Fuel Charges for Parboiling (Rs/Qtl)	0.00	0.00	0.00	0.00
a. Petrol/Diesel (Rs/Qtl)	0.00	0.00	0.00	0.00
b. Firewood (Rs/Qtl)	0.00	0.00	0.00	0.00
c. Bio Mass (Rs/Qtl)	0.00	0.00	0.00	0.00
Packing Material Cost (Rs/Qtl)	0.62	0.79	0.57	0.66
Maintenance/Repair Cost (Rs/Qtl)	1.63	1.61	2.08	1.78
Storage Cost Specify (Rs/Qtl.)	0.50	0.53	0.67	0.57
Other Cost Specify ( Rs/Qtl)	0.00	0.00	0.40	0.40
Sub-total	10.36	12.67	14.88	12.64
<b>Fixed Cost (B)</b>				
Insurance ( Rs/Qtl)	0.33	0.60	0.83	0.59
Depreciation ( Rs/Qtl)	0.15	0.15	0.15	0.15
Adm. Expenses ( Rs/Qtl)	1.83	1.65	1.75	1.74
Other Specify ( Rs/Qtl)	0.00	0.00	0.00	0.00
<b>Sub-total</b>	<b>2.31</b>	<b>2.51</b>	<b>2.73</b>	<b>2.58</b>
<b>Total (A+B)</b>	<b>12.66</b>	<b>15.08</b>	<b>17.61</b>	<b>15.12</b>

Source: Survey

### 3.3. Economics of modern mills running under owner-cum-trader

The basic tenet of the economics of rice mills centres on the benefits or profit on the investment made by the mills. For the purpose, prior understanding of the detail cost, investment and valuation of the output and by-products in both modern and traditional mills is required. The gross investments made by modern and traditional mills in the three years from 207-08 to 2009-10 are given in Table 5.

The gross investment in this section is excluding the seed cost or initial machine cost. It consists of two components: a) sum total of total market incidentals; electricity cost; labour cost and depreciation charges, b) total value of paddy purchased for processing. However, the second component (total value of paddy purchased for processing) was not included in the case of traditional mills of the present study because they run on the custom hiring basis. The three years average gross investment of modern rice mill was Rs 25,769 lakh and Rs 384.6 lakh was the three years average gross investment. The average gross investment was increasing year after year from Rs 365.9 lakh per mill in 2007-08 to Rs 383.1 lakh in 2008-09 and then rose to Rs 404.8 per modern rice mill in 2009-10. Interestingly, the average gross investment in Phase I was quite higher than other two phases. The average (three years) gross investment in Phase I was Rs 645.3 lakh per mill and for Phase II, it was Rs 312.3 lakh per unit — just a half of Phase I. However, in Phase III, the gross investment rose to Rs 382.2 lakh per mill in three years. In the case of traditional mills, three years average gross investment was Rs 1.2 lakh per unit. It was Rs 0.8 lakh per unit in 2007-08 and rose to Rs 1.6 in 2008-09, and slightly fell to Rs 1.2 lakh per unit in 2009-10.

**Table 5**

Total Investment made by Rice Mills (Rs in Lakh).

Type of Mills	No. of Units	2007-08	2008-09	2009-10	Average*
1. All Modern Mills	67	24516 (365.9)	25673 (383.1)	27119 (404.8)	25769 (384.6)
Phase I	7	4377 (625.3)	4509 (644.1)	4665 (666.4)	4517 (645.3)
Phase II	24	7284 (303.5)	7379 (307.5)	7821 (325.9)	7495 (312.3)
Phase III	36	12855 (357.1)	13785 (382.9)	14633 (406.5)	13758 (382.2)
2. Traditional Mills	25	21 (0.8)	41 (1.6)	30 (1.2)	31 (1.2)
All (Modern and Traditional) (1+2)	92	24537 (266.7)	25714 (279.5)	27149 (295.1)	25800 (280.4)

Source: Survey

\*Three years Average; Figures in parenthesis are average investment per unit.

Compared to the modern mills, the gross investment in traditional mills was much less. It was primarily due to the absent of value of paddy purchased for processing in the traditional mills as they were running under the custom hiring basis, besides low cost machines. The overall (both modern and traditional) average gross investment was Rs 280.4 lakh per unit of the 92 sample units in three years. It was Rs 266.7 lakh per unit in 2007-08, and gradually rose to 279.5 lakh per unit in 2008-08, and Rs 295.1 lakh per unit in 2009-10.

**Table 6**

Economics of Modern Rice Mills– Running on Owner-cum-Trader Basis

No.	Components	2007-08	2008-09	2009-10	Average
1	Paddy Processed	3043.9	3176.1	3337.7	3185.9
2	Value of Paddy Processed	22902	23937	25185	24008
3	Conversion Ratio of Fine Rice	62.7	62.6	62.8	62.7
4	Quantity of Fine Rice Produced	1918.7	1999.3	2107.9	2008.6
5	Value of Fine Rice Produced	23663	24789	26159	24870
6	Conversion Ratio Broken Rice	2.2	2.2	2.2	2.2
7	Quantity of Broken Rice Produced	66.8	71.1	72.4	70.1
8	Value of Broken Rice Produced	383	412	422	406
9	Conversion Ratio of Bran	4.3	4.4	4.5	4.4
10	Bran Produced	132.4	141.2	148.9	140.9
11	Value of Bran Produced	855	922	975	917
12	Conversion Ratio of Husk	20.5	19.8	20.2	20.2
13	Husk Produced	636.4	646.5	689.0	657.3
14	Value of Husk Produced	110	121	130	120
15	Total Value of By-Product (8+11+14)	1349	1454	1528	1444
16	Gross Value of Returns (5+15)	25011	26244	27687	26314
17	Total Market Incidentals	249	284	323	285
18	Total Electricity Cost	539	565	612	572
19	Total Bio-fuel Cost	NA	NA	NA	NA
20	Total Labour Cost	475	531	615	541
21	Total Depreciation & Other Costs	351	356	383	363
22	Total Cost (17+18+19+20+21)	1613	1737	1933	1761
23	Net Returns (16-22-2)	495	570	568	545
24	Net Return (23/1) (Rs/Qtl)	16.3	17.9	17.0	17.1

Source: Survey

Note: Quantity in '000 Quintal, Value/Cost in Rs Lakh; NA=Not Available



Coming to the economics of modern rice mills, it is expected to result higher yield of rice as well make the by-products like broken-rice, bran, husk, etc., available separately and in smaller quantities. It is mandatory for the rice mills irrespective of the quantity of paddy milled because the economics of modernisation is essentially based on better rate of recovery and not on the quantum of production. Table 6 portrays the overall picture of the economics of modern rice mills. For the entire sample modern rice mills (67 units of three phases), the net return per quintal of paddy processed turned out to be Rs 17.1 on an average from 2007-08 to 2009-10. The share of by-products (broken-rice, bran and husk) in value terms was 5.5 per cent of gross returns from milling operations and for the main product, viz. fine rice, it was 94.5 percent of gross returns. The share of total costs (including market incidentals, processing costs) stood at 6.8 percent of gross investment, while the net return was only 2.1 percent of the gross investment.

Our interest is in the net return per quintal of paddy processed. The overall net return per quintal of paddy processed was Rs 16.3 in 2007-08 and rose to Rs 17.9 in 2008-09. However, there was slight downfall in 2009-10 as the net return of the modern mills turned out to be Rs 17.0 per quintal of paddy processed in the study period.

### 3.4. Economics of traditional (hullers) mills running under custom hiring basis

The economic aspects of traditional mills running on custom hiring basis and producing non-parboiled rice are presented in the Table 7. The milling ratio was 58.7 kg per quintal of paddy processed. As mentioned above, the value of rice was not given for these mills as they are run on the custom hiring bases. The net return was realised at Rs 25.0 per quintal of paddy processed.

**Table 7**

Economics of Traditional Rice Mills Running on Custom Hiring Basis

Sr. No.	Year	2007-08	2008-09	2009-10	Average
1	Quantity of Paddy Processed (qtl)	228.3	375.3	238.6	280.7
2	Quantity of Fine Rice Produced (qtl)	133.7	221.1	139.6	164.8
3	Broken Rice Produced (qtl)	13.2	19.1	11.9	14.8
4	Conversion Ratio of rice (kg/qtl)	58.6	58.9	58.5	58.7
5	Conversion Ratio Broken Rice (kg/qtl)	10.2	10.2	10.2	10.2
6	By-product obtained (kg/qtl)	23.6	23.6	23.6	23.6
7	Customs Charges (Rs/qtl)	35.1	35.1	36.1	35.5
8	Value of Custom Charges (Rs Lakh)	80	132	86	99
9	By-products if Sold	NA	NA	NA	NA
10	Value of By-Product	NA	NA	NA	NA
11	Total Electricity cost (Rs in lakh)	10	21	15	16
12	Total Labour Cost (Rs in lakh)	7	15	11	11
13	Depreciation & Other Costs (in lakh)	3	5	3	4
14	Gross Returns (8+10) (Rs in lakh)	80	132	86	99
15	Total Cost (11+12+13) (Rs in lakh)	21	41	30	31
16	Net Returns (14-15) (Rs in lakh)	60	91	56	69
17	Net Returns (Rs./Qt) (16/1)	26	24	24	25

Source: Survey

Note: Qty in '000 qtl; NA= Not Available

Unlike modern mills, the share of by-products (broken-rice, bran and husk) of gross return does not arise in case of traditional mills because the by-products were being taken away by the customers and the same applies to the main product, viz., fine rice, as well. When we look at the year-wise performance, the average net return in 2007-08 was Rs 26 per quintal of paddy processed, and slightly fell down equally to Rs 24 per quintal of paddy processed for both 2008-09 and 2009-10. The yearly average total cost of traditional mills was Rs 31 lakh in three years, and in terms of per unit, it was Rs 124 lakh per mill in three years. However, though it is found to be technologically low compared to the modern mills, the conversion ratio was not that much lower as we expected, and stood at 58.7 percent per quintal of paddy processed. However, the conversion ratio of broken rice was quite high at 10.2 percent per quintal of paddy processed when compared to 2.2 percent per quintal of paddy processed



in modern mills. The traditional mills had lesser capital investment compared to the modern mills and their annual paddy processing capacity was much lower than the modern mills.

**4. Share of by-product by different mills**

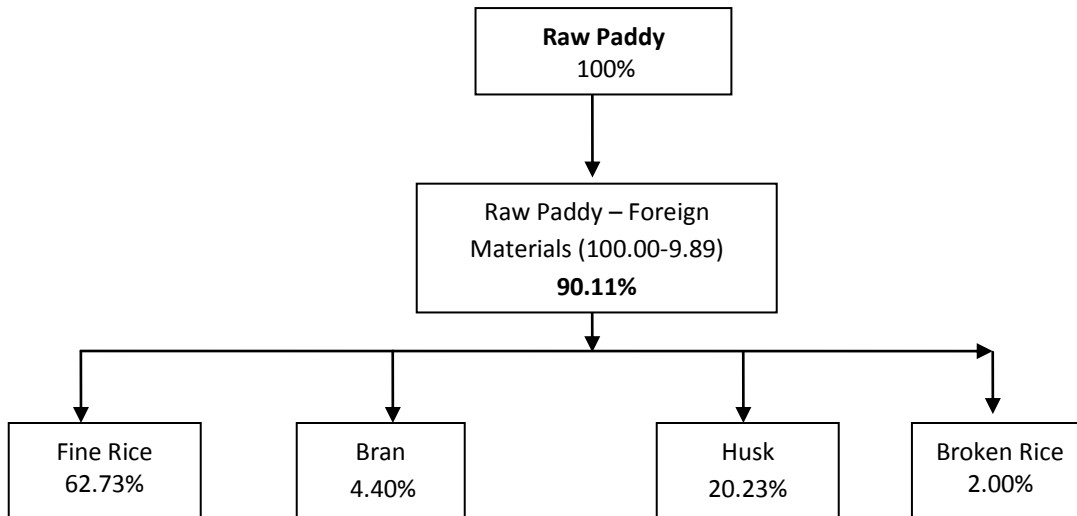
It is intuitive to note that the share of by-product decreases as technology of mills is upgraded through the different phases. Conversely, the out-turn ratio of rice increases as the technology improves. Unlike traditional mills, apart from the main product, fine rice or polished rice, the by-products like, broken rice, bran and husk is produced separately in the modern mills. Also, the quality of the by-products produced by improved mills were of better quality and in great demand in the fodder or cattle feed markets and for extraction of oil while the husk was used as fuel by the rice mills to generate steam for parboiling rice or sold as fuel to other industrial units.

**Table 8**  
Average Paddy Processed and By-Products of Modern Mills (in %).

Types of Unit	Fine Rice	Broken Rice	Husk	Bran
Modern Rice Mills (All)	62.73	2.00	20.23	4.40
Modern Rice Mills belonging to Phase I	61.20	2.00	19.70	4.20
Modern Rice Mills belonging to Phase II	63.00	2.00	19.00	5.00
Modern Rice Mills belonging to Phase III	64.00	2.00	22.00	4.00

Source: Survey

The distribution of the main product and the by-products produced by all the modern rice mills processing raw paddy can be seen in Table 8 and Figure 1. It was observed that the ratio of paddy to fine rice (i.e. the milling ratio) was 62.73 per cent on an average, while the ratio for broken rice stood at 2.00 per cent. The proportion of husk per quintal of paddy turned out to be about 20.23 per cent while the ratio of bran was 4.40 percent on an average. This table reiterates that the milling ratio or out-turn ratio increased as the technology improved from Phase I to Phase II to Phase III type of mills. The out-turn ratio was 61 kg of rice per quintal in 2007-08, it increased to 63 kg of rice per quintal in 2008-09, and then rose to 64 kg of rice per quintal of paddy processed in 2009-10. However, the share of husk produced was same for all the phases.



**Fig. 1.** Flow Chart of Paddy Processing and its By-Products of Modern Rice Mill.

The flow chart of Figure 1 gives a better understanding of the paddy processing in the modern mills by depicting the process and the outputs. It is also clear that unlike traditional mills, foreign materials were removed from the raw paddy to get good quality rice. As mentioned above, in reality the out-turn ratio can be read as 69.6

percent as the total quantity of paddy processed was 90.11 kg after removing 9.89 kg of foreign materials from the raw paddy.

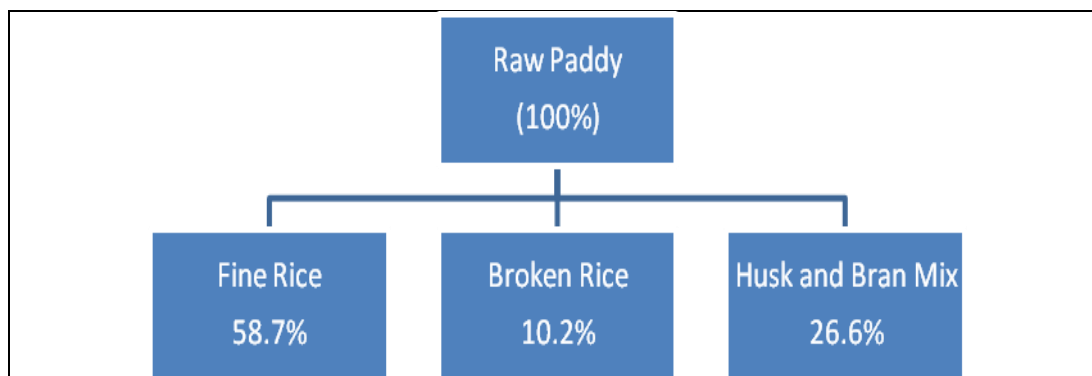
In the case of traditional mills, the out-turn ratio was much lower than modern mills. The technology of traditional mills was inferior to the modern ones. A detailed presentation of paddy processing and its outputs is made in Table 9 and Figure 2. As has been shown earlier, the rate of recovery of fine rice (or the out-turn ratio) in the traditional rice mills, viz., the huller units, turned out to be 58.70 per cent – which is about 11 per cent less than that of modern rice mills. It should also be noted here that in traditional huller units, the recovery of broken-rice was much higher than the modern rice mills.

**Table 9**  
Average Paddy Processed and By-Products of Traditional Mills (in %)

Types of Unit	Fine Rice	Broken Rice	Husk and Bran Mixture
Traditional Mills	58.7	10.2	26.6

Source: Survey

In particular, on an average, the ratio of broken-rice turned out to be as much as 10.2 kg for every quintal of cleaned paddy processed. Unlike modern mills, the huller units (traditional mills) recover a mixture of bran, husk (and fragments of broken-rice also) which made up 26.6 percent per quintal of paddy processed. This mixture has a lower oil-content with high level of impurities and does not command a great demand from the solvent extraction industry when compared to pure bran produced by modern mills. Also, the foreign materials cannot be separated in traditional mills. However, in case of modern mills, it is separated before milling.



**Fig. 2.** Flow chart of paddy processing and its by-products of traditional mills.

### 5. Analysis of economics of paddy processing

The costs incurred during the processing of paddy by the modern rice mills remains central to the analysis of the economics of modern rice milling. It is here we find significant differences among the various components of costs for the modern rice mills in the different phases of modernisation. The modern rice mills of Phase II have comparative cost advantage in processing paddy over the phase I, while those of Phase III were the most cost-inefficient mills. In particular, Phase III modern rice mills were heavily capital intensive and extremely mechanised, which in turn increased expenditure on electricity, maintenance, etc. In contrast to the modern rice mills, the processing costs per quintal of paddy in the traditional rice mills (hullers) run on custom hiring basis remained much lower. It was in case of small scale production only. However, in the large scale operation, the situation is in favour of modern rice mills, especially with the most sophisticated one (Phase III) and economies of scale prevail in the long run.

The modern rice mills function as individual commercial business units that purchase paddy from the farmers, traders, local stockists, etc., and convert it into fine rice. The fine rice is then sold to the whole-sellers, retailers and even to the government as levy. In the process, profit is accrued for the value added in processing raw paddy into fine rice. The 'modern' rice mills were expected to give higher yields of rice and by-products like, broken-rice, bran, husk, etc., separately. The economics of modernisation is essentially based on better rate of recovery and not on

the quantum of production. It is here that the net return per quintal of paddy processed turns out to be Rs 17.01 on an average, varying from a low of Rs 14.00 for the modern rice mills belonging to Phase I to as much as Rs.15.00 for Phase II and Rs 19.00 for Phase III. The share of by-products in value terms stood at 5.05 percent of gross return, while that for the main product, viz. fine rice, stood at 94.05 percent of gross return. The share of total costs (including market incidentals, processing costs) stood at 6.8 percent of gross investment (i.e. total costs and value of paddy purchased for processing), while the net return stood at 2.1 percent of the gross investment only.

On the other hand, the traditional huller units do not produce fine rice, broken rice and other by-products separately. A mixture of broken-bran-husk is produced. Therefore, a perfect comparison between modern and traditional mills cannot be made in this context. However, for analysis of profit of the traditional huller units, the costs of running the huller unit should be deducted from the custom charges. Unlike modern mills, some benefits from the by-products did not arise because the mills were run under the custom hiring basis. As such, the basic economic principle of the huller units running on a custom hiring basis thrived solely on the profit accrued to the huller units out of the difference between the custom charges earned by processing paddy brought by the farmer clients and the cost of running the huller units. Therefore, the efficiency and quantum of paddy processed or capacity of paddy processed by the traditional mills cannot be compared with the advanced modern mills. However, the huller units remain very important for the poor farmers in the rural area because it is much cheaper than the modern rice mills. Thus, it appears that the huller units running on a custom hiring basis perform similar tasks as the modern rice mills at much greater convenience. For traditional huller units run on a custom hiring basis, the issues relating to the marketing of rice did not arise at all. However, for the modern rice mills, marketing of products and by-products were their major business activities.

In case of availability of fine rice and by-products, it was observed that on an average, out-turn ratio of paddy to fine rice of modern rice mills was 62.70 per cent, while the ratio for broken rice, husk and bran stood at 2.20 per cent, 20.20, and 4.40 per cent, respectively. The rest of the raw material, viz., un-cleaned raw paddy accounted for the refraction/foreign materials and loss of moisture in processing. On the other hand, the rate of recovery of fine rice in case of traditional rice mills turned out to be 58.70 per cent. It is exactly 6 percent lower than the modern rice mills. The recovery of broken-rice came was 10.20 per cent in traditional hullers while 23.60 per cent was a mixture of bran and husk.

In case of the relative share of modern and traditional paddy processing units in the paddy processing industry, it was observed that 92 percent of paddy was processed by the modern rice mill as against 8 percent by the traditional rice mills, viz., the hullers in the study area. Again, among all types of paddy processing units, almost half (49%) of the paddy was processed by the modern rice mills belonging to Phase III. It is due to the economies of scale and the quality of rice demanded by the market.

## **6. Conclusion**

The above discussion on the economic aspects of the rice milling industry reveals many things such as variation in the market incidentals, different costs driving the industry, profitability of the custom hiring mills and the domination of the different mill types operating in the study area. The study on market incidentals showed a sharp increase in cost over the three years in rice procurement. This was mainly because of the increase in prices of raw materials in the market.

It was a good sign that the major share of paddy was processed by modern type of rice mills. However, there is still a lot of scope to upgrade the existing hullers into modern rice mills and it is also suggested that the mill owners and farmers be made aware of the benefits of producing parboiled rice because it generates greater out-turn ratio compared to non-parboiled rice (Lele, 1970). It is slightly inconvenient for the individual farmers to go for parboiling before processing because small quantities or subsistence level paddy is processed in the rural areas.

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