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RESEARCH PAPER

Comparative analysis of processing conversion in conventional and modern rice mills of southern Tamil Nadu

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ABSTRACT

Rice is the staple food of Asian countries. China and India are the two important rice production centres that supply half of the world's rice. During 2012, the total food grains production in India reached an all-time high of 259.32 million tonnes. Tamil Nadu ranks fifth in rice production (6.32 lakh tonnes) during the year 2011–2012. Rice milling is the largest agro-based industry wherein the outer layer (husk) and inner layer (bran) of the paddy was removed and rice is obtained. The conversion ratio of paddy depends on the milling efficiency of the unit, technology adopted for paddy processing and quality of the procured paddy. The modern paddy processing unit has more head rice recovery and better utilization of the capacity when compared to the conventional unit.

KEY WORDS : Paddy processing, Conversion ratio, Value of conversion

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Rice is one of most important foods and this unique grain helps to sustain two-thirds of the world's population. The paddy production is geographically concentrated in Asian countries making it the biggest rice producer and it accounts for 90 per cent of the world's production and consumption of rice. China and India are the two important rice production centres that supply half of the world's rice.

India accounts for about 2.4 per cent of the worlds geographical area but supports 17 per cent of the worlds human population. Agriculture is an important sector ofthe Indian economy, accounting for 14 per cent of the nation's GDP, about 11 per cent of its exports. Nearly half of the population still relies on agriculture as its principal source of income and it is a source of raw material for a large number of industries. India holds the second largest agricultural land (179.9 million hectares) in the world. It is the largest producer of pulses, milk, tea, cashew and jute; and the second largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds. The total food grains production in India reached an all-time high of 259.32 million tonnes during 2012. India will again be the world's "Raja of rice" exports in 2013-14, touching about 11 million tonnes ($6.5 billion), with a basmati (fragrant/aromatic) component of 3.5 to 4 million tonnes and non-basmati 6.5 to7 million tonnes (AIREA, 2013)

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Indian rice exports :

World rice trade was at 38 million tonnes and India's share would be 28 per cent in the forth-coming year. There will not be any competition for Indian parboiled rice exports as part of Iran and African requirements were shifting from Vietnam to India. Iranian export was largely monopolised by the millers or exporters in North India – Punjab, Haryana and

Uttar Pradesh. Non-basmati rice export was now the forte of millers and traders of the South and Eastern States of India where millers have established parboiling, de-husking, milling and sorting facilities. This includes paddy/rice from Chhattisgarh, Bihar, Jharkhand and Andhra Pradesh. Some of the heavily subsidised rice/paddy under the targeted PDS also filters into export channels (Business Line, 2013). Nigeria, Benin and South Africa are covering a larger tonnage of "parboiled rice" from India. In West African countries (Senegal, Cote d'Ivoire, Benin, Somalia, Togo, Kenya, Cameroon), the Indian 25 per cent broken "white" variety was now preferred over Vietnam rice due to better elongation of cooked rice. Bangladesh, Yemen and Iraq are also prominent importers of Indian non-basmati rice.

Indian rice industry :

Agro-processing is now regarded as the sunrise sector of the Indian economy *in view* of its large potential for growth through creation of socio-economic impact, specifically on employment and income generation. Rice is the staple food for more than 70 per cent of Asians. In India, the rice is cultivated in both the seasons – winter and summer. Rice and wheat production in the country stood at 105.3 million tonnes and 94.9 million tonnes, respectively (IBEF, 2013).West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Tamil Nadu, Bihar, Orissa, Assam, Karnataka and Haryana are the major rice producing states in India (Gupta and George, 1974 and Gupta *et al.* (1974). More than 50 per cent of total production comes from the first four states (*www.ricetrade.com*).

Indian rice industry constitutes two forms of rice, basmati and non-basmati. The non-basmati rice production is miles ahead of basmati rice in terms of production. The basmati rice production of India constitutes less than 1 per cent of the total rice produced in India. This makes the basmati sector saturated offering hardly any scope for expansion. The non-basmati sector constituting approximately 99 per cent of the total rice produced gives ample opportunity for major rice processors to thrive in domestic and international markets (Table A).

Rice milling in India :

Rice milling industry is the largest agro-based industry in India. In 2009, India has approximately 1.74 lakh rice milling units. The number of hullers was 95,808, shellers 6,724 huller-cum-shellers 10,540 and modern/modernized rice mills 36,088, respectively (MOFPI, 2010).

Most rice varieties are composed of roughly 20 per cent rice hull or husk, 11per cent bran layers, and 69 per cent starchy endosperm, also referred to as the total milled rice. In an ideal milling process this will result in the following fractions: 20 per cent husk, 8-12 per cent bran depending on the milling degree and 68-72 per cent milled rice or white rice depending on the variety (IRRI). Total milled rice contains whole grains or head rice, and brokens. The by-products in rice milling are rice hull, rice germ and bran layers, and fine brokens. A rice milling system can be a simple one or two step process, or a multi stage process. In one-step milling process, husk and bran removal are done in one pass and milled or white rice is produced directly out of paddy. In two-step process, removing husk and removing bran are done separately, and brown rice is produced as an intermediate product. In multistage milling, rice will undergo a number of different processing steps (Piggott, 2007).

Milling is the process wherein the outer and inner layers of paddy grain is removed using various technologies. The outer layer is termed as the husk and the inner layer is termed as bran. The brown rice is obtained when the outer cover was removed and the white rice is obtained by polishing the brown rice. When the paddy is soaked, boiled and subjected to milling process, then it is termed as parboiled rice. During milling process (hulling and whitening) the paddy grain is subjected to mechanical and heat stress. Rice breakage at this stage would be an economic loss to the processors. The quality loss also occurs at this stage since the rice kernel was exposed to mechanical operation while removing the outer and inner layers.

It is reported about 11.7 lakh metric tonnes (MT) of food grains was lost in government godowns due to wastage or pilferage since 2010 and 30 per cent of food grains supplied

Table A : State-wise total production of rice **(Quantity in lakh MT)**

Sr. No.	States	2009 - 2010	2010-2011	2011-2012
1.	Punjab	11.23	10.83	11.31
2.	Uttar Pardesh	10.78	12.01	12.89
3.	West Bengal	14.6	13.33	11.65
4.	Andhra Pradesh	11.03	14.38	9.02
5.	Tamil Nadu	5.91	6.13	6.32
6.	Orissa	6.69	6.55	6.01
7.	Haryana	3.62	3.47	3.96
8.	Bihar	3.59	3.32	4.75

Source: USDA, 2013

through PDS was lost every year (The Hindustan Times, 2013). The post-harvest loss of paddy is quite significant, especially due to the inefficient processing or poor milling techniques. Therefore, efficient milling technique is one of the measures that can prevent post-harvest loss of paddy to a large and significant extent. Singha (2013) in his study on Paddy Processing Mills in India inferred that the conversion ratio was 64 per cent per quintal of paddy processed in the modern mills. The ratio was 58.6 per cent for the traditional (huller) mills. The conversion ratio was the highest in case of traditional (68.8 %) and modern (69.50 %) mills in the state of Punjab. The technological advancement, infrastructural facilities, regular power supply, availability of skilled engineers and quality of raw paddy were the main factors that influenced the conversion ratio. Thakur *et al.* (2012) concluded that the conversion of paddy to rice ratio was found to be higher in parboiled rice (65.77 %) when compared non-parboiled rice (53.85 %). An average mill owner in Chhattisgarh processed 1.09 lakh tonnes of grade A" variety paddy and produced 0.56 lakh tonnes of non-parboiled rice per year with paddy to rice conversion ratio of 51.84 per cent. The mills of Chhattisgarh also reported conversion ratio of 61.79 per cent for grade A variety (0.14 lakh tonnes parboiled rice from 0.23 lakh tonnes). Thus, the conversion ratio of paddy to rice was found to be more in parboiled rice as compared to non- parboiled rice. Chattopadhayay (2011) stated that the out-turn ratio for the hullers in West Bengal district was 57.22 per cent as compared to the modern rice mills (63.16 %). The out-turn ratio of modern rice mills increased by 1.5 per cent when the mills moved from one modernization or improvement phase to the other. Thus it indicated improvement of milling techniques had a direct impact on the out-turn ratio of paddy. Sori *et al.* (2014) conducted the study to know about the constraints in processing paddy in Mahasamund district of Chattisgarh. They found that among six major problems related to processing of paddy, electricity problem ranked first by sampled paddy processors with average score of 90.21 while efficiency ranked second. Transportation and administrative problems were observed less severe by the processors of Mahasamund block with average score of 87.02 and 85.68, respectively.

METHODOLOGY

About 30 PPUs from Madurai, Puduvayal and Dhalavaipuram were selected. Based on the technology adopted, the PPUs were categorized into conventional, modern and hi-tech units. About 10 conventional and 10 modern processing units were randomly selected from Madurai, Dhalavaipuram and Puduvayal clusters. Therefore thirty conventional PPUs and thirty modern PPUs were selected for the study. A well-structured interview schedule was prepared based on the objectives of the study for collection of primary data. The data required for the study was gathered by personal interview from the selected PPUs.

The data on the quantity of paddy processed and rice conversion were collected. The data on paddy processing was collected on monthly basis from January to December from each unit. Even though some of the mills processed both parboiled and raw rice varieties, the conversion data was obtained only for the parboiled varieties. The conversion ratio depends on the quality of the paddy procured, varieties processed and the technology adopted for processing.

The conversion ratio was expressed as the ratio rice produced per ton of paddy processed. The conversion ratio is given below :

$$CR = \frac{y}{x} \times 100$$

where,

y = Quantity of rice obtained in tonnes

x = Quantity of paddy processed in tonnes

CR = Conversion ratio (milling ratio).

ANALYSIS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Conversion ratio in conventional PPUs :

The conversion ratio of conventional PPUs across Madurai, Dhalavaipuram and Puduvayal cluster are presented in Table 1.

The mills were classified under conventional category when the soaking was done in soaking tanks or the hulling unit comprised of the traditional huller with wooden fan box and the shaker. Generally the capacity of these mills was lesser compared to modern and hi-tech units. Totally thirty conventional PPUs were studied. It could be concluded from the table that the average out turn ratio in the conventional PPU was the highest in Madurai cluster (50.88 %) compared to Puduvayal (48.91 %) and Dhalavaipuram (47.74 %) clusters.

The average conversion ratio among the conventional PPU located in the selected clusters was found to be 49.18 per cent.

Conversion ratio in modern PPUs :

The conversion ratio of the modern PPUs across Madurai, Dhalavaipuram and Puduvayal cluster are presented in Table 2.

The mills were grouped under modern category when the parboiling operations were carried out in steam boilers and the hulling unit comprised of sheller, cone / silky polishers, grader, colour sorter. The hi-tech rice mills are those mills

wherein all the operations are fully automated and the manual interference was nil. The entire paddy processing was taken care by an electronic control panel. Totally thirty number of modern / hi-tech mills were studied. It was clear from the table that the average out turn ratio in the modern PPU was the highest in Puduvayal cluster (62.76 %) followed by Dhalavaipuram (61.52 %) and Madurai (60.58 %) clusters.

The average conversion ratio among the modern PPU located in the selected clusters was found to be 61.62 per cent. The difference in average conversion ratio between modern and conventional PPUs was 12.44 per cent. The increase in average conversion ratio among the modern PPUs was achieved by adopting better technology and higher capacity utilization. The increased output of head rice recovery would help the modern PPUs to achieve better price and returns.

Table 1 : Conversion ratio in conventional PPUs

Sr. No.	Madurai			Puduvayal			Dhalavaipuram		
	Paddy processed (Qty in tonnes)	Rice obtained (Qty in tonnes)	CR (%)	Paddy processed (Qty in tonnes)	Rice obtained (Qty in tonnes)	CR (%)	Paddy processed (Qty in tonnes)	Rice obtained (Qty in tonnes)	CR (%)
1.	1777.96	965.76	54.32	2448.61	1186.38	48.45	2017.85	989.26	49.03
2.	1160.98	602.85	51.93	2052.64	984.27	47.95	960.88	486.85	50.66
3.	1141.38	565.48	49.54	1932.48	869.71	50.20	1541.84	735.19	47.68
4.	1638.60	838.35	51.16	2525.49	1285.34	50.89	1099.67	501.64	45.62
5.	1118.56	578.02	51.68	1692.38	794.68	46.96	1357.24	666.84	49.13
6.	1307.83	647.17	49.48	2657.16	1364.59	51.36	1019.57	490.24	48.08
7.	1597.16	830.33	51.99	3403.89	1698.37	49.89	1128.67	528.64	46.84
8.	1354.49	702.02	51.83	1908.22	884.35	46.34	1457.68	728.64	49.99
9.	1049.28	498.48	47.51	2029.34	1004.34	49.49	1785.61	794.35	44.49
10.	1242.45	612.71	49.31	2294.57	1092.54	47.61	1587.22	728.59	45.90
	Average		50.88	Average		48.91	Average		47.74

Source: Primary survey

Table 2 : Conversion ratio in modern mills

Sr. No.	Puduvayal			Dhalavaipuram			Madurai		
	Paddy processed (Qty in tonnes)	Rice obtained (Qty in tonnes)	CR (%)	Paddy processed (Qty in tonnes)	Rice obtained (Qty in tonnes)	CR (%)	Paddy processed (Qty in tonnes)	Rice obtained (Qty in tonnes)	CR (%)
1.	65880.15	41872.24	63.56	14979.79	9678.46	64.61	11630.97	7172.04	61.66
2.	13470.69	8395.67	62.33	8052.31	4902.42	60.88	7943.98	4853.05	61.09
3.	7356.94	4459.82	60.62	8530.21	5135.69	60.15	8541.57	5253.32	61.50
4.	11329.49	7329.57	64.69	9908.94	6123.49	61.80	8833.23	5211.96	59.00
5.	9113.45	5482.37	60.16	10012.35	6156.57	61.49	12235.49	7983.45	65.25
6.	43920.58	28546.94	65.00	8742.16	5249.99	60.05	8102.29	4747.09	58.61
7.	10432.86	6485.29	62.16	9981.56	6097.03	61.08	6742.16	4023.87	59.68
8.	8774.24	5569.57	63.48	8871.55	5459.71	61.54	8862.00	5250.56	59.25
9.	13725.94	8528.54	62.13	9150.76	5586.43	61.05	7959.85	4980.64	62.57
10.	17211.67	10918.51	63.44	11382.59	7120.93	62.55	8649.00	4946.61	57.19
	Average		62.76	Average		61.52	Average		60.58

Source: Primary survey

Table 3 : Average conversion recovery of paddy to rice in conventional and modern PPUs

By-products	Conventional PPU (%)	Value (Rs. lakhs)	Modern PPU (%)	Value (Rs. Lakhs)
Head rice	54.00	24.30	63.00	28.35
Brokens	13.00	3.12	6.00	1.44
Bran	11.00	1.32	16.00	1.92
Black rice	4.00	0.32	1.00	0.08
Husk and Impurities	18.00	0.54	14.00	0.42
Total		29.60		32.21

Source: Primary survey

Value of conversion :

The conversion ratio reflected the quantity of head rice produced per unit of paddy processed either in conventional or modern PPUs. The economic value was higher for the head rice when compared to its by-products. If it is assumed that 100 tonnes of paddy are to be processed using either in conventional or modern PPU, the average quantity of rice and its by-products obtained are presented in the Table 3. For calculating the value of conversion, the average market price prevailing in the study area is used. The value realized from the rice and by-products by the modern PPUs was higher (Rs. 32.21 lakhs) when compared to conventional PPU. The value enhancement (waste reduction) in the modern PPU was 8.82 per cent more than the conventional PPU.

$$\text{Value enhancement through modern PPU} = \frac{32.21 - 29.60}{29.60} \times 100$$

= 8.82 per cent.

Similar work related to the present topic was also done by Amrutha (1994), Bawa and Kainth (1989), Piggott *et al.* (2007), Gautam *et al.* (1988), also Balappa (1997) worked on redgram and Dalvi (1989) and Dev (1998) worked on cashew processing industry.

Conclusion :

The conversion ratio was influenced by factors such as technology used for milling process, capacity utilization within the firm, quality of the paddy procured, varieties processed, competition among the firms, types of rice the firms produce and the maintenance of the firm. From the above study it could be concluded that the conversion ratio was the highest in case of modern mills in all the clusters. The difference in the ratio between the clusters was very negligible in case of modern units and it was high in conventional units. As the milling performance determined the head rice yield, the firms have to improve the conversion efficiency to minimize their economic loss. The economic value realized from the rice and by-products by the modern PPUs was higher when compared to conventional PPU. The value enhancement (waste reduction) in the modern PPU was 8.82 per cent more than the conventional PPU.

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