Rice Research: Open Access

Singha et al., J Rice Res 2013, 1:2
http://dx.doi.org/10.4172/jrr.1000115

Research Article Open Access

Paddy Processing Mills in India: An Analysis

Komol Singha*

Institute for Social and Economic Change, India

Abstract

Rice (*Oryza sativa L.)* has been the staple food for more than half of humanity in the world. India is the second largest producer of rice in the world, consuming around 95% of what it produces. India is also the third largest exporter of rice in the world. Due to the high growth of population in recent years, there has been more pressure on arable land. This in turn has created a need for higher productivity in food crops. Concurrently, large quantities of food-grain were reported to be lost due to inefficient milling processes in the country. As such, there have been calls for better processing techniques in order to reduce processing losses. Using 442 sample mills across five major paddy producing States, the conversion ratio from paddy to polished rice was estimated and found to be around 64% for modern and 58.6% for traditional (huller) mills. The variation of conversion ratios among the States was found to be quite negligible, and fractional variation observed was due to differences in quality of the raw paddy used and infrastructure facilities available.

Keywords: Conversion ratio; Modern mill; Paddy; Rice; Traditional mill

Introduction

Rice (*Oryza sativa L.)* has been the staple food for more than half of the humanity in the world [1,2] or two-third of the World's population [3]. Rice is the seed or kernel of paddy, which is covered by two different layers, namely- bran (inner layer) and husk (outer layer). Literally, paddy becomes rice only when the two layers are removed properly through different milling processes. In the first step, *brown rice* is extracted by removing hull/husk from the paddy, which contains *bran* layer still intact around the kernel. In the second step, the bran layer is removed by polishing machine that rubs the grains together under pressure, and the output is the polished white kernel or fine rice, which is ready for cooking [4,5]. The former process is known as hulling and the latter is known as milling of paddy. But, in short, it is the conversion ratio from paddy to rice, or one can term it as hulling and milling ratio. Therefore, the two terms-1) hulling and milling ratio; 2) conversion ratio, will be used interchangeably throughout this paper.

In term of production, India has become the second largest producer of rice in the world (21 per cent of global rice production), next to China [6,7]. As on 2009, rough total production of paddy was 14, 8260 thousand MT in the country [8], but, as estimated by USDA [9], it was 13, 2013 thousand MT. On the demand side, India's domestic consumption was, on an average, 95% of what it produced and was still the third largest exporter of rice, after Thailand and Vietnam, with about 20% of the world's total rice exports in 2006-07 [10]. In the recent years, with the growth of population, more pressure on the arable land has been made and this in turn, the need for higher productivity of crops was felt in the country. At the same time, large quantity of food-grain was reported to be lost due to inefficient milling processes in the country. Therefore, it calls for a better processing technique of rice to prevent processing loss.

Generally, rice kernels are often susceptible to breakage due to inefficient milling processes. Therefore, more efficient milling processes are highly recommended for better recovery ratio and quality rice kernel production. It is also identified as one of the most important remedies for preventing post-harvest loss and an issue that is widely recognized around the world [11,5]. With the facts mentioned above, this study tries to explore the conversion ratio of paddy in India by two different milling techniques– modern and traditional mills. Variation in the conversion ratio among the Indian States is analysed along with an inter-state comparison of conversion ratios.

Conceptual Framework and Methodology

According to an estimate of Joshi and Bhavesh [6], about 10 per cent of the total production of paddy was lost in India due to the use of old and outdated methods of drying and milling processes. In Philippines too, due to lack of adequate processing equipment, storage and drying contributed significantly to post-harvest loss of rice, as high as 40 per cent of total production of the country [12]. Albeit, the exact figure was not mentioned, Kumar et al. [13] opined that the post-harvest loss of paddy was higher than that of *pulses* (9.5 per cent) in the State of Uttarakhand, India.

Though different studies provide slightly different figures, one thing is certain that post-harvest loss of paddy was quite significant, especially due to the inefficient processing or poor milling techniques. Therefore, efficient milling technique is one of the measures which can prevent post-harvest loss of paddy to a large extent. According to Lele Uma [14], efficiency of rice milling processes can be determined by three factors-technologies, degree of competition and capacity of utilisation. Of the three, the first (technology) and the last (utilisation capacity) come under the same category of milling technique or efficient milling process, and it has more impact on the cost of conversion, quality and quantity of rice and its by-products. Also, milling performance is largely measured by head rice yield or quality of *kernel* produced [15,2]. Quality of finished rice/polished rice is also determined by the quality of raw paddy used for conversion, technical knowhow, quality of the mills, etc.

***Corresponding author:** Komol Singha, Institute for Social and Economic Change, India, Tel: +91-80-23215468; E-mail: komol@isec.ac.in

Received October 17, 2013; **Accepted** November 17, 2013; **Published** November 20, 2013

Citation: Singha K (2013) Paddy Processing Mills in India: An Analysis. J Rice Res 1: 115. doi: 10.4172/jrr.1000115

The present study is based purely on the primary data collected from five major paddy growing States of India. For spatial representation, the State of Karnataka was included to represent southern region of the country. Chhattisgarh and Madhya Pradesh were included to represent the central region. West Bengal and Punjab were included to represent eastern and northern region of the country respectively. No State was taken from the western region of the country as it does not come under the rice growing region in India [16]. As of the primary data, altogether 442 (four hundred forty-two) sample rice mills were interviewed in the five States taken for the study, which consist of 237 modern mills and 205 traditional (huller) mills. State-wise breakup of the sample mills were as follows-92 sample rice mills from Karnataka (which consist of 67 modern and 25 traditional mills), 90 sample mills from Punjab (40 modern and 50 traditional mills), 100 sample mills from West Bengal (50 each of modern and traditional mills), 80 sample from Chhattisgarh (40 each of modern and traditional mills) and 80 samples mills from Madhya Pradesh (40 mills each of modern and traditional mills). Huller mill implies traditional mill and these two terms will be used interchangeably throughout this paper.

The data on the quantity of paddy processed and their final output, i.e. fine (polished) rice were collected and the collected data were basically analysed in the form of ratio and averages as per requirements of the study. Coefficient of variation (CV) was estimated to understand inter-state variation of the conversion ratio. For present study, a period of three years (2007-08 to 2009-10) was taken, and though three different phases of modern mill (phase I, II and III) were present, no such classification was made in this study. Similarly, only non-parboiled paddy was considered for the study (though two categories of paddy are used– parboiled and non-parboiled). The conversion ratio was expressed as the ratio rice produced per quintal of paddy processed. It was estimated through a simple ratio by dividing the quantity of actual rice (polished rice) produced by the actual quantity of raw paddy processed and their value (quotient) was multiplied by hundred to obtain ratio. The conversion ratio is given as: $CR = \frac{Y}{X} \times 100$. Where, CR implies conversion ratio (hulling and milling ratio), subscript X implies the quantity of raw paddy and the superscript Y implies the quantity of processed rice (fine rice).

Conversion Ratio of Paddy In India

As per a report given National Bank for Agriculture and Rural Development (NABARD), the recovery ratio of whole grains in a traditional rice mill by using steel hullers for de-husking was found to be around 52-54 per cent in India [17]. There was excessive loss in the form of coarse and fine broken. Generally, the loss of large portion of endosperm layers accentuated during the de-husking operation. Against it, the recovery ratio of whole grains in modern rice mills using rubber roll shellers for de-husking operation was found to be around 62-64 per cent. Further, the whole grain recovery ratio increased to around 66-68 per cent, in case of milling of parboiled paddy [18].

Therefore, maintaining a good milling ratio is greatly needed by the nation, at least to reduce post-harvest loss and food security problem, to some extent. A study finding, in Bangladesh by Baqui [19] depicted that the parboiled paddy gets better recovery ratio than that of non-parboiled. For instances, the Engleberg (large) type (Huller in our study) of mills produce 60 per cent to 65 per cent of polished rice of non-parboiled paddy and 65 per cent to 68 per cent by parboiled paddy of the same mills. However, rubber roller mills (modern mills in their term) could produce 66 per cent to 72 per cent of conversion ratio in Bangladesh. However, the study by Islam et al. [20] revealed that on an average, the conversion ratio was around 60 to 65 per cent in the same country. Detail conversion ratio by different mills in India can be seen from the following sections.

Conversion ratio of modern mills

The hulling and milling ratio of modern mills of different States with respect to the types of rice produced are presented in Table 1. In general, it was observed that there were considerable differences in the milling ratio among the different types of mills and different grades of rice produced. Understandably, the milling ratio of modern type of rice mills was considerably higher than that of traditional ones.

Table 1 shows that the average out-turn ratio (paddy to rice conversion ratio) of modern mills in three years from 2007-08 to 2009-10 of Karnataka was found to be 63 per cent and almost same for the West Bengal as well during the same period. However, the ratio of conversion from paddy to rice of Punjab was found to be at the highest amongst the States taken for the study, stood at 69.5 per cent during the same period. The conversion ratio of Chhattisgarh was also relatively higher, stood at the second position with 65.7 per cent, next to Punjab. However, the State of Madhya Pradesh was at the bottom with 58.7 per cent of conversion ratio in the three years study period. The co-efficient of variation was also lingering around 6.2 per cent among the States. It implies that the conversion ratio among the States in the country is more or less same.

Conversion ratio of traditional mills

Under the traditional type of rice mills, only 205 huller mills were included in this study. For the present analysis, fifty (50) units each of huller mill (traditional) were covered from Punjab and West Bengal, 40 units each from Madhya Pradesh and Chhattisgarh, and 25 units from the State of Karnataka. All the units collected under traditional (huller) mills were found to be run under custom hiring basis. The detail conversion ratios and efficiency levels of huller mills can be seen from the Table 2. The quantity of paddy processed by traditional mills in different States was found to be varying widely from one State to another. But conversion ratio can be given precedence in this study and standardises the variation.

From the Table 2 we can see that there is a wide difference in term of quantity of paddy processed by the traditional mills in different States. Nevertheless, our analysis concentrates mainly on the conversion ratios of the mills. The State of Punjab registered highest conversion ratio with an average of 68.8 per cent in the three years study period. It was followed by Karnataka with an average of 58.7 per cent and West Bengal with 57.2 per cent of conversion ratio during the same period. The States of Madhya Pradesh and Chhattisgarh were found to be at the bottom with 53.3 per cent and 54.8 per cent of conversion ratios respectively. The co-efficient of variation of conversion ratio under traditional mills was also found to be lingering at around 10.4 per cent among the States.

Average Variation of Milling Ratio and Its Factors

In this section, we have clubbed both modern and traditional mills together and average conversion ratio was calculated. From the Table 3, we can see that the overall average conversion ratio (combined modern and traditional mills) of the five States together turned out to be 63.3% of rice per quintal of paddy processed. The State of Punjab was found to be at the highest with around 69.4% of conversion ratio. It was followed

States	Particular *(Qty in '000 qtl)*	2007-08	2008-09	2009-10	Average
Karnataka	Paddy Processed	3043.9	3176.1	3337.7	3185.9
	Fine Rice Produced	1918.3	1998.0	2108.8	2008.4
	Out-Turn Ratio (%)	63.0	62.9	63.2	63.0
Punjab	Paddy Processed	1457.6	1478.0	1409.2	1448.3
	Fine Rice Produced	1016.4	1012.0	991.6	1006.7
	Out-Turn Ratio (%)	69.7	68.5	70.4	69.5
West Bengal	Paddy Processed	2559.5	2441.1	2732.5	2577.7
	Fine Rice	1616.7	1545.6	1721.8	1628.0
	Out Turn Ratio (%)	63.2	63.3	63.0	63.2
Madhya Pradesh	Paddy Processed	1568.7	2395.8	1577.2	1847.2
	Fine Rice	912.5	1417.1	928.2	1086.0
	Out Turn Ratio (%)	58.2	59.2	58.9	58.7
Chhattisgarh	Paddy Processed	1920.0	1960.0	2080.0	1986.7
	Fine Rice	1240.0	1280.0	1400.0	1306.7
	Out Turn Ratio (%)	64.6	65.3	67.3	65.7
India (five States) Average (n=237)		63.74	63.84	64.56	64.02
CV		6.5	5.3	6.8	6.2

Source: Primary Field Survey

Table 1: Quantity of paddy processed and conversion ratio of modern mills.

States	Particulars	2007-08	2008-09	2009-10	Average
Karnataka	Paddy Processed	228.3	375.3	238.6	280.7
	Fine Rice Produced	133.7	221.1	139.6	164.8
	Out Turn Ratio (%)	58.6	58.9	58.5	58.7
West Bengal	Paddy Processed	287.4	254.4	202.7	248.1
	Fine Rice Produced	164.5	145.4	116.1	142.0
	Out Turn Ratio (%)	57.2	57.2	57.3	57.2
Punjab	Paddy Processed	294.5	310.0	268.0	290.8
	Fine Rice Produced	202.0	213.5	184.5	200.0
	Out Turn Ratio (%)	68.6	68.9	68.8	68.8
Madhya Pradesh	Paddy Processed	160.0	136.0	143.0	146.3
	Fine Rice Produced	85.0	73.0	76.0	78.0
	Out Turn Ratio (%)	53.1	53.7	53.1	53.3
Chhattisgarh	Paddy Processed	177.4	155.8	135.7	156.3
	Fine Rice Produced	95.6	87.3	74.0	85.6
	Out Turn Ratio (%)	53.9	56.0	54.5	54.8
Mean (n=205)		58.28	58.94	58.44	58.56
CV		10.6	10.0	10.6	10.4

Source: Primary Field Survey

Table 2: Conversion ratio of traditional rice mills (Quantity in '000 Qtls).

by Chhattisgarh with 64.9%. West Bengal and Karnataka was lingering around 63%, but Madhya Pradesh was found to be at the bottom with 58.3% of conversion ratio during the three years study period. The co-efficient of variation of conversion ratio was also lingering around 6.4 per cent among the States.

Understandably, there was a considerable difference of milling ratio among the States due to the different quality of raw paddy processed, the infrastructure and the technology available with them. According to Appiah et al. [11], in Ghana, the advanced mills (SB30 milling machine) was found to be more efficient and could produced 67.3% of head grains compared to inefficient mills (SB10 milling machine) that produced 50% and the locally manufactured mills hardly produced 47.3% of rice. As per the estimates of Saunders et al. [12], the modern mill has got 2.5% and 6.6% more advantage of out-turn ratio than that of sheller and huller (traditional) mills respectively.

From the above analysis we can draw a conclusion that the conversion ratio of Punjab was at the highest and the Madhya Pradesh was at the bottom. What makes this fraction happened among the States is the issue in this section. Table 4 highlight some of the factors responsible for the variation of conversion ratio, if not complete. The highest number of days (133 in a year) was found to be closed the processing mills in Madhya Pradesh due to irregular power supply and unavailability of engineers to get repaired their mills. However, opposite is the case in Punjab. Again, the highest share of broken rice was contributed by Madhya Pradesh (18%) compared to 3% of Punjab. It was mainly due to poor quality of raw paddy available for processing in Madhya Pradesh. Similarly, the milling capacity was found to be the lowest in Madhya Pradesh (41%) compared to 77% of Punjab.

Conclusion

When we observed the conversion ratio from paddy to rice of modern and traditional mills in India, on an average, it was approximately 64 per cent per quintal of paddy processed for modern mills and 58.6 per cent for traditional (huller) mills. The variation of

States	Particulars	2007-08	2008-09	2009-10	Average
Karnataka	Paddy Processed	3272.2	3551.4	3576.3	3466.6
	Fine Rice Produced	2052.0	2219.1	2248.4	2173.2
	Out-Turn Ratio (%)	62.7	62.5	62.9	62.7
West Bengal	Paddy Processed	2846.9	2695.5	2935.2	2825.9
	Fine Rice Produced	1781.2	1691.0	1837.9	1770.0
	Out-Turn Ratio (%)	62.6	62.7	62.6	62.6
Punjab	Paddy Processed	1752.1	1788.0	1677.2	1739.1
	Fine Rice Produced	1218.4	1225.5	1176.1	1206.7
	Out-Turn Ratio (%)	69.5	68.5	70.1	69.4
Madhya Pradesh	Paddy Processed	1728.7	2531.8	1720.2	1993.6
	Fine Rice Produced	997.5	1490.1	1004.2	1163.9
	Out-Turn Ratio (%)	57.7	58.9	58.4	58.3
Chhattisgarh	Paddy Processed	2097.4	2115.8	2215.7	2143.0
	Fine Rice Produced	1335.6	1367.3	1474.0	1392.3
	Out-Turn Ratio (%)	63.7	64.6	66.5	64.9
India/Five States	Paddy Processed	11697.3	12682.5	12124.6	12168.2
	Fine Rice Produced	7384.7	7993.0	7740.6	7706.1
	Out-Turn Ratio (%)	63.1	63.0	63.8	63.3
CV		6.7	5.6	6.9	6.4

Note: Quantity in '000 quintals
Source: Primary Field Survey

Table 3: Conversion ratio of paddy (Modern and traditional mills combined).

States	Mill Closed Per Year*	% of Broken Rice/quintal**	Milling Capacity (in %)	Conversion Ratio/quintal
Karnataka	71	10	55	63
West Bengal	69	5	56	63
Punjab	70	3	77	69
Chattisgarh	117	13	51	65
Madhya Pradesh	133	18	41	58

*Mill closed mainly due to power shortage and break down of machine; ** Share of broken rice is determined by raw paddy used and quality of mill.
Source: Primary Field Survey

Table 4: Milling capacity, milled closed and conversion ratio.

conversion ratio among the States was very negligible, at the tune of 6.4 per cent only. Of the States, Punjab was found to be performed well compared to the other four States and Madhya Pradesh was found to be least performed State compared to other four States, not only in the case of traditional mills but also the modern mills. The main factors behind this variation was credited to the technological advancement, infrastructural facilities (regular power supply, availability of skilled engineers) and quality of raw paddy available for processing in the States.

Improvement of milling ratio not only gives good yield but also good quality of rice and higher net returns on investment. Upgrading the existing hullers or traditional rice mills to advanced techniques or modern rice mills can improve the milling ratio as discussed in the previous sections. This will ultimately help in improving the milling ratio in the country, and reduce post-harvest loss and food security problem to some extent.

Acknowledgement

This paper is part of a larger study on "Hulling and Milling Ratios of Major Paddy Producing States of India: A Consolidated Report" submitted to the Ministry of Agriculture, Government of India, New Delhi, prepared by the author. The author wants to thank the Ministry of Agriculture, Government of India for the support.

References

1. Singha Komol (2012) Structure and Performance of Paddy Processing Industry in India: A Case of Karnataka. Scientific & Academic Publishing, USA.
2. Razavi SMA, Farahmandfar R (2008) Effect of Hulling and Milling on the Physical Properties of Rice Grains. International Agro-physics. 22: 353-59.
3. Roy P, Orikasa T, Okadome H, Nakamura N, Shiina T (2011) Processing conditions, rice properties, health and environment. Int J Environ Res Public Health 8: 1957-1976.
4. Patil RT (2011) Post-harvest Technology of Rice. Central Institute of Post Harvest Engineering and Technology, Punjab Agriculture University, Ludhiana (India). Rice Knowledge Management Portal: Directorate of Rice Research.
5. TDAP (2010) Post-Harvest Losses of Rice. Agro Food Division: Trade Development Authority of Pakistan. Government of Pakistan.
6. Joshi, Bhavesh K (2004) Post Harvest Profile of Paddy/Rice. Directorate of Marketing and Inspection, Dept of Agriculture and Cooperation, Ministry of Agriculture, Government of India.
7. Nayak, Purusottam (1996) Problems and Prospects of Rice Mill Modernization: A Case Study. Journal of Assam University. 1: 22-28.
8. NIPUNA (2013) Major Rice Producing Nations.
9. USDA (2009) Foreign Agricultural Services.
10. Clarkson N, Kulkarni KG (2011) Effects of India's Trade Policy on Rice Production and Exports.
11. Appaiah F, Guisse R, Dartey PKA (2011) Post Harvest Losses of Rice from Harvesting to Milling in Ghana. Journal of Stored Products and Post-harvest Research 2: 64-71.
12. Saunders RM, Mossman AP, Wasserman T, Beagle BC (1980) Rice Post-harvest Losses in Developing Countries. U.S. Department of Agriculture Science and Education Administration. Agricultural Reviews and Manuals.
13. Kumar S, Bourai VA, Kumar Hitendra (2011) Post Harvest Losses in Pulses of

Uttarakhand: A Specific Study of Sample Villages of Assan Valley. Economic Affairs. 56: 243-47.

14. Lele Uma J (1970) Modernisation of Rice Milling Industry: Lesson from Past Experience. Economic and Political Weekly. 5: 87-90.
15. Musa Dauda S, Adeoye PA, Bello K, Agboola, Abdulfatai A (2012) Performance Evaluation of a Locally Developed Rice De-hulling Machine. International Journal of Agronomy and Agricultural Research. 2: 15-21.
16. Singha K (2013) Hulling and Milling Ratio in the Major Paddy Growing States of India: A Consolidated Report. Institute for Social and Economic Change.
17. NABARD (2010) Annual Report 2011-12, NABARD.
18. Singha Komol (2012) Economics of Paddy Processing Industry in India: A Case of Karnataka. Scientific Journal of Agriculture. 1: 80-91.
19. Baqui A (1994) Rice Post-harvest Processing in Bangladesh: Strategies for Development both for Domestic Need and Export. A paper presented in the National Workshop on "Post Harvest Processing and Preservation of Agricultural Products its present Status and Future Strategy in Bangladesh", held at Dhaka: Bangladesh Agricultural Research Council.
20. Islam MS, Abdul Ghani M, Saiful Islam AKM, Rahman MA (2003) Effect of Drying and Tempering on the Milling Quality of Long Grain Aromatic Paddy Processing in Bangladesh. Pakistan Journal of Biological Sciences. 6: 1675-1680.

Citation: Singha K (2013) Paddy Processing Mills in India: An Analysis. J Rice Res 1: 115. doi: 10.4172/jrr.1000115