Cluster profile
Berhampur rice mills

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Promoting Energy Efficiency in SMEs
SAMEEEKSHA

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India

For more information

Project Monitoring Cell
T E R I
Darbari Seth Block
IH C Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 2468 2111
E-mail pmc@teri.res.in
Fax 2468 2144 or 2468 2145
Web www.teriin.org
India +91 • Delhi (0)11

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Berhampur rice mill cluster

Overview of cluster

Berhampur is a subdivision of Ganjam district located in western side of Odisha. There are more than 750 industries in Berhampur subdivision, which includes general engineering, pharmaceutical, food, plastics, cements and rice millers. About 160 rice mills are engaged in producing raw rice in this cluster. Raw rice millers use only electrical energy for motive loads in different process steps. Different by-products generated in paddy processing include husk, bran and broken rice. The husk generated in raw rice milling process is completely sold as by-product, unlike parboiled units which use husk as the main fuel in boilers to raise steam. The average revenue generated from tonne of paddy processed is Rs 13,000.

Source: Google Maps

Details of by-products in paddy processing

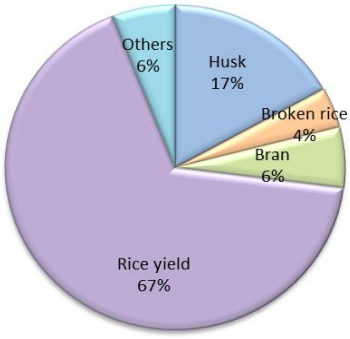
By-product	Yield (kg/tonne)	Rate (Rs/tonne)	Revenue (Rs/ t paddy)
Bran	60	12000	720
Broken rice	40	10000	400
Husk	170	1200	204
Total revenue from by-products			**1324**

Apart from rice mills, some of the medium and large industries include Jayashree Chemicals (P) Ltd (chemicals), Indian Rare Earth Ltd (refractories), Aska Spinning Mill (P) Ltd (textile) and Virat Crane Agro Tech (P) Ltd (food).

In Odisha, paddy is procured from the farmers through primary agricultural cooperative societies on behalf of the state government. The paddy is distributed to the registered rice mill for further processing. The rice from the mills is taken back by the government for 'public distribution system' (PDS) under "Food and Procurement Policy" of the Government of Odisha. Interactions with state level industry association indicated that the processing charges are fixed by the government time to time to take care of the expenses towards processing of paddy to produce rice.

Product types and production capacities

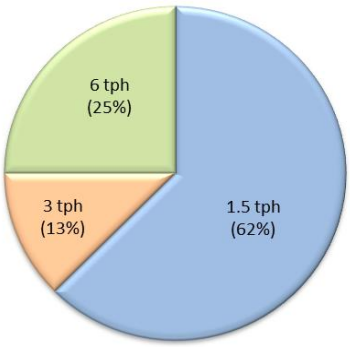
About 95% of the processed paddy in Odisha is used for producing parboiled rice; the remaining 5% produce raw rice. Apart from rice, the important by-products from rice mills include husk (17%), which is used in house as boiler fuel and bran (6%), which is procured by the bran oil manufacturer for further processing. The rice mills in Berhampur generally cater to the PDS established by the state government of Orissa.



Rice yield in paddy processing

A majority of rice mills in Berhampur district are involved in producing raw rice. Mass balance of raw rice milling process with yield and products are provided with figure. Average raw rice yield is around 67% and about 17% husk is the main by products in milling raw rice from paddy.

There are about 160 rice mills located in different locality or industrial areas of Berhampur subdivision. Based on the installed capacity, the rice mills are categorized into three categories: (i) Paddy processing capacity of 1.5 tonne per day (tpd), (ii) Paddy processing capacity of 3 tpd and (iii) Paddy processing capacity of 6 tpd. Of these, 62% mills have paddy processing capacity of 1.5 tonne per day in one shift of 8 hour operation. Majority of these mills falls under MSME as defined by the Ministry of MSME. Figure provides the distribution of different category of these mills.



Distribution of rice mills

More than 50 traditional aromatic paddy varieties with pleasant aroma are grown in various parts of the state. These indigenous scented paddy varieties such as Kalajeera, Badsabhog, Neelabati, Krushnabhog, Govindabhog, Padmakeshari, Tulasiphoola, Chinikamini, Saragdhuli, and Thakurabhog are predominant in coastal belts, whereas a few traditional scented varieties such as Pimpudibasa, Karpurakeli, Kalikati, Laxmibilas, Jubraj, Durgabhog, Karpurakranti, and Makarakanda are common in the plateau regions of the state (source: http:/ / books.irri.org/ TechnicalBulletin16_content.pdf assessed on 02 April 2016). A few popular variety of rice using above grown paddy in the state are Swarna rice, Ratna rice, White rice, Sonamasuri rice, Miniket rice, Basmati rice, Gobindobhag rice, etc. (source: http:/ / dir.indiamart.com/ balasore/ rice.html as assessed on 02 April 2016).

In spite of the 'small' category accounts for about 62% of the total installed rice mills in Berhampur cluster but their combined annual production share is less than 18 % as can be seen from the table.

Annual estimated production of rice mills

Category	Installed capacity (tpd)	Number of units	Production	
			tonne per year	Share
Small	1.5	100	5400	17.5%
Medium	3	20	5760	18.5%
Large	6	40	20160	64%
	Total	**160**	**31320**	

Raw material usage in cluster

The major raw materials used in rice milling are paddy supplied by the government under PDS establishment. More than 0.031 million tonne of paddy is processed in Berhampur rice cluster during 2015-16.

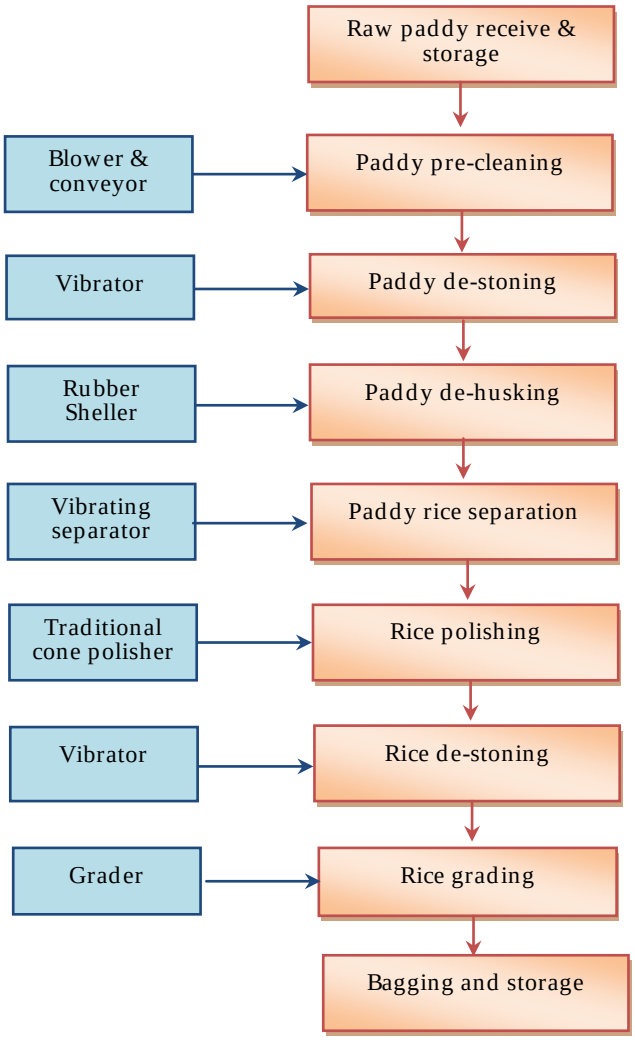
The industries are paid to the tune of Rs 200 per tonne of paddy towards processing charges; in addition the transportation cost is also reimbursed to the industries separately as per the existing rates. The processing charges are based on a yield ratio of 0.68 i.e. the rice mill will be reimbursed based on an output of 680 kg of rice per 1000 kg of paddy. However, the typical yield ratio of the local paddy is claimed to vary based on the quality of grains and contaminants present in raw paddy.

Production process

Paddy in rice mill under goes various processes and sub processes before it reaches to rice yard for bagging. The complete paddy processing to produce raw rice could be grouped into following major steps:

(1) **Paddy preparation**[1]: Various contaminants namely rice straw, dust, stone, sand and immature seedless paddy is removed from paddy using blower fan and vibrator.

(2) **Milling**: Rice is produced along with by-products such as husk, bran and broken rice. Husk is sold to potential industrial buyers as the source of thermal energy or process raw material depending upon target application. Bran, having 60% of nutrients in rice kernel, is used for making rice bran oil and other useful by-products such as poultry feed. Rice bran accounts for more than 6% of total weight of paddy. Depending upon the facilities, further grading and silky polishing of raw rice is under taken to produce premium quality product.



Production process in rice mill

Technologies employed

The processing of paddy into raw rice involves the following equipment in process to remove husk, separating stone, paddy, broken rice and bran from final product:

(i) Sheller

Pre-cleaned paddy is continuously supplied to Sheller, de-husking machines to remove husk from paddy surface. Generally, some of the paddy passes with its husk as well as rice, which is later removed and recycled back from downstream process to Sheller for de-husking.

[1] locally known as jharai or safai

(ii) Polishers

Rice produced in Sheller is transferred to cone polisher with the help of belt conveyor. In this stage, bran is also separated from raw rice. Polishing takes place in series from coarse to finer grade. Sheller and series of cone polisher is belt driven from a common shaft, which is connected to a higher capacity motor.

Polishing

(iii) Vibrator and separator

These are used at different stages of the process such as preparation of paddy by removing all contaminants like straw, seedless paddy, stone, grass leaves etc., separating stone, broken rice and carryover of paddy from Sheller. Normally, small motor of 1–2 hp is connected single arrangement unlike common drive for Sheller and polishers.

De-stoning

(iv) Grader

Traditionally, polished rice are transferred through conveyor to bagging yard without separating different categories of rice such as fully matured, partially matured (thin), discoloured, partially broken etc. from the final product. Presently, graders are used to separate all these rice with the help of specially designed vibrating mesh separator to produce uniform quality product for better premium.

Rice grader

Energy consumption

In raw rice milling, only electricity from grid is used for different motive loads in the processing sections to operate connected motors in place. Most of the traditional rice millers have single motor with common drive shaft. Modern rice millers with grading and silky polishing facilities have better system lay out with separate motor for individual drive.

(i) Unit level consumption

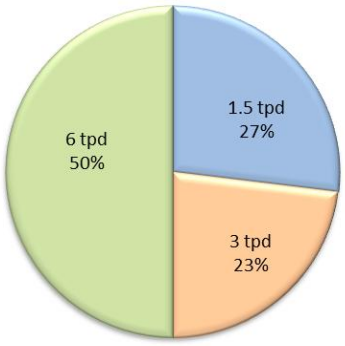
The unit level energy consumption in a raw rice mill is only electricity. There is no thermal energy is required in raw rice milling process. The unit level energy consumption depends on the type of technology exist in the plant. The average 'specific energy consumption' (SEC) of Berhampur raw rice mills is estimated to be 19 kWh per tonne of (raw) rice production (equivalent to 0.0163 toe/ tonne), which may vary within 30–15 kWh/ tonne. The typical energy consumption of different capacities of rice mills are shown in table.

Energy consumption of typical capacity of rice mills

Average capacity	Unit level energy consumption		
(tpd)	(kWh/tonne)	(kWh/year)	(toe/year)
1.5	30	1620	0.14
3	25	7200	0.62
6	15	7560	0.65

(ii) Cluster level consumption

The energy consumption pattern shows a majority share (50%) by large capacity units as can be observed in the figure. The overall annual energy consumption of the cluster is estimated to be 52 toe. The estimated 'greenhouse gas' (GHG) emissions from rice mills at cluster level is 596 tonne of CO_2. It may be noted from table above that the modernization of the plant will not only reduce energy consumption and GHG emissions but the plant will be also produce premium quality product for better cash flow.



Cluster level energy consumption

Total energy consumption of Berhampur rice cluster (2015-16)

Milling capacity (tpd)	Number of mills	Energy consumption (MWh/year)	Equivalent energy (toe)	Annual energy bill (million INR)
1.5	100	162	14	1.05
3	20	144	12	0.94
6	40	302	26	1.96
Total	160	608	52	3.95

Energy saving opportunities and potential

Raw rice mills offer significant scope for energy efficiency improvements in its process. Some of the options are discussed below.

(i) Shift from common drive to individual drives

A majority of rice mills in Berhampur uses traditional system with common drive shaft for power transmission with the help of belt and pulley (100 mills). The overall power transmission will be very low with this kind of arrangement. Further, connected motors are also old model with very low efficiency. The existing system could be modified with individual energy efficient motor either directly coupled or attached with cogged v-belt for better transmission. This will reduce the unit level energy consumption in the range of 20–25% in total kWh consumption per tonne of paddy processing.

About 100 rice mills uses traditional common shaft drive with total energy consumption equal to 162000 kWh per year can be benefitted with adopting dedicated motor to individual process steps. The envisaged energy saving is 32400 kWh per year (equivalent to 2.78 toe). The equivalent monetary value of electrical energy saved is Rs 2.1 lakh.

(ii) Biomass gasifiers for power generation

The rice husk generated from raw rice milling is totally surplus and can be used in biomass gasifiers for power generation. The in-house rice husk can be effectively used to generate producer gas, which is rich in carbon monoxide (CO) and hydrogen (H_2). This gas can be transferred to an internal combustion (IC) engines for power generation. Thus the plant can either use in house power in their process or can have arrangement to bank on the local grid. Rice husk being renewal energy, this would further reduce the overall GHG emission from the cluster.

(iii) Others

A list of energy efficiency options applicable for Berhampur rice mill cluster is provided below. Based on the applicability and priorities, the rice mills can adopt EE options that would help in saving energy resulting in monetary benefits and reduction in GHG emissions.

Energy saving options in rice mills in Berhampur rice mill cluster	
1.	Shift from common drive to individual drive system
2.	Use of EE motors in different drives
3.	Switch to modern technology to produce silky polished rice
4.	Use of rice husk based gasifiers for power generation
5.	Switch to EE lighting

Major stakeholders

The major stakeholders include district level and state level industry associations. The industry associations are generally engaged with the government on paddy procurement and related processing charges. They have very little experience and activities related to technology issues in the cluster; however the associations showed keen interest towards technology upgradation of rice mills including 'renewable energy' (RE) applications. Other important stakeholders in rice mills are MSME-Development Institute (DI), District Industries Centre (DIC) and PDS. Presence of 'Local service providers' (LSP) such as equipment suppliers, fabricators, technology providers, testing centres and energy auditors is very limited in the cluster.

Major industry associations in Berhampur rice mill cluster

Name of association	Location
Ganjam District Rice Millers Association	Berhampur
All Odisha Rice Millers Association	Bhubaneswar

Cluster development activities

There are no specific cluster level activities in Berhampur rice mill cluster.

About TERI

A dynamic and flexible not-for-profit organization with a global vision and a local focus, TERI (The Energy and Resources Institute) is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to tackling issues of global climate change across many continents and advancing solutions to growing urban transport and air pollution problems, TERI's activities range from formulating local and national level strategies to suggesting global solutions to critical energy and environmental issues. The Industrial Energy Efficiency Division of TERI works closely with both large industries and energy intensive Micro Small and Medium Enterprises (MSMEs) to improve their energy and environmental performance.

About SDC

SDC (Swiss Agency for Development and Cooperation) has been working in India since 1961. In 1991, SDC established a Global Environment Programme to support developing countries in implementing measures aimed at protecting the global environment. In pursuance of this goal, SDC India, in collaboration with Indian institutions such as TERI, conducted a study of the small-scale industry sector in India to identify areas in which to introduce technologies that would yield greater energy savings and reduce greenhouse gas emissions. SDC strives to find ways by which the MSME sector can meet the challenges of the new era by means of improved technology, increased productivity and competitiveness, and measures aimed at improving the socio-economic conditions of the workforce.

About SAMEEEKSHA

SAMEEEKSHA (Small and Medium Enterprises: Energy Efficiency Knowledge Sharing) is a collaborative platform set up with the aim of pooling knowledge and synergizing the efforts of various organizations and institutions - Indian and international, public and private - that are working towards the development of the MSME sector in India through the promotion and adoption of clean, energy-efficient technologies and practices. The key partners are of SAMEEEKSHA platform are (1) SDC (2) Bureau of Energy Efficiency (BEE) (3) Ministry of MSME, Government of India and (4) TERI.

As part of its activities, SAMEEEKSHA collates energy consumption and related information from various energy intensive MSME sub-sectors in India. For further details about SAMEEEKSHA, visit http:/ / www.sameeeksha.org