Cluster Profile
Bargarh rice mills

teri

Promoting Energy Efficiency in SMEs
SAMEEEKSHA

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development
and Cooperation SDC

Certificate of originality

Original work of TERI done under the project "INDIA: TERI-SDC Partnership: Scaling up Energy Efficient Technologies in Small Enterprises (EESE)"

Suggested format for citation

TERI. 2015
Cluster Profile Report – Bargarh rice mills
New Delhi: The Energy and Resources Institute 10 pp.
[Project Report No. 2014IE15]

Disclaimer

This document is an output of a research exercise undertaken by TERI supported by the Swiss Agency for Development and Cooperation (SDC) for the benefit of MSME sector. While every effort has been made to avoid any mistakes or omissions, TERI and SDC would not be in any way liable to any persons/organisations by reason of any mistake/ omission in the publication.

Published by

T E R I Press
The Energy and Resources Institute
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi-110 003
India

For more information

Project Monitoring Cell
T E R I
Darbari Seth Block
IHC 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

Contents

Acknowledgements

TERI places on record its sincere thanks to the Swiss Agency for Development and Cooperation (SDC) for supporting the long-term partnership project focusing on energy intensive MSME clusters in India.

TERI team is indebted to Mr Shyam Lal Agrawal, State President of All Odisha Rice Millers Association (AORMA), Odisha for providing support and information related to rice mills in Orissa. TERI also places in record the support provided by Mr Rohit Kumar Singhal, Director, Bargarh Rice Millers Consortium (P) Ltd for organizing field visits and interactions with the rice mill entrepreneurs during the study for the preparation of this cluster profile report.

TERI extends its sincere thanks to Mr P K Gupta, Director (I/c) and Mr C P Reddy, Assistant Director, MSME-DI (Cuttack) for facilitating field visits.

Last but not least, our sincere thanks to MSME entrepreneurs and other key stakeholders in the cluster for providing valuable data and inputs that helped in cluster analysis.

Bargarh rice mills

Overview of cluster

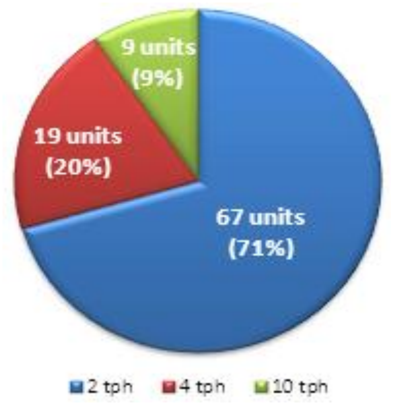
Bargarh, located in western side of Odisha has more than 1000 registered[1] industries, which include micro & small enterprises and artisan units. The micro & small industries comprise mainly rice, rice bran oil, engineering & fabrication, mineral, brass & bell metal, aluminium downstream products, readymade garments, coir, textile, paper products, groundnut processing, spices, cashew kernels, dry fish, poultry/ cattle field, pharmaceutical, ayurvedic products, fly ash bricks, granite tiles & slabs and terracotta. Some of the medium and large industries include ACC Cement Ltd, Bargarh Sugar Mills, Granular Fertilizers Pvt Ltd, Krishna Solvent Extraction Plant and Kripla Springs Pvt Ltd.

The total paddy production from Orissa is estimated to be 7.5 million tonne. While about 3.5 million tonne of paddy is transported to other states, the balance 4.5 million tonne of paddy is processed within Orissa. Of this, about 95% is accounted for production of parboiled rice and 5% for raw rice. Three districts, namely Bargarh, Sambalpur and Kalahandi account for about 50% of rice production in the state; Bargarh district alone accounts for about 30% of rice production in Orissa, which is 100% parboiled rice. The total estimated rice production in Bargarh cluster is 0.75 million tonne.

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

The major raw materials used in rice milling are paddy supplied by the government under PDS establishment. Bargarh rice cluster processes about 1.2 million tonne of paddy per year. The industries are paid to the tune of Rs 300 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.



Distribution of rice mills in Bargarh cluster

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

1 Brief industrial profile of Bargarh district, MSME-Development Institute

by-products from rice mills include husk (23%), which is used in house as boiler fuel and bran (7%), which is procured by the bran oil manufacturer for further processing. The rice mills in Bargarh generally cater to the PDS established by the state government of Orissa.

There are about 95 rice mills located in Bargarh district. Majority of these mills falls under MSME as defined by the Ministry of MSME. Based on the installed capacity, the rice mills are categorized into the following:

- Small mills: Paddy processing capacity of 2 tonne per hour (tph)
- Medium mills: Paddy processing capacity of 4 tph
- Large mills: Paddy processing capacity of 10 tph

More than 70% of the rice mills in the cluster have a production capacity of about 2 tph. The distribution of rice mills in Bargarh cluster shows that the 'small' category accounts for about 45% of the installed capacity.

Annual estimated production of rice mills

Category	Installed capacity (tph)	Number of units	tonne per year	Production Share (%)
Small	2	67	3,43,855	45
Medium	4	19	1,95,022	25
Large	10	9	2,30,947	30
	Total	95	7,69,824	

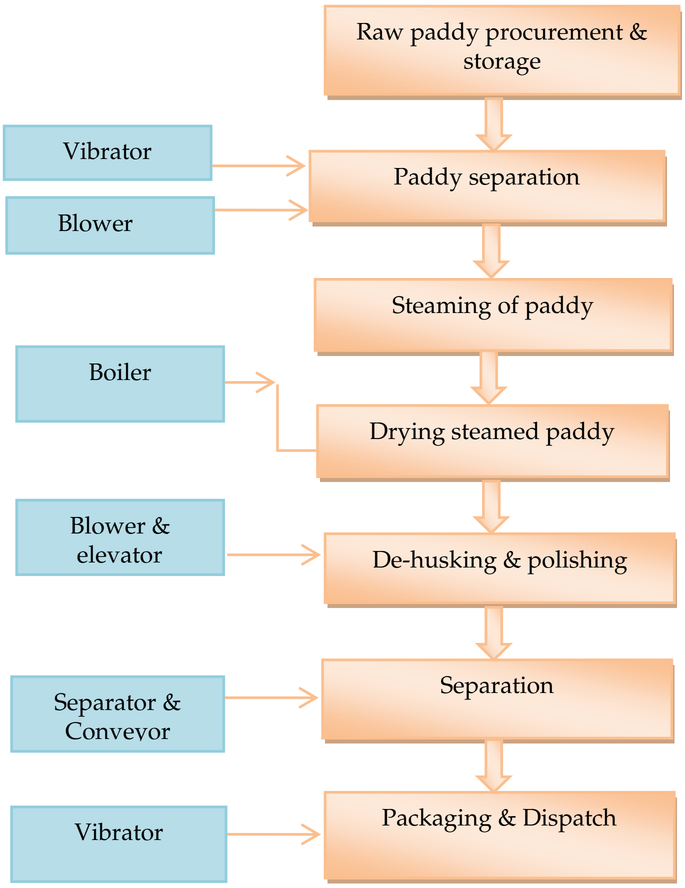
Energy scenario in the cluster

The rice mills use mainly rice husk produced during processing of paddy as the main source of energy. Electricity is sourced from grid and the average cost of electricity is Rs 5.60 per kWh.

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 parboiled rice could be grouped into following major steps:

(1) **Paddy preparation**[2]: Various contaminants namely rice straw, dust, stone, sand and seedless paddy are removed from paddy.



Production process in rice mill

[2] locally known as jharai or safai

(2) **Steaming**: Paddy is heated using steam in two stages[3] for full-parboiled rice or single stage for semi-parboiled rice. In case of raw rice, steaming operation is not required.

(3) **Drying**: Steamed paddy is dried either on open concrete floor[4] in sun light or by indirect heat transfer in hot air dryer system.

(4) **Milling**: Rice is produced along with by-products such as husk and bran. Husk is used as fuel in boiler. 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 about 7% of total weight of paddy.

Technologies employed

The processing of paddy into parboiled rice involves the following equipment for processing of paddy:

(i) Boiler

Boiler is used for generation of steam and hot water. Steam is generated at a pressure of about 10 kg/cm^2 (g). Generally 3-pass boiler is used in the cluster and majority of the boilers do not have any waste heat recovery system e.g. economiser except for locally fabricated system for preheating boiler feedwater. In-house generated rice husk is used as fuel in boiler. A forced draught fan is used for supply of combustion air as well as for fuel feeding system. Apart from pressure gauge, the rice mills do not use any instrumentation to monitor the operating parameters of steam generation and distribution system.

Rice husk fired boiler

(ii) Steaming bowl

Paddy is loaded into steaming bowls (soaking pits are generally used in traditional mills, which are inefficient). Hot water prepared by mixing steam with water is first circulated into the bowls for about 20 to 30 minutes in close loop. The temperature of hot water is maintained at about 60-70 ^oC for this purpose. After about 10 minutes of holding, the water from bowls is drained out. After draining of hot water, steam is directly injected into the bowls from bottom till the steam starts coming out from top lid. The used steam is condensed and drained out. The hot water and used steam are collected to passed on to effluent treatment section.

Steaming bowl

(iii) Dryer

In conventional rice mills, paddy is sent for sun drying which is time and labour intensive. Also, sun drying is not a suitable option during rainy season. However, in modern

Dryer

[3] Locally known as vapa and sheeddo
[4] locally known as chattal

rice mills, the wet paddy is dried separately in a dryer section, which helps in overcoming the problems faced by traditional rice mills and supports continuous operation. The steamed paddy is moved to the top of dryer channel arrangement with the help of a bucket elevator system for repeated circulation in a counter flow arrangement to ensure complete drying. The bucket elevators are made of mild steel in old mills and the potential alterative is plastic bucket elevator which would reduce the energy consumption to a significant extent. The dryer comprises an indirect heat exchanger in which steam at 10 kg/cm^2 (g) pressure (at about 180 °C) is used to exchange heat with ambient air to generate hot air which in turn removes the moisture from steamed paddy. Steam traps are also used to remove condensate formed in steam lines.

(iv) Milling section

The dried paddy is shifted to milling section and stored in silos before converting the paddy into rice. The milling section comprises the following areas:

Destoning: In this pre-cleaning area, the carry-over along with paddy such as stones are removed in a vibrating platform having sieves.

De-husking: In this, the husk is removed from the paddy, which produces brown rice. Husk is used as fuel in boiler for steam generation.

Destoning of paddy

Whitening & polishing: De-husking produces brown rice, which comprises a brown layer called bran. The bran is removed from the brown rice in polishing area to produce white rice. Bran is a by-product rich in protein content and is used for producing rice bran oil and poultry products.

Some of the utilities used in rice mills include pumps for water pumping, material conveying system and compressors for meeting compressed air requirement.

Rice polishing

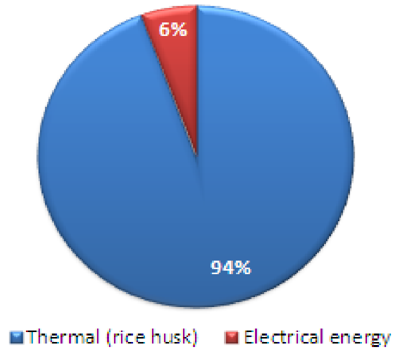
Energy consumption

The major energy forms used by rice mills in Bargarh cluster include (1) electricity and (2) husk. Electricity from grid is used for different motive loads in the processing sections, water pumping and blowers. Thermal energy in the form of steam/ hot water is used for soaking of paddy and subsequent drying. Husk, a by-product in paddy processing is used as the fuel in boiler for generating steam. As a thumb rule, about 23% of husk is produced while processing paddy. Almost 90% of husk is used in-house for steam generation and the balance 10% is sold out in open market. Generally steam at 10 kg/cm^2 pressure is used in par-boiling section. The average capacity of boilers used in rice mills is 4 tonne per hour (tph), Steam is used mainly for three purposes in a rice mill:

- Generation of hot water (around 60°C) by steam injection, which is used for soaking of paddy in steaming bowls
- Direct injection of steam in steaming bowl during boiling of paddy
- Generation of hot air through indirect heat transfer in radiant heat exchanger towards drying of wet paddy after completion of steaming process

(i) Unit level consumption

The unit level energy consumption in a rice mill includes rice husk and electricity. Internally generated rice husk constitutes for about 94% of total energy requirement in a rice mill unit; only 6% of energy is met through electricity. Paddy steaming and dryer sections account for major thermal energy consumption in a rice mill. The average 'specific energy consumption' (SEC) of Bargarh rice mills is estimated to be 43 kWh per tonne of (parboiled) rice production (equivalent to 0.1 toe/tonne). The typical energy consumption of different capacities of rice mills are shown in table.



Energy share in a rice mill

Energy consumption of typical capacity of rice mills

Average capacity (tph)	Thermal energy (tpy)	Electricity (kWh/yr)	Total energy (toe/yr/mill)
2	1610	3,33,590	512
4	3219	6,67,181	1023
10	8048	16,67,952	2558

(ii) Cluster level consumption

The energy consumption pattern shows a majority share (94%) by rice husk, although it is produced as a by-product. A small share of excess rice husk is sold to units such as rice bran oil industries. Electricity accounts for a small share of 6% of total energy requirements in a rice mill unit. The average SEC at cluster level is 43 kWh/tonne rice (~ 0.1 toe/t rice). The overall energy consumption of the cluster is estimated to be 76,737 toe. The estimated 'greenhouse gas' (GHG) emissions from rice mills at cluster level is 4903 tonne of CO_2. It may be noted that excess production of rice husk (meaning low consumption level in boilers through EE improvements) would help in generating more revenue for the rice mills.

Total energy consumption of Bargarh rice cluster (2014-15)

Energy type	Annual consumption	Equivalent energy (toe)	Annual energy bill (million INR)
Rice husk*	2,41,445 tonne	72,433	290
Electricity	50 million kWh	4,303	280
	Total	76,737	570

* *Based on selling price of excess husk from rice mills sold to other industries*

(iii) Cogeneration from rice mills

Electricity from grid is used in rice mills and a majority of the rice mills have only small backup facilities for mandatory load. About 3 units in Bargarh cluster have installed 'captive power generation' (CPP) and adopted cogeneration route. Steam is generated at about 48 kg/cm^2 and used in steam turbines for power generation to meet internal demands of the mill. Low pressure steam is used in the paddy processing section. It may be noted that all the units use electricity for their internal consumption and do not sell electricity to grid or other units. The total installed capacity of the CPP is 2 MW in Bargarh cluster. Thus, these CPP based units are self-sustaining with regard to their total energy requirements.

Cogeneration: Installed capacity in Bargarh rice mill cluster

Number of units	Installed capacity (MW per unit)	Total installed capacity (MW)
1	1	1
2	0.5	1
	Total installed capacity	2

Energy saving opportunities and potential

Rice mills offer significant scope for energy efficiency improvements both in thermal and electrical areas. These options are discussed below.

(i) Economiser for boilers

A majority of rice mills in Bargarh uses three-pass rice husk fired boilers generally without any 'waste heat recovery' (WHR) system. For example, an economiser put in a boiler will utilize the waste heat in flue gases and use it for preheating of feedwater. As a thumb rule, about 6 °C preheating of feedwater would result in an energy saving of 1%. Considering the feedwater to boiler is preheated upto 90 °C, through preheating in economiser and improving condensate recovery, it would lead to about 10% saving in fuel. About 86 rice mills belonging to small and medium type can be benefitted with adopting waste heat recovery in boiler. The envisaged energy saving is 16,900 tonnes per year of rice husk (equivalent to 5,070 toe). The equivalent monetary value of rice husk saved is Rs 20.3 million.

(ii) Cogeneration in rice mill

Only 3 rice mills of capacity more than 10 tph have cogeneration system installed in their units. There is a scope for remaining 6 rice mills to adopt cogeneration mode to meet both electricity and steam demands. The envisaged cogeneration potential is 6 MW from the rice mills that are equivalent to above 10 tph capacity.

(iii) Biomass gasifiers for power generation

The excess rice husk after steam generation in boilers can further be used in biomass gasifiers for power generation. By improving the efficiency of steam generation and distribution system, the availability of rice husk in the mill can be optimised. This rice husk is used to generate producer gas, which is rich in carbon monoxide (CO) and hydrogen (H_2). This gas can be effectively utilised in internal combustion (IC) engines to replace completely/ partially diesel used for power generation. Thus the high pressure steam circuit along with steam turbine can be avoided in this mode.

(iv) Solar water heater

Rice mills provide significant scope for adoption of solar water heaters that can be used for generation of hot water at about 60-70 °C. Hot water is required in soaking of paddy in steam bowls. Further the boiler feedwater can also be fed to boiler higher temperatures i.e. preheating of feedwater that would help in saving rice husk. The estimated energy saving potential is 20,000 tonnes per year of rice husk (equivalent to 6,000 toe). The equivalent monetary saving is Rs 24.1 million.

(v) Others

A significant reduction in energy losses is possible in areas such as steam distribution including insulation and steam traps, steaming bowl and paddy dryer. Further, it may be noted that the level of reuse of water from different processes in rice mills is very low, which has a potential for improvement. On electrical side, pumping of (cold & hot) water and drives constitute important energy consuming areas which have potential for EE improvements. Further, monitoring and control of operating parameters in different process sections e.g. temperature monitoring in hot water preparation area would help in operating the mill close to design level.

A list of energy efficiency options applicable for Bargarh 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 Bargarh rice mill cluster	
Short-term	
1.	Insulation of steam piping and other hot surfaces
2.	Effective use of day lighting facility
Medium-term	
1.	Incorporating 'waste heat recovery' (WHR) system e.g. economizer for preheating of feedwater
2.	Monitoring and control of combustion air in boiler
3.	Exploring independent fuel feeding arrangement in boiler
4.	Enhanced recycling of hot water drained from steaming bowl
5.	Improvement of condensate and waste heat recovery from dryer
6.	On-line instrumentation for monitoring and control of process parameters
7.	Introduction of load cells in bucket elevators
8.	Shift from common drive to individual drive system
9.	Use of EE motors in different drives
10.	Replacement of mild steel buckets with plastic buckets in elevator system
11.	Switch to EE lighting
Long-term	
1.	Replacement of inefficient boilers with EE boiler
2.	Solar water heater for preheating of water
3.	Cogeneration to produce electricity for in-house needs and export to grid
4.	Use of rice husk based gasifiers for power generation

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 Bargarh rice mill cluster

Name of association	Location
Bargarh Rice Millers Association	Bargarh
State level Rice Mill Association	Bargarh

Cluster development activities

The Bargarh cluster has formed a 'special purpose vehicle' (SPV) to create a 'common facility centre' (CFC) for production of rice bran oil. The CFC has established Bargarh Rice Millers Consortium (P) Ltd with financial support from MSME-DI (Cuttack). This CFC can further be strengthened through capacity building activities such as training and provision of EE services in the 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

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation 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