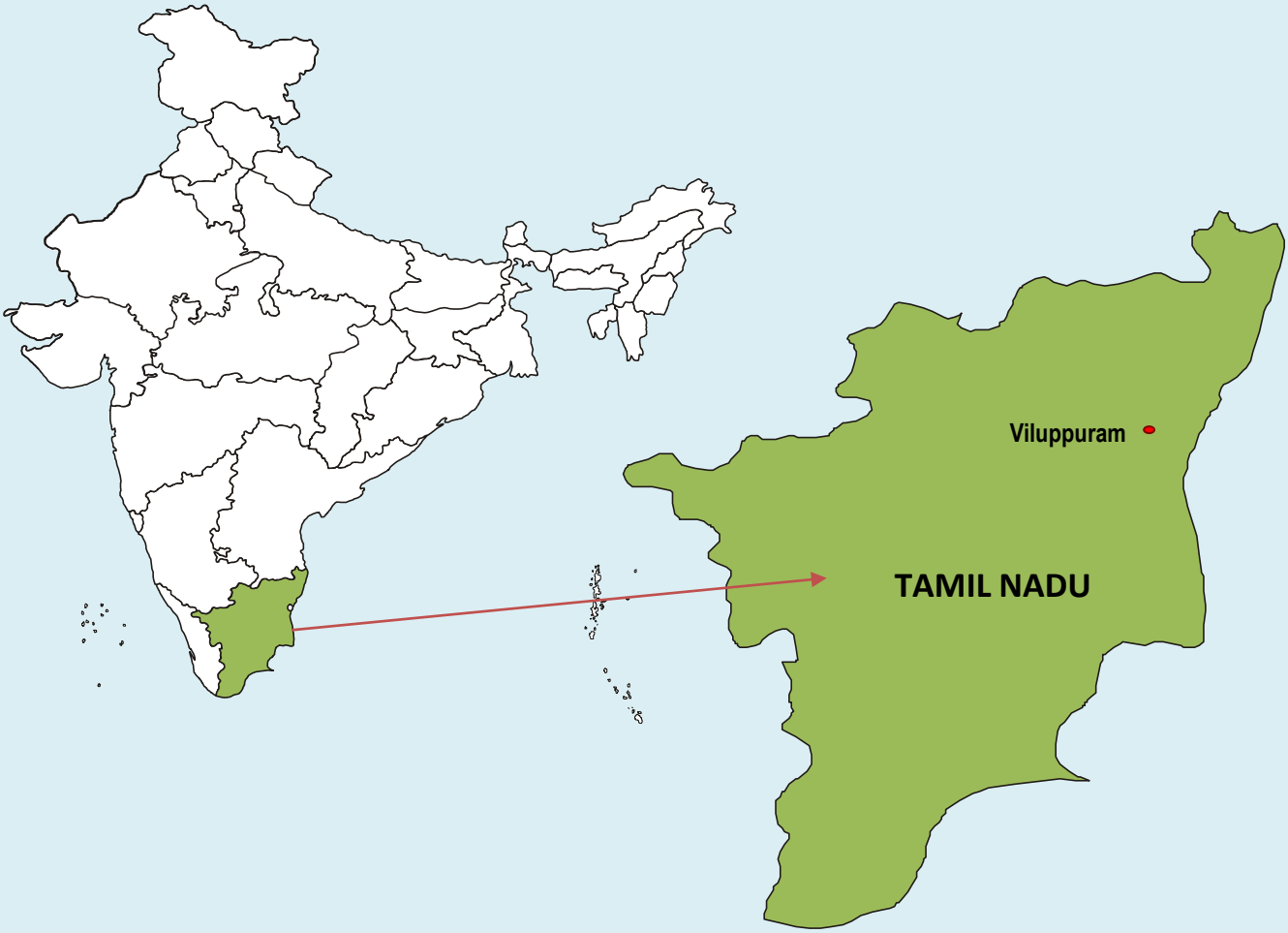
# Cluster Profile
# Villupuram rice mills

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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.

# Villupuram rice mills

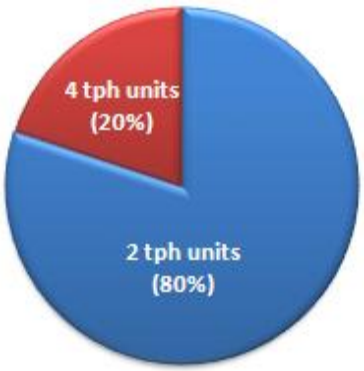
## Overview of cluster

Villupuram is surrounded on East and South by Cuddalore District, West by Salem and Dharmapuri Districts and on the North by Thiruvannamalai and Kanchipuram Districts. There are about 6733 registered industrial units in Villupuram district (*Source: Brief industrial profile of Villupuram District, MSME Development Institute, Chennai*). The medium and large type of industries operating in the district include sugar, vanaspati, yarn, flour mobiles, engineering tool, automobile fasteners, shoe uppers, etc, The small industries mainly comprise rice mills, cattle feed, milk chilling, kraft paper, wood sawing, readymade garments, furniture, etc. Rice mills are located in different areas of the district such as Thindivanam, Vikravandi, Kallakurichi, Chinnaselam, Villupuram, etc. There are also 5 rice bran oil extraction units in the district.

## Product types and production capacities

The major raw materials used in rice milling are paddy procured from open market. With existing demands in the market, generally 50% of the mills are in operation at about 30% capacity utilization. The rice yield from local paddy is about 60% as reported by rice mills in the district.

A majority of rice mills in Villupuram district are involved in producing parboiled rice. The important by-products from rice mills include (1) husk (20%), which is used in-house as fuel for boiler and (2) bran (10%), which is sold outside for further processing. There are about 90 rice mills located in different locality or industrial areas of Villupuram district. Of this, presently only about 50 mills are in operation. Majority of these mills falls under MSME as defined by the Ministry of MSME.




**Distribution of rice mills in Villupuram district**

Based on the installed capacity, the rice mills are categorized into two categories (1) Paddy processing capacity of 2 tonne per hour (tph) and (2) Paddy processing capacity of 4 tph. About 80% of rice mills in the district falls under 2 tph category and the balance 20% have an average capacity of 4 tph. A variety of rice are processed in the rice mills which include the following: *(source: http://www.indiamart.com/bmsmodern-ricemill/profile.html as assessed on 20 October 2015)*.

- Ponni raw rice
- Idli rice
- BPT rice
- Delux rice
- ADT 36
- Rajabogam delux
- Sharbati basmati rice
- Short grain white rice
- Parboiled rice
- Broken rice
- Paddy rice
- White basmati rice

### Annual estimated production of rice mills

Although there are about 90 rice mills, close to 50 rice mills are in operation but at lower capacity utilisation of about 30%. Based on this, the total annual rice production from the district is estimated to be about 76,000 tonne.

**Rice production from Villupuram district**

| Installed capacity (tph) | Number of operating units | Production tonne per year | Share (%) |
|---|---|---|---|
| 2 | 40 | 34,560 | 45 |
| 4 | 10 | 41,472 | 55 |
| | 50 | 76,032 | |

## 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 Tamil Nadu Generation and Distribution Corporation Ltd. (TANGEDCO). The average cost of grid electricity is Rs 6.65 per kWh.

## Production process

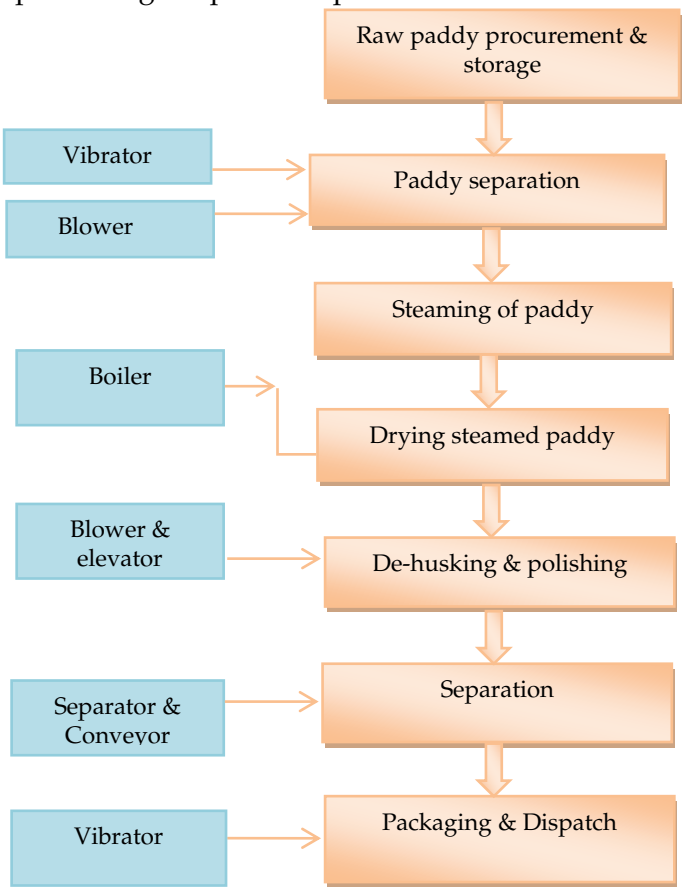
Paddy in rice mill under goes various processes and sub processes before it reaches to rice yard for bagging. The complete paddy processing to produce parboiled rice could be grouped into following major steps:

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

(2) **Steaming**: Paddy is heated using steam in two stages 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 floor 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 10% of total weight of paddy.




**Production process in rice mill**

# 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 8 kg/cm$^2$(g). The average capacity of boilers used in rice mills is 3 tonne per hour (tph). A majority of the boilers do not have any waste heat recovery system. In-house generated rice husk along with firewood is used as fuel in boiler. The rice mills do not use any instrumentation other than steam pressure to monitor the operating parameters of steam generation and distribution system. Some of the large units use steam traps to improve the quality of steam at end-use points. Boilers used by smaller rice mill units are of obsolete design and do not have any monitoring and control 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-Larger unit

Steaming bowl-Smaller unit

## (iii) Dryer

In large capacity rice mills, steam drying is practices for removal of moisture from processed paddy. The dryer comprises an indirect heat exchanger in which steam at about 8 kg/cm$^2$ (g) pressure is used to exchange heat with ambient air to generate hot air which in turn removes the moisture from steamed paddy. In small capacity rice mills, wood fired dryers are used to generate hot air. 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

Wood fired dryer

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. Steam traps are also used in large size mills to remove condensate formed in steam lines. Smaller mills do not have steam traps as well as not able to control steam quality.

### (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.

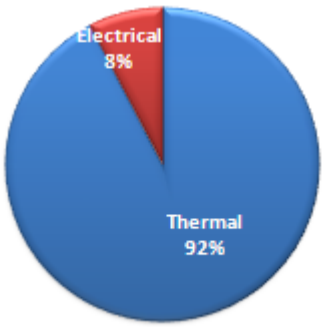
**Whitening & polishing**: De-husking produces brown rice, which comprises a brown layer called bran. The bran is removed from the brown rice in polishing area to produce white rice. Bran is a by-product rich in protein content and is used for producing rice bran oil and poultry products.


**Milling**

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

## Energy consumption

The major energy forms used by rice mills in Villupuram district include (1) electricity, (2) husk and (3) firewood. 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 in rice mills of soaking capacities 4 tph. Husk, a by-product in paddy processing is used as the fuel in boiler for generating steam and hot water. About 20% of husk is produced while processing paddy. Almost all husk produced in the mills are used for steam generation. Apart from this, the rice mills also use firewood to meet the additional requirements for thermal loads. Generally, steam at 8 kg/cm$^2$ pressure is used in par-boiling section. The average capacity of boilers used in rice mills is 3 tph. Steam is used mainly for three purposes in a rice mill:




**Energy share in a rice mill**

- Generation of hot water (around 60 $^oC$) 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

In rice mills of 2 tph capacity, dryers use mainly firewood for generation of hot air to remove the moisture from paddy.

### (i) Unit level consumption

The unit level energy consumption in a rice mill includes rice husk, firewood and electricity. Paddy steaming and dryer sections account for major thermal energy consumption in a rice mill. The 'specific energy consumption' (SEC) of rice mills is estimated to be 0.14-0.16 toe per tonne of rice. The typical energy consumption of different capacities of rice mills are shown in table.

**Energy consumption of rice mills**

| Average capacity (tph) | Thermal energy (toe) | Electricity (toe) | Total energy (toe/yr/mill) |
|---|---|---|---|
| 2 | 131 | 8 | 139 |
| 4 | 519 | 56 | 574 |

### (ii) Cluster level consumption

At district level, internally generated rice husk constitutes for about 72% of total energy requirement and 20% of thermal energy needs is met by firewood in a rice mill unit; only 8% of energy is met through electricity. The average (SEC) of rice mills in the district is about 0.15 toe per tonne of rice. The overall energy consumption of rice mills at district level is estimated to be 11,305 toe.

**Energy consumption of rice mills in Villupuram cluster (2014-15)**

| Energy type | Annual consumption | Equivalent energy (toe) | Annual energy bill (million INR) |
|---|---|---|---|
| Rice husk* | 25,344 tonne | 8,186 | - |
| Firewood | 5,640 tonne | 2,260 | 19.7 |
| Electricity | 10 million kWh | 859 | 66.4 |
| Total | | 11,305 | 86.2 |

* *In-house generation during de-husking process*

## 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 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 ºC preheating of feedwater would result in an energy saving of 1%. Considering the feedwater to boiler is preheated upto 90 ºC, through preheating in economiser and improving condensate recovery, it would lead to about 10% saving in fuel. About 50 rice mills can be benefitted with adopting waste heat recovery in boiler. The envisaged energy saving is 2304 tonnes per year of rice husk (equivalent to 744 toe), equivalent to a monetary saving of Rs 28 lakh.

### (ii) Biomass gasifiers for hot air generation in smaller units

At present, majority of the smaller rice mills in the district use firewood for generation of hot air for drying of paddy. This is an inefficient system as well as practice. Further, efficiency improvements in steam generation system would help in saving rice husk consumption for steam generation. Either the rice husk or firewood can be effectively utilised in biomass gasifier system for generating hot air. The estimated fuel saving by using biomass gasifier is 30-50%.The biomass gasifier can be retrofitted to about 40 smaller rice mill units of 2 tph capacity with an estimated energy saving potential of 900 toe.

### (iii) 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 $^{o}$C. Hot water is required in soaking of paddy in steam bowls. Further the boiler feedwater can also be fed to boiler at higher temperatures i.e. preheating of feedwater that would help in saving rice husk. The estimated energy saving potential is 421 tonne rice husk per year equivalent to 136 toe.

### (iv) Others

A significant reduction in energy losses is possible in areas such as steam distribution including insulation of steam, hot water line, boiler surfaces, steaming bowl and paddy dryer. The quality of steam generated can be improved by removing the condensate using steam traps. Further, it may be noted that the level of reuse of water from different processes in rice mills is quite low, which can be improved. On electrical side, pumping of (cold & hot) water and drives constitute important energy consuming areas have potential for energy efficiency 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 efficiently.

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

| Energy saving options for rice mills in Villupuram district |
|---|
| **Short-term** |
| 1. Insulation of steam, hot water piping and other hot surfaces |
| 2. Steam traps for removal of condensate from steam lines |
| **Medium-term** |
| 1. Economizer for preheating of feedwater |
| 2. Combustion control in boiler |
| 3. Enhanced recycling of hot water drained from steaming bowl |
| 4. Improvement of condensate and waste heat recovery from dryer |
| 5. Replacement of mild steel buckets with plastic buckets in elevator system |
| 6. Use of EE motors in different drives |
| 7. Switch to EE lighting |
| **Long-term** |
| 1. Replacement of inefficient boilers with EE boiler |
| 2. Solar water heater for preheating of water |

## Major stakeholders

The major stakeholders include district level and state level industry associations. The industry associations are generally engaged with the government on various issues related to the industry such as procurement and sale. The associations have very little experience and activities related to technology issues in rice mills. The industry associations include The Federation of Tamil Nadu Rice Mill Owners & Paddy Rice Dealers Associations (FTPDA), Tiruchirappalli, and District level Rice Mill Association, Viluppuram.

## Cluster development activities

The cluster has formed Thindivanam Rice Millers Consortium Private Limited with support from MSME-DI (Chennai). The consortium is looking forward towards energy efficiency options that would help in reducing their overall production costs.

## 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

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**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

Promoting Energy Efficiency in SMEs
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