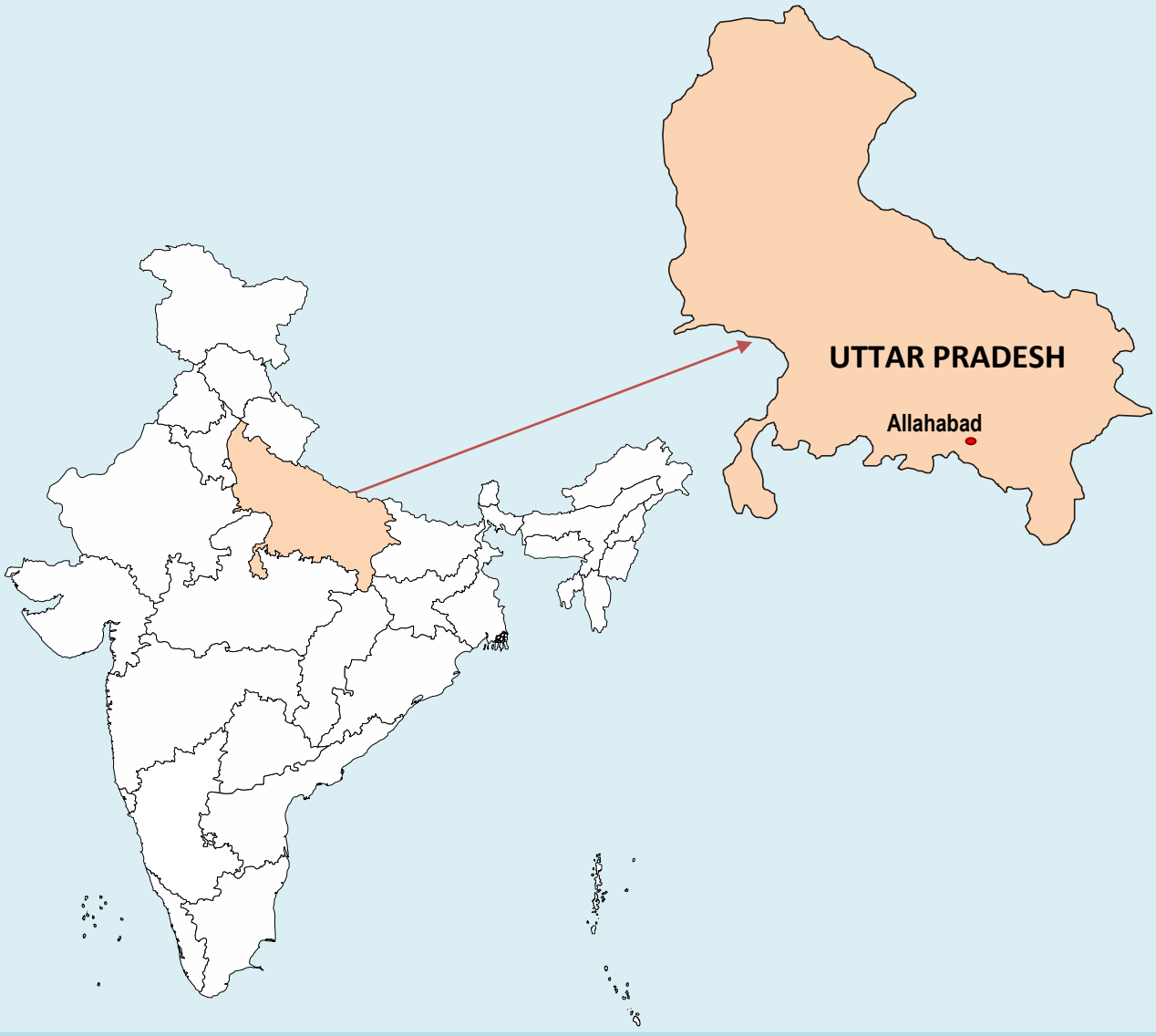
Cluster Profile
Allahabad bakeries



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Promoting Energy Efficiency in SMEs
SAMEEEKSHA

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The Energy and Resources Institute
Darbari Seth Block
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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

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

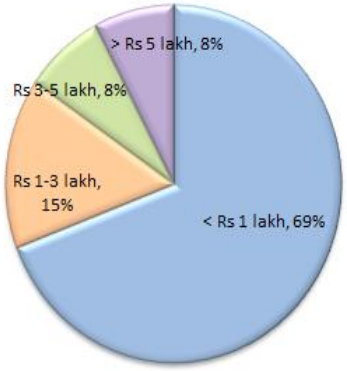
Allahabad bakeries

Overview of cluster

Allahabad also known as Prayag is located in the state of Uttar Pradesh. Allahabad is the administrative headquarters of Allahabad District. It is among the biggest centres for commercial activities in Uttar Pradesh. There are about 3000 small scale industries exist in the city. There are about 18 number of medium and large industries in and around Allahabad. The industry sector provides direct and indirect employment to thousands of people. Some of the large industries in the city are Reliance Industries, Triveni Structurals Limited, Hindustan Cables Limited, GEEP Battery.

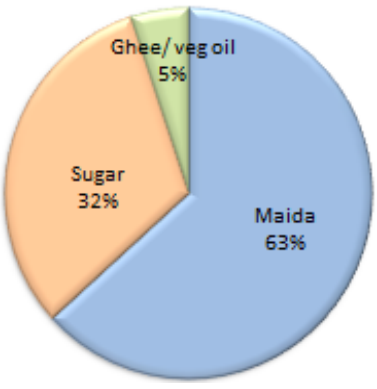
Allahabad bakery cluster in Uttar Pradesh
Source: Google Maps

Bakery is one of the industry sectors among MSMEs operating in Allahabad cluster. It is estimated that there are more about 130 bakeries operating in the cluster which are scattered across the city. The total estimated number of ovens operating in these units is about 250. These bakeries Among these, a majority of the units (about 90 units) have a turnover of less than Rs 1 lakh per month (figure). A few units are of bigger size with a turnover of over Rs 5 lakh per month. The total turnover of bakery cluster is estimated to be Rs 52 crore.

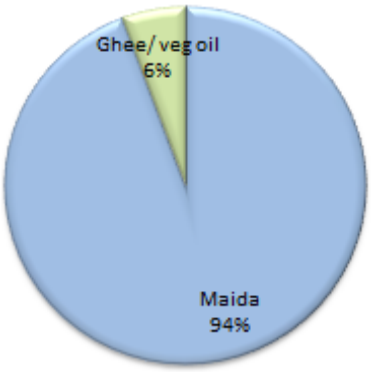


Distribution of bakeries (Turnover-wise)

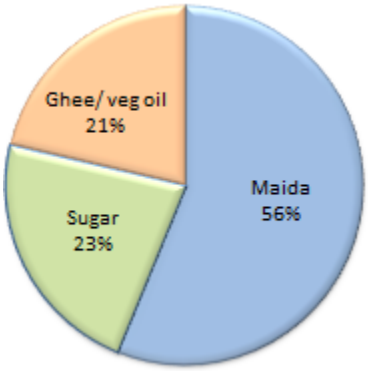
Product types and production capacities



Bun/ bread



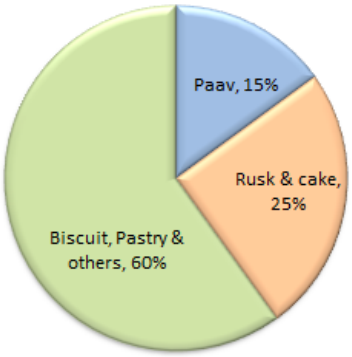
Papdi



Cream roll

Ingredients used in bakery products

Different ingredients used for preparation of bakery products include maida, sugar, ghee/ vegetable oils. The share of each ingredient depends on type of bakery product. The weight of products depends on their type e.g. bun – 240 mg, papdi – 275 gm and cream roll – 750 gm. Of these, cream roll fetches more revenue for the units. A vast majority of these bakery products caters to local market. The bakeries can be categorized based on types of products which include (1) paav, (2) rusk & cake and (3) biscuit, pastry & others. About 60% of the units are involved in producing biscuit and pastry. Other products such as bun, bread, rusk and cake contribute to about 40% of total products in the cluster (figure). The number of bakeries operating in the cluster based on type of product is provided in the table.



Product-wise distribution of bakeries

Distribution of bakeries

Type of product	Number of bakeries
Biscuit & pastry	78
Rusk & cake	32
Paav	20
Total	**130**

Energy scenario in the cluster

A large number of small sized bakeries in the cluster use wood as the fuel. Diesel is used in rotary oven based systems. Wood and diesel are mainly used in ovens for baking of Diesel is also used to run DG sets in case of power failure. The sources and prices of different energy forms used in the cluster are shown in the table.

Prices of major energy sources

Energy type	Source	Price (Rs)
Wood	Local market	5000 per tonne
Electricity	Purvanchal Vidyut Vitran Nigam Limited	7.50 per kWh
Diesel	Local market	48.65 per lit

Production process

The major steps involved in production of bakery products are mixing of ingredients, shaping & sizing, baking, curing and packing & dispatch. The generic process steps followed by the unit are briefed below:

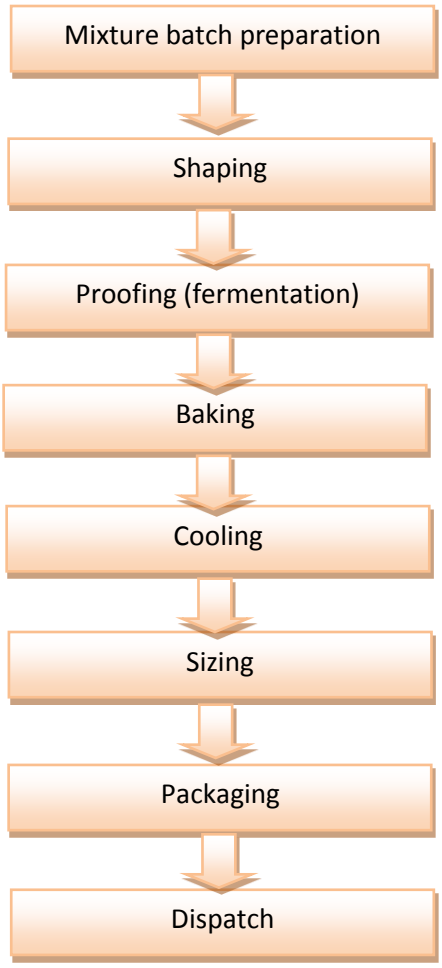
(1) **Raw material procurement and weighing**. Raw materials like sugar, flour, ghee and other ingredients are procured and weighed as per recipe requirement. Weighing is done carefully which otherwise can ruin the entire batch.

(2) **Raw materials mixing, dividing and shaping**. Different ingredients are mixed in mixer and poured into the moulds as per product shapes required. These are then cut into the various sizes.

(3) **Resting and baking**. The prepared moulds are kept for yeast action where mixer of ingredients balloons up in case of buns and breads. The fermented products are baked in ovens at different temperatures as per product type. Baking operation is done in batches.

(4) **Cooling and cutting**. Baked products are taken out and cooled naturally. Cutting of the baked products in case of buns and breads is done manually before sent for packing.

(5) **Packing and dispatch**. The final products are packed and sent for dispatch.



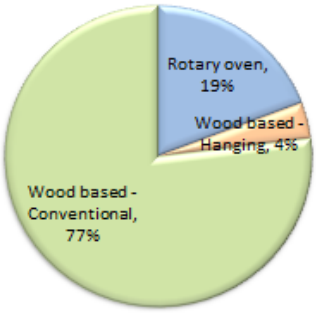
Production process

The production process for different bakery product is almost same with the main differences being differences in share of ingredients, baking temperature and baking time. Bread and buns require about 250°C with longer soaking period in the ovens. Products such as macaroons require only about 80°C. Cakes and pastries are baked at 180°C and cookies and biscuits are baked at 150°C. Depending on type of products, the mixing time can also vary. Cutting and shaping machines are also used by few units to reduce production time.

Technologies employed

(i) Baking ovens

Baking ovens are used for baking of different types of bakery products. Of the total 130 bakeries existing in the cluster, more than 80% of the units use wood fired system as shown in the figure. Few wood based units are also provided with moving hangers that help in improved quality of baked products. The rotary ovens are oil (diesel) fired and are generally equipped with better control system. High-end rotary ovens are also used by few units, which have better control system. The baking furnaces used in the cluster are shown in the figure.



Types of baking ovens

Wood fired baking oven

Diesel fired baking oven

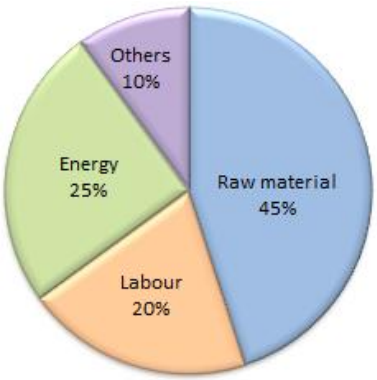
(ii) Mixers

Mixers are used for preparing homogenous mixture of raw materials or ingredients. Water, generally at room temperatures is added along with basic ingredients for preparing recipe which are product dependent. The mixing machines are conventional machines and require manual interventions for preparation of recipe. The mixers generally have 3-speed arrangement. The motors used in mixers are low capacity of 2 to 3 hp to handle low volume batch recipes. These are conventional machines with simple on-off control system. Some mixers come with timer settings.

Conventional mixer

Energy consumption

A major share of energy is consumed in baking furnace. Mixing of ingredients requires electricity. Other activities such as shaping, sizing, etc. consume less energy but are labour intensive. Wood fired furnaces are conventional furnaces and are large in number. Rotary ovens use diesel. Energy consumption forms about 25% of total production costs and raw materials account for about 45% of the costs as shown in the figure.



Typical production costs

(i) Unit level consumption

Wood and diesel are used in baking furnaces. The use of electricity is minimal in case of wood fired, mainly for mixing and lighting purposes and all other activities are carried out manually. The typical energy consumption of different types of bakery units varies from 16.5-23.1 toe per year as shown in the table.

Typical energy consumption of bakery units

Type of unit	Wood (kg/day)	Diesel - Ovens (lit/day)	Diesel – DG sets (lit/day)	Electricity (kWh/day)	Energy consumption (toe/unit/year)
Wood fired furnaces	250	–	–	4	22.6
Rotary ovens	–	50	5	32	16.5
Rotary ovens (High end)	–	15	18	530	23.1

(ii) Cluster level consumption

The total energy consumption of Allahabad bakery cluster is estimated to be 6,179 toe. Wood accounts for about 74% of total energy consumption in the bakery cluster. The breakup of energy consumption in the cluster is shown in the table.

Energy consumption* of the Belgaum foundry cluster (2014-15)

Energy type	Annual consumption	Equivalent energy (toe)	Annual energy bill (million INR)
Electricity	1.335 million kWh	115	22.5
Wood	18,750 tonne	5,625	93.8
Diesel	462 kilo litre	439	10.0
Total		**6,179**	**126.2**

* *Castings produced by induction route is 90%*

Energy saving opportunities and potential

Some of the major energy-saving opportunities in Belgaum foundry units are discussed below.

(i) Energy efficient burners for ovens

Presently diesel fired ovens have monoblock burners with attached blowers. These burners need proper tuning; further these burners have limitation of reduction in temperature when diesel is off as blower is kept running. This would lead to lower of temperature insdie the oven, which increases the overall operating time of the burner thereby increasing the specific energy consumption. Hence it is recommended to use energy efficient recuperative type burners which consume less fuel.

(ii) Insulation for ovens

Rotary ovens are generally provided with ceramic insulation and refractory bricks are used in case of wood fired ovens. It is recommended to use hot face insulation to reduce surface losses. This would include ceramic fibre/ plates, insulating bricks, as required. The outside surface temperautre may be maintained close to a maximum of 20 ^{o}C above ambient temperature. This will also reduce heat losses and improve workplace environment.

(iii) Thyristor control for electrical ovens

Electrical ovens used are of resistance heating type. Normally on-off controls are used to control heating cycle. Due to continuous switching, life of heating coil reduces due to thermal shocks and frequent failure occurs. Thyristor control can be used instead of on-off control, which can give around 7-15% energy savings and can increase coil life due to smooth switching with the precise temperature control.

(iv) Direct coupled mixers

Presently the mixers are driven using pulley and belt arrangement. It is preferable to have direct shaft arrangement that would help in reducing transmission losses. This arrangement can also be equipped with autoamatic ‘variable speed drives’ (VSDs) which would further energy efficiency of mixers.

Mixers

(v) Reduction of deadweight of baking racks

The products are baked by keeping them on fixtures with multiple shelfs which are fabricated locally using mild steel angles and plates. The MS rack accounts for around 90% of total weight of trolley structure. Both the products and fixtures are heated inside the oven upto about 180 ^{o}C. Since batch operation is followed, the fixutre (which provides only support to the product) is subjected to alternate heating and cooling. The weight of fixture can be reduced by introducing SS mesh trays to replace existing support plates which are kept in the middle. A potential weight redution to the extent of 20% is feasible without affecting performance. This would enhance the product to fixture ratio and hence would lead to reduction in fuel consumption. The potential energy saving with this arrangement is around 5-10%.

Baking racks

(vi) Switch over from wood based ovens to rotary ovens

Wood based oven are inefficient and polluting. The productivity is low with wood based ovens and it would be diffciult to produce value added/ premium bakery products to meet niche market. It is recommended to swtich over to energy efficient systems such as rotary ovens which will have the following benefits. The approximate investment requirements for a rotary voen is about Rs 4 lakh.

- Increased production level of about 150%
- Enhanced product portfolio
- Improved product quality
- Reduced energy costs
- Lower emissions and improved work place environment

(vii) Adoption of biomass gasification in wood based ovens

The efficiency of wood firing in wood based ovens is very low resulting in higher wood consumption and generation of higher GHG emissions. The wood can be better utilized through a gasification system instead of direct burning. The biomass gasification has following attributes.

Biomass gasifier

- Wood is converted to producer gas, a clean form of fuel
- Easy to monitor and control operating parameters
- Higher efficiency of the system
- Less emission and better work place environment
- Improved product quality and higher productivity
- Potential wood saving upto 50%
- Tailor made customization of gasification system is possible.

(viii) Replacement of rewound motors with energy efficient motors

The bakery units use rewounded motors quite exensively. Rewinding leads to drop in efficiency by about 3-5%. It is recommended to repalce all old motors which have undergone rewinding two times or more with EE motors (IE3 efficiency class). This would result in an energy saving of 3-7% result in saving in energy costs. The payback period for EE morots varies from 1.5 to 3 years.

(ix) Use of cogged v-belts

The driving motors are generally coupled with flat V-belts. The transmission efficiency of flat V-belt is around 90–92%. It is recommended to use cogged V-belt instead of flat V-belt. The transmission efficiency of cogged V-belt is 3–5% higher than flat belt.

Cogged V-belts use a trapezoidal cross section to create a wedging action on the pulleys to increase friction and the power transfer capability of belts. V-belt drives can have a peak efficiency of 95-98%. They play a very dynamic role in allowing for heat dissipation and better contact with the pulley. There are several other potential benefits of using cog belts which include (i) less slippage at high torque, (ii) low maintenance and re-tensioning and (iii) suitable for wet or oily environments.

Cogged v-belt

(x) Solar energy for electricity and hot water

Generally, the bakery units have large area of roof tops which can be used to tap solar enregy. The solar energy can be utilized to replace existing coventional water heating arrangement and/or to meet part of electrical loads such as lighting and lower range. Customised soultions can be developed for unit specific applications.

Natural ventilation

(xi) Use of natural ventilation

The bakeries normally are not equipped with chimney arrangements to disburse emissions from kilns. This leads to localised emissions and poor workplace envirnoment. This can be improved by providing roof top natural ventillation system. This does not incur any energy costs for its operaton.

(xii) Product branding

The bakeries cater to local demands and their product portfolios are restricted to local demands which are mostly low end products. The local industry associations should target to develop branded products apart from local demans with the help of appropriate government bodies and availing financial schemes. This would increase the market share and sustainability of the local bakery industry.

Major stakeholders

The major stakeholders in the clusters include (1) Naini Industries Association wherein the bakeries are members, (2) MSME-Development Institute (Allahabad) and (3) District Industries Centre.

Cluster development activities

There is very little cluster level development activities in Allahabad with regard to bakeries.

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