CLUSTER PROFILE
PUNJAB DAIRY INDUSTRIES

Submitted to

UNIDO

CONTENTS

Punjab dairy cluster

Cluster background

The dairy sector in Punjab is working on "Anand Model" or the Gujarat cooperative dairy model for its development. There are 21 large dairy processing plants in the state. The state accounts for nearly 10% of the total milk production of the country and ranks fourth among other states in total milk production. "Verka" is a popular brand of Punjab State Cooperative Milk Producers' Federation Limited and has retail outlets across the state and beyond.

Cluster size and turnover

Punjab has about 11 cooperative milk processing plants. There is a strong network of about 6,432 milk producers cooperative societies organized at village level. About 365,000 milk producers are attached to these societies. Fresh milk is procured from the milk producers twice a day through village level societies directly without the assistance of any middleman. The average daily milk production in the state was 25.4 million litres in 2008-09. For preserving the milk during transportation, the milk is cooled/chilled before transportation. More than 1000 Automotive Milk Collection Stations are deployed in the societies for efficiency and transparency in milk procurement.

Apart from milk, the other dairy products like infant milk food, instant milk mix, skim milk powder, ice-cream, paneer, sweetened condensed milk, dairy whitener and butter are also produced. Apart from cooperative societies, there are about four joint sector and 46 private sector dairy plants is in Punjab. These plants are not associated with the cooperative society and hence buy milk directly from local producers. However, most of the private players are very small except Nestle India Ltd. The turnover of the dairy sector in Punjab is estimated to be about Rs 20,000 crores. The sector provides direct and indirect employment for to more than 6,50,000 people.

Industry associations

The Punjab State Cooperative Milk Producers' Federation Limited popularly known as MILKFED Punjab, came into existence in 1973 with a twin objective of providing remunerative milk market to the milk producers in the state by value addition and marketing of produce on one hand and to provide technical inputs to the milk producers for enhancement of milk production on the other hand. The setup of the organisation is a three tier system, Milk Producers Cooperative Societies at the village level, Milk Unions at District level and Federation as an Apex Body at state level. The other major industry associations are the following:

- Indian Dairy Association – North Zone
- Progressive Dairy Farmers Association, Punjab

Technology status and energy use

The raw milk collected in the chilling centres and cooled to below 10 ^{o}C before transporting to the dairies for further processing. Refrigeration and steam generator (boiler) account for more than 75 % of the total energy cost in a dairy. Most steam generators and refrigeration plants in operation are energy inefficient. The electricity availability in the urban and sub-urban areas of the Punjab are about 20 – 23 hours whereas rural areas are below 18 hours per day. Hence, most of the dairies have captive power generation plants. The captive plants meet about 20% (average) of the total electrical load of the industry.

The steam generators, which meet the steam and hot water requirements for pasteurization and cleaning, are usually single pass. The refrigeration plants are ammonia based and have ice built tank (IBT) to take care of fluctuations in cooling demand. The quantity of the fuels consumed by the dairy industry per annum and their energy equivalent in Giga joules/year (GJ/year) are given in table below. The total amount of energy consumed in the cluster is estimated to be 112,155 toe/yr.

Energy consumption in Punjab dairy cluster

Energy form	Consumption per year	Total energy consumed (toe/yr)	Share [%]
Electricity	435 million kWh	29,942	27
Furnace Oil	62.56 million litres	53,180	47
HSD	29 million litres	29,033	26
		112,155	100

Energy and environmental performance

The large cooperative milk processing plants are designed to process chilled milk whereas the small and private sector plants are processing milk from the raw milk temperature. Preliminary audits reveal the specific energy consumption in the Punjab dairies varies in the range of 0.44 to 0. 57 GJ/tonne milk (0.011-0.014 toe/tonne). The performance of the overall cluster, in terms of specific energy consumption (SEC) and the emission intensity (EI), is given in table below.

Performance of Punjab dairy cluster

Total energy consumption	112,155 toe/yr
Specific energy consumption (average)	0.012 toe/tonne
Total CO_2 generation	0.54 million tonne
Emission intensity	0.06 t CO_2/ t product

Options to enhance energy efficiency

The units under the cooperative societies are operating at higher specific energy consumption level whereas the private dairies like Nestle and Supreme Agro food are using state-of-the- art technology. The major energy saving and renewable energy options in the cluster are described below.

(i) Use of solar water heater for pre-heating of process water

A huge amount of hot water is required for milk pasteurization and cleaning in a dairy unit. Preheating the process water using solar water heating system will reduce the furnace oil consumption in the boilers. It is estimated that the use of solar hot water based system could reduce the overall thermal energy consumption by at least 10 - 12% in the dairy industries.

(ii) Improving the energy efficiency of the boiler and steam distribution system

In Punjab dairies, most of the boilers are using are of inefficient design and usually single pass type. The flue gas temperature is usually quite high (in range of 250-300 ^{o}C). In addition, the steam and hot water lines, joint and flanges are not properly insulated which leads to a significant heat loss in steam distribution system.

The heat lost in flue gases can recovered to enhance the efficiency of the boilers by installing air pre heater and/or economizer. In addition, proper insulation of the steam distribution network would reduce the line heat losses. These modifications will lead to reduction in fossil fuel consumption by approximately 10 %.

(iii) Installing desuperheater in ammonia refrigeration system

Adiabatic compression in ammonia compressors results in high discharge gas temperatures (120^{o}C and above) at compressor outlet. The gas is then cooled and condensed in a condenser and stored in a receiver at 12 to 16 kg/cm^2 pressure and atmospheric temperature. The condensing temperatures, vary between 30 ^{0}C to 40 ^{0}C.

It is possible to install a desuperheater in the ammonia circuit (in between the compressor discharge and condenser). The heat removed in desuperheater can heat the circulating water up to 55 ^{0}C – 70 ^{0}C. This water could be available free of cost for various requirements in the dairy. It is estimated that addition of the desuperheater will reduce the energy consumption in the boiler by at least 5%.

(iv) Optimization of electrical motors and drive system

Electrical energy accounts for approximate 50% of the total energy consumption in the dairy industry. The major electrical consumption centres are the following:

- Milk powder plant hot air fan
- Ammonia compressor and its auxiliaries
- Water circulation pumps (hot & cold)
- Milk transfer pumps and
- Condenser water pumps

Most of the electrical motors used are old, oversized and rewound. Each rewinding results in decrease of operational efficiency by 3 – 5%. In small processing units, the loading of the motors were observed to be less than the recommended level (20 – 30% only). The drive system can be also be optimized by application of adequate control mechanism like variable speed drives, variable voltage drives and soft starter mechanism. It is estimated that energy saving upto 10 - 15% is possible on the electrical energy consumption of a milk processing unit by optimising the electric motor and drive system.

(v) Installation of new insulated shell type IBT

Refrigeration accounts for nearly 64% of the total electrical energy consumption in a dairy unit. All the dairies units in Punjab are having ammonia based refrigeration and ice built tank (IBT). The basic function of IBT is to stabilize the temperature requirement of the chilled water during fluctuating cooling demand. Most of the units have concrete ice built tanks with wooden covers. The heat loss in these IBT structures is in the range of 18 – 30%. Well installed metallic insulated shell type ice built tank can reduce the heat loss to only 3 – 5%. It is possible to save approximate 5% of energy consumption of the refrigeration plant by adoption of new insulated shell type IBTs.

(vi) Other energy saving options

Additional energy saving of about 7 - 10% is possible by adoption of other energy conservation measures such as the following:

- Installation of digester at ETP to produce gas for heating application.
- Waste heat recovery from flue gases of diesel generators
- Use the poly-V belt cogged type

Table below summaries the total energy saving and CO_2 reduction potential in the cluster.

Energy saving and CO_2 reduction potential

Total energy saving potential	23,168 toe/yr
Total CO_2 reduction potential	0.09 million tonne

References

- Discussions of TERI team with MILKFED, Nestle & other dairies.
- Visits of TERI team in the cluster (Feb 2010)
- http://Punjab.gov.nic
- Department of Animal Husbandry, Punjab
- Dairy scenario in Punjab, Punjab Agricultural University
- Private sector initiative in dairy development in India: case study of Nestlé India in Punjab Region of India