Partnership for sustainable water management practices in Indian Dairy Industry

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Abstract

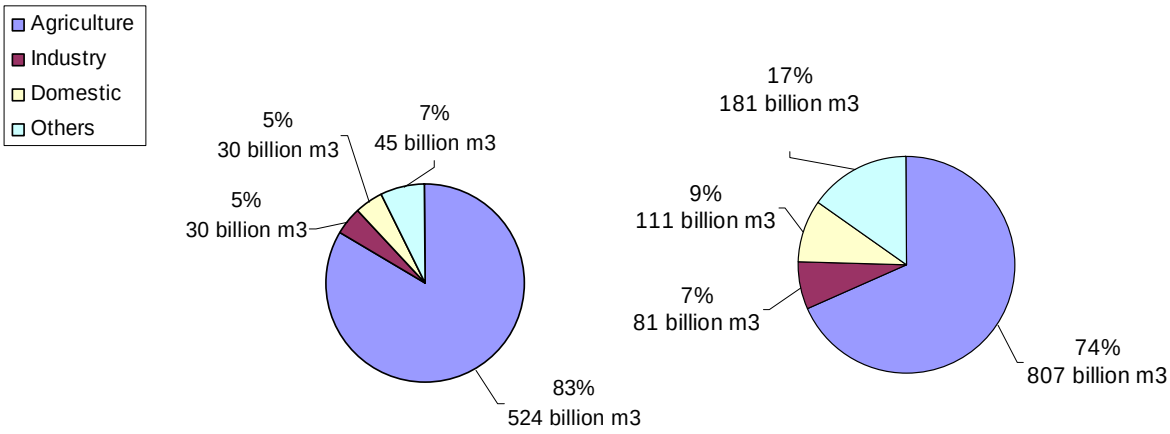
In India, growing number of water intensive industries are adding to the increasing water demand and further widening the demand supply gap. In addition to mounting pressure on the already sparse supply, inadequate treatment of the effluent being generated from these industries, is leading to the deterioration in the quality of surface and ground water resources thus affecting human health and aquatic life. Several efforts are underway by various government agencies, research institutions, non governmental organizations and private consultants, to tackle the problem of wastewater treatment. However, measures towards minimizing water demand and promoting recycling and reuse of treated water have been limited. This approach requires an integrated effort of the entire consortium of technical experts/organizations, government agencies/policy makers and the industries themselves. The initiatives of the industries are particularly important for the sustainability and replication of the developed practices/approach.

This paper highlights the experience of the authors in development of a partnership with a state government affiliated dairy industry managed by students of dairy technology. The findings are part of an ongoing project sponsored by the European Commission on partnerships for promotion of industrial water efficiency in the textile and food processing industries. As part of this partnership, a comprehensive water management study of the state government affiliated dairy unit was undertaken and possible long, medium and short term solutions were evolved. The role of the industry, particularly the students in multiplying the learnings to the entire dairy sector thereby leading to greater impact will be discussed.

Introduction

In India, annual precipitation including snowmelt is 4000 billion cubic meter of which utilizable water is only 1122 billion cubic meter whereas the projected water demand in 2050 is 1180 billion cubic meter. Although currently, agriculture dominates water use with a consumption of 524 billion cubic meter, water consumption in the industrial sector is increasing and is expected to rise from 30 billion cubic meter to 81 billion cubic meter by 2050 (Figure 1). In addition to the growing demand on the water resources, the industries play a major role in affecting the quality of water. As per the Central Pollution Control Board, effluent from the industries has to be treated to the prescribed standards before disposal in the aquatic bodies or land.

Figure 1: Water use by sectors in 2005 and 2050



Textile and food processing industries are two highly water intensive industries in India. The effluent generated from these industries also has high pollutant levels, thus disposal without proper treatment has several harmful effects on both aquatic and human life. The project INDUS- Partnerships for promotion of industrial water efficiency was conceptualized to address the growing water demand in these two industrial sectors through the combined efforts of the European institutions, TERI and the industrial units. The objective of the project was to create awareness on the environmental benefits of water conservation and reuse and assist the industries in developing strategies to achieve this. The partnership was formed with a view to support the industries in adopting the appropriate measures including tools technologies, and best practices. Subsequently, the approach can be applied to other industrial sectors in India as well as in other parts of Asia, thereby multiplying the project learnings.

Dairy industry in India

India is the second largest milk producing country with a production of about 78 million tons during 1999-2000 (http://www.mofpi.nic.in/industryspecificinformation/milk/milk.htm). The production of milk products such as infant milk food, malted food, condensed milk & cheese was 0.307 million tonnes during the same year. Production of lactose, casein and improved cheese varieties has also commenced in a few plants. The growth of milk processing industry in India can be attributed to "Operation Flood" programme which started in the early seventies and has led to trebling of India's annual milk production in the last 30 years (CPCB, 1993; http://www.indiadairy.com/ind_operationflood.html). This rapid growth and modernization is due to the contribution of dairy co-operatives that were created by NDDB (National Dairy Development Board) under this programme. These co-operatives helped the farmers reach the consumers in towns and cities. The dairies in urban areas received milk and powder and fat from rural dairies called milk sheds, resulting in properly organized production and marketing of milk and milk products.

Each Indian state has a state dairy federation as well as several dairy cooperatives or district cooperative unions who are engaged in milk production, procurement, processing and marketing.

Methodology of partnership formation

The partnership between TERI and the European institutions was formed during the proposal formulation based on the expertise of each of the partner on the proposed activities of the project. TERI has the necessary proficiency in directing, co-ordinating, planning and implementing projects in various industrial sectors. Further, TERI also has in-house technical expertise in water and wastewater treatment. The UPT, Germany has experience in co-ordination of research projects in different industries; The QUESTOR Centre ATU, in UK works closely with local SME's, offering an extensive consultancy service, particularly in the areas of water and wastewater treatment, waste minimization and energy efficiency. The Centre also has experience of providing seminars and training courses

targeted at industry and has worked extensively with the food and textiles industries in the United Kingdom and the Republic of Ireland.

The major activities of the project included
- Needs assessment of the units in terms of water use, awareness level, training and scope for improvement over the existing status;
- Test unit analysis
- Organization of training programmes for the target industries

Identification of various units in the dairy sector was initiated through communication with private dairies, institutions such as National Dairy Development Board and various state dairy federations. This resulted in development of a database containing the details of various plants such as capacity, type of products, water usage patterns, wastewater generation and reuse. The interest and need of the units in improving the water use efficiency was assessed along with other factors such as sustainability of the initiatives and replication potential.

For the identification of the unit for carrying out the analysis, some of the factors, which were considered, are:
- Size
- Product profile
- Existing water use and wastewater treatment status
- Desire to improve
- Openness in disclosing data
- Location

4 units were shortlisted and their details including the motivation and constraints are listed in Table 1.

Table 1: Description of various dairy units

Products	Milk processed/day	Existing status	Remarks
Ghee, milk powder	300,000	Condensate water reused, aerated lagoon	Less range of products. Open to new initiatives
Ghee, milk powder, Casein, Yoghurt, Liquid milk	700,000	Condensate water reused, UASB treatment	Good variety of products, scope for wastewater reuse. No irrigation option. May not disclose data related to treatment
Liquid milk, butter, milk powder, ghee	200,000	RO under planning phase, no recovery, irrigation	Federation. Variety of products. Scope for improvement and implementation
Liquid milk, cheese, butter/ghee, ice cream	200,000	Installation of water meters, recovery of whey, irrigation	Federation, student dairy. Open to initiatives. Sustainability ensured

It was observed that private units were more reluctant to divulge information relating to their detailed operation; further they were also concerned about sharing the details of the analysis with other units and the pollution control board authorities. This reluctance to disseminate the analysis in various forums was perceived as a significant constraint to the replication of the project learnings. Yet another observation was these units were primarily interested in profits and were less responsive to the environmental benefits aspects. As it is difficult to project the cost associated with the environmental

benefits, it was not easy to convince the unit management to adopt various measures for achieving water efficiency. Thus units under the state federations were shortlisted for creating the partnership. Of the 2 government run units, one unit was managed by students of dairy technology. As part of their degree course, it is mandatory for the students to complete one year practical training at the plant. This system ensured sustainability of any adopted measures due to the institution's interest in new initiatives and learnings and commitment towards conservation of resources and environment rather than the direct economic benefits alone. The replication potential associated with this partnership was enormous, as the learnings will be carried forward by each of the student to various dairies, which the students will join on completion of the course.

Outcomes of the analysis of the selected test unit

The test unit which is one of the four shortlisted units is located in the state of Gujarat, which has the capacity to handle 100 KL of milk per day for producing 1000 kg of ghee (butter oil), 2000 liters of ice cream, 650 kg of paneer (Indian cheese) and 1200 kg of cheese per day. The dairy uses 56% of its capacity. It combines indigenous and imported milk processing methods to manufacture a range of milk products such as ghee, ice cream, paneer and various European cheeses such as Cheddar, Mozzarella, Emmental etc. The plant is also designed for semi-automatic operation for milk reception, processing and standardization, and is cleaned by a cleaning in place (CIP) unit.

The test unit analysis included the development of complete water and energy balance of the plant along with the wastewater characteristics. The key indicators to identify the various points of losses and inefficient water use were generated. Based on the scope for improvement in various operations, possible measures were suggested. These were categorized as:

- Organizational measures such as alarm systems for prevention of leakages, identification of dedicated person responsible for environment and monitoring water consumption and quality, training of the staff
- Optimizing existing plants and incorporation of better techniques for improving the quality of water, consumption of water in washing units and for treatment, recycle and reuse.

The suggestions were based on the interactions between the European experts, TERI and the industrial unit through exchange of data and information and visits to the plant. In addition to data collection, a team spirit was inculcated in the units so as to get the cooperation from the staff of the plant and to create the interest in the unit to adopt various measures. It was observed that in the process of data collection, the staff got a better understanding of their current status and the scope for improvement. It also led to increased motivation amongst the staff and active participation during the discussions.
During the analysis, the problem and the needs of the unit were discussed and the constraints in implementation were also analyzed. This resulted in development of action plan for low, moderate and high investment measures thereby assisting the unit to generate an immediate activity schedule for implementation. (Table 2)

Table 2: Action plan of the test unit

Low investment

S. No.	Action	Responsible person	Priority	Budget
1.	Sealing off leakages	A	High	5000
2.	Replacement of worn sealings	B	High	10000
3.	Insulation of tanks			
4.	Optimisation of regeneration intervals in the ion exchanger	C	High	10000
5.	Grey water pipes to use cooling tower bleed, boiler blow down treated effluent		Low	
6.	Optimisation of the rinsing for the crates	D	Medium	5000
7.	Optimisation of CIP unit	D	Medium	Nil
8.	Optimisation of ion exchanger via conductivity measurement	C	Low	250000

Moderate Investment

S. No.	Action	Responsible person	Priority	Budget
1.	Removal of iron and manganese in the Borewell water		Low	
2.	Feeding the cooling water in to a stratified storage tank; using water for rinsing purposes		Low	
3.	Purchasing a new crate washing machine	B	Medium	550000
4.	Use of Rainwater	D	Medium	50000

High Investment

S. no.	Action	Responsible person	Priority	Budget
1.	Using submerged membranes for optimizing the ETP; Germ Free		Low	
2.	Installation of an anaerobic treatment stage for whey	C	Medium	700000

Initiatives for dissemination and replication

The analysis of the test unit was presented to the larger group consisting of personnel from various dairy industries, regulatory bodies and research institutions in a training programme. This resulted in creating awareness and in dissemination of the findings to other dairies. This allowed the units to compare their problems with the test unit and helped them in identifying suitable options based on suggestions made for the test unit. The interest could be ascertained from the requests received from other dairy units for conducting similar analysis at their plant. Other measures for multiplying the learnings include organization of discussion forums with the cluster of industries at the regional level. This will facilitate closer interactions with the interested industries to initiate similar efforts that would lead to water use efficiency.

It is felt that the reluctance of the private units can be overcome by developing trust that any information, which can affect the unit, will not be divulged at our discretion. These units however appreciate the benefits of being test unit and participated enthusiastically in the workshop and are also interested in follow up meetings which is going to be organized for a small group of the dairy units where unit specific problems can be addressed. Various follow up meetings and visits are being planned with the private units and the units are also approaching us for specific solutions. Although there are no specific norms applicable to the private units for making it environment friendly, there are minimal national standards developed by the pollution control board for the discharge of treated effluent. In addition, the Ministry of Non conventional Energy Sources provides financial support for effluent treatment plants resulting in energy generation.

The other shortlisted units are expected to participate in the follow up meetings and it is too early to comment on the actions of the units and on the replication. However the test unit is planning to use the outcomes of the analysis and other learnings in their courses, which will also be included in the manual and case studies which will be used for wider dissemination and for exposing the students of the test unit to the various aspects of industrial water efficiency.