Water use in dairying

National Dairy Development Board

Water use in dairy industry

- Water is an essential resource in the dairy industry, playing a vital role throughout the milk supply chain.

- Understanding its uses can help optimize operations, promote sustainability, and reduce overall water usage in milk production and processing.

- **Water use in milk production:** crop production, drinking and servicing of animals.

- **Water use in milk processing:** cleaning of equipment, storage tanks and pipelines, sanitization, and pasteurization.

Freshwater status

- India is among top ten countries with the highest share in global groundwater withdrawal (United Nations, 2022).
- About **59%** of total groundwater recharge (241 of 449 billion cubic meter) is extracted in India (Ministry of Jal Shakti, 2023).
- More than **60%** of irrigated agriculture and **85%** of drinking water supplies are dependent on groundwater.
- Rainfall (average 119 cm/year) is the main source of groundwater recharge (about 60%) in India.

Freshwater status *(contd…)*

- India's groundwater resources are under significant stress due to over-extraction, particularly for **agricultural irrigation**, which constitutes about **89%** of the total annual groundwater extraction. The remainder is attributed to municipality (8%), industry (2%) and others (1%).

- As per estimates, about **70%** of total agricultural water use is for **crop production** and **30%** is for **livestock**.

- **Over-exploited regions:** North-Western (Punjab, Haryana, Delhi, West UP), Western (Rajasthan, Gujarat) and Southern (Karnataka, Tamil Nadu, Telangana, Andhra Pradesh).

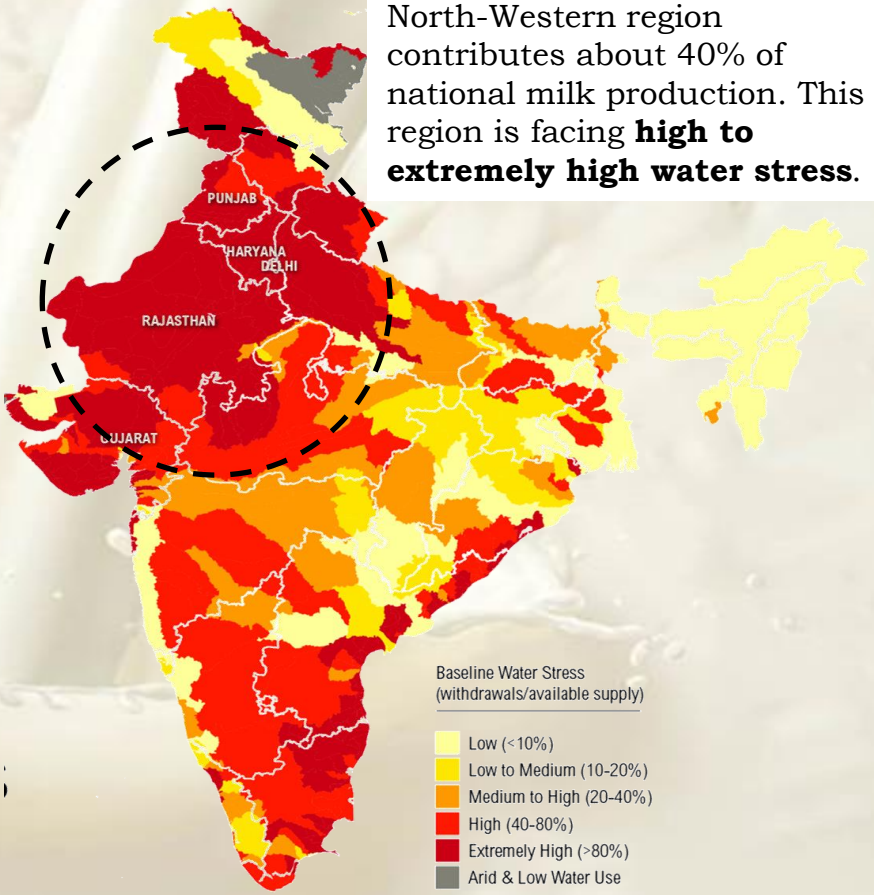
Key challenges

- **Population growth:** increased water demand.
- **Climate change:** changes in rainfall pattern, increased frequency of heat waves, droughts, floods, tropical cyclones, etc.
- **Over-extraction:** subsidised electricity, excessive pumping/ flood irrigation in agriculture, indiscriminate use in industry, etc.
- **Pollution:** contamination from industrial discharge, agricultural runoff, and untreated sewage.
- **Water scarcity:** declining groundwater table leading to water shortage.
- **Ecosystem damage:** drying up of rivers, wetlands and lakes connected to aquifers.
- **Economic stress:** increased cost of water extraction and treatment.

Water use in dairying

- Water footprint (WF) of **milk production** in **India** is about **1078 Lit./kg**, against global average of 1020 Lit./kg (Hoekstra, 2012; Mekonnen & Hoekstra, 2012).
- WF of milk in China: 1282, Netherlands: 528 and USA: 796 Lit./kg
- WF of **milk processing**: 0.6 to 1.0 Lit./kg.
- Out of total consumptive water use for milk production, about **90-95%** is used for **feed and fodder production** and remaining is for cleaning and drinking of animals.
- About **65%** of freshwater use for milk production is from **blue water** resources (surface and ground water) and **35%** is **green water** (rain water).

North-Western region contributes about 40% of national milk production. This region is facing **high to extremely high water stress**.



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Strategies to optimise water use in dairy value chain

1) <u>Feed and Fodder Production</u>:

- Adjustment of crop planting time as per weather changes.
- Adoption of drip and sprinkler irrigation, over flood irrigation.
- Precision land levelling (15-30% water saving, 4-6% higher yield).
- Use of high biomass yielding fodder crop verities (certified seeds have 30% higher yield per unit of land than local seeds)
- Round the year fodder production
- Conservation of green fodder and propagation of less water intensive crops for semi-arid regions (e.g. Thornless Cactus).
- Sustainable use of groundwater through solar energy

Strategies to optimise water use in dairy value chain *(contd…)*

2) <u>Milk Production (Farm Management)</u>:

- Improving water use efficiency through scientific feeding (Ration Balancing, Total Mixed Ration, etc.).
- Using seasonally available low WF feeds in animal ration.
- Value addition of crop residues for feeding dairy animals.
- Cycling cow cooling system (on-off) in coordination with fan.
- Using scraper for dung cleaning (before washing).
- Using high pressure, low-water flow/ water jet cleaning system.
- Reusing/ recycling wastewater for flushing of farms
- Rain water harvesting

Strategies to optimise water use in dairy value chain *(contd…)*

3) <u>Milk Processing</u>:

- Using water efficient cleaning system (e.g. CIP), advanced pasteurisation and cooling system that recycle water.
- **Effluent management:** ETP plants – recycling and reusing wastewater
- **Process optimisation:** dry cleaning before wet cleaning, minimise water use during cleaning cycles.
- Installing **rain water harvesting** system
- **Circular economy –** integrate by-products (whey & wastewater) into biogas/fertiliser production to reduce indirect water footprint.
- **Training and awareness** of staff on water conservation practices, regular maintenance and leakage prevention.

NDDB's Initiatives to Improve Water Use Efficiency in Dairy Value Chain

Crop Production

Farm Management

Milk Processing

(A) Crop Production

1) Manure Management Initiative

- Small capacity biogas plants installed in backyards of dairy farms to produce renewable energy (biogas) and organic fertilisers.
- In addition to additional income, production of clean energy and organic manure, such initiative also improves water holding capacity, soil productivity and fertility.
- Slurry application also help reduce freshwater use for crop irrigation.

(A) Crop Production *(contd…)*

2) Solar energy for irrigation

- A pilot - 11 farmers have installed solar panels for sustainable use of groundwater for irrigation. Surplus electricity is transported to the grid through **'Solar Pump Irrigators' Cooperative Enterprise (SPICE)'**.

- Help generate additional income, avoid groundwater exploitation, generate renewable energy, reduce agricultural subsidy burden, reduce freshwater usage and CO_2 emissions.

(B) Farm Management

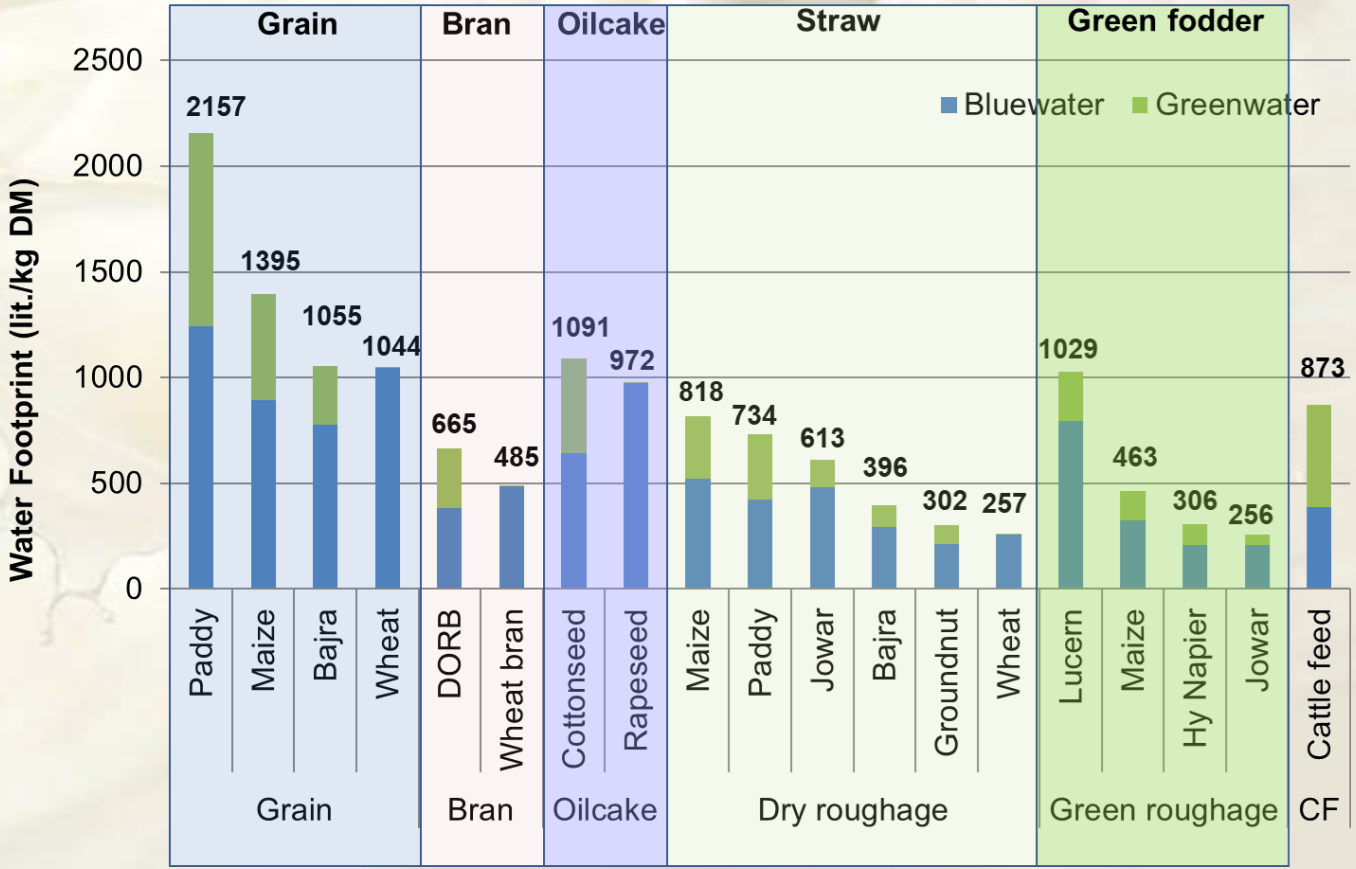
1) Fodder production & conservation

- Fodder seed production through dairy coops.
  - **NDP-I:** produced 14,000 MT quality fodder seed, distributed 31,000 MT fodder seeds (2012-19).
  - **NLM:** produced 14,000 MT certified seeds (2021-24).
- **Fodder Plus FPO:** Promotion of 100 FPOs for sustainable fodder production and to address fodder deficit.
- Training and demonstration to about 5000 farmers/year for round the year fodder production and conservation.
- Propagation of less water intensive crops for semi-arid regions (Thornless Cactus).
- **Crop residue management:** Promotion of farm equipment.

(B) Farm Management *(contd…)*

- **Crop residues & their byproducts** have lower water footprint than grains.
- Therefore, **crop-residue based feeding system** contributes to lower water footprint of milk.

Water Footprint of Feed Ingredients



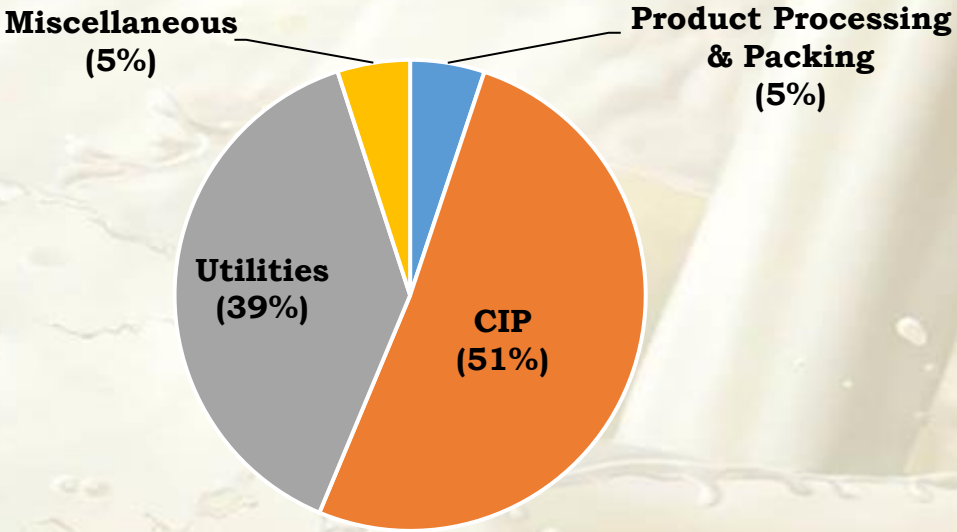
(B) Farm Management *(contd…)*

2) Scientific Feeding Practices

- ***Ration Balancing Programme:***
  - Educated farmers on scientific feeding by providing doorstep advisory service (2.8 million animals, 18 states)
  - Help reduce **WF of milk by 15%**, in addition to improvement in milk productivity and income of farmers.
- ***Total Mixed Ration***:
  - **Dry-TMR:** Crop residue based TMR (blocks and pellets). Installed two plants for commercial production of dry-TMR.
  - **Conventional TMR:** Silage/green fodder, crop residues & concentrates based 'Ready-to-eat TMR'. First commercial plant is being set-up by Amul under NLM.

(C) Milk Processing

Water usage in automated milk processing plant



- **Product processing & packing** (processing & packing of liquid milk, white butter & ghee)
- **CIP** (tanker CIP & other equipment)
- **Utilities** (refrigeration & boiler plant)
- **Miscellaneous** (floor cleaning, drinking water, lavatories, etc.)

Water usage in milk processing plants

Plant type	Milk processed : Water consumption ratio
Manual	1: 3 to 4
Semi-automated	1: 2 to 2.5
Automated*	1: 0.6 to 1

* Ratio can be reduced from 1: 1.1 to **1: 0.6** by adoption of technologies for **3R** (reduce, recycle & reuse water), **Tertiary Treatment Plant** & MBR for treatment of **Murky condensate**.

(C) Milk Processing *(contd…)*

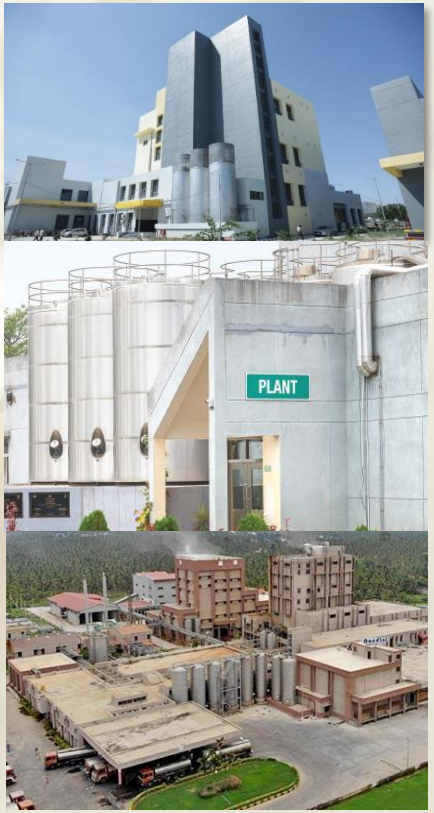
NDDB's initiatives for improving water use efficiency of milk processing plants

1) Recovery & reuse of dairy effluents

- ***Tertiary Treatment Plant:***
  - Advanced stage wastewater treatment to remove residual contaminants and improve quality of treated water to a level that meets specific reuse/environmental standards.

2) Recovery & reuse of water from food production/processing

- ***Recovery & reuse of Murky condensate generated from powder plant:***
  - Murky water from powder plant (wastewater generated during production of powdered products) can be reused after treating to comply with environmental standards.



(C) Milk Processing *(contd…)*

Tertiary Treatment Plant (TTP):

- Installed at **Jaipur Milk Union** to cater water requirements of dairy utilities in boiler and refrigeration plant.
- The state PCB has also mandated **Zero Liquid Discharge (ZLD)** for the industries.

- **Impact of TTP:**

  - ***Water saving:*** Significantly reduced **dependency on tanker & borewell water** (due to reuse of recycled treated water), about **70% reduction** in the disposal quantity of ETP-treated water
  - ***Improved Water-to-Milk ratio:*** 1: 1.27 (before) *vs.* **1:1 (after)** using TTP & ZLD
  - ***Cost saving:*** Approximately **Rs. 117 lakh** per year
  - ***Balance water:*** can be reused to **further improve water-to-milk ratio** from 1:1

(C) Milk Processing *(contd…)*

Murky condensate plant:

- Installed at **OMFED Milk Union** to treat the murky condensate generated from powder plant and utilize the same in dairy utilities particularly in boiler feed water and make-up of condenser water in refrigeration plant.
- The treated murky condensate also finds use for plant CIP.

- **Impact of Murky condensate plant -**
  - ***Water saving:*** Instead of draining and adding to ETP load, now **murky condensate is utilised** in dairy utilities. **Significantly reduced the dependency on freshwater** from dam.
  - About 100 KLD water is recycled & reused in boiler & refrigeration plant.
  - ***Cost saving:*** Approximately **Rs. 49.5 lakh** per year

Summary of interventions in milk supply chain

- ***Cradle-to-factory gate*** water footprint of milk is about **1079 Lit/kg** of milk
  (1078 Lit/kg milk at *cradle-to-farm gate* and 0.6 to 1.0 Lit/kg milk at *post-farm to factory gate*)*

Category	Intervention	Impact on water use efficiency
Crop Production	Manure management	Slurry application help reduce freshwater usage for irrigation, organic fertilisers help improve water holding capacity & productivity of soil.
	Solar energy (irrigation)	Sustainable use of groundwater (help minimise exploitation of natural resource)
Milk Production	Fodder production & crop residue management	Contribute to reduce water footprint (WF) of milk (due low WF of green and dry fodder, Propagation of certified seeds)
	Scientific feeding	About 15% reduction in water footprint of milk
Milk Processing	Tertiary Treatment Plant	Improved water-to-milk ratio (1:1 *vs.* 1: 1.27), reduced dependency on freshwater resources, reduction in disposal quantity of ETP-treated water
	Murky Condensate Plant	Reduced dependency on freshwater resources, reduction in disposal quantity of ETP-treated water

**Estimate based on selected data. For more precise estimate, large scale data collection would be required.*

Thank you