
# Integrated Water Management Framework for Industries

# Contents

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## *Water Working Group*

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# About the Knowledge Paper

Water is a prerequisite resource for organizations across the globe. Without regular or continuous access to clean water, businesses can neither function nor sustain. Industries that rely on water for operations or manufacturing realize this risk and consider themselves as the most vulnerable. Today, an increasing number of businesses recognise the importance of water.

The 2011 Carbon Disclosure Project's Gaining Competitive Advantage in a Water Constrained World[1], prepared with Deloitte, reveals that over half of 185 Global 500 companies in water-intensive sectors or those exposed to water-related risks have experienced negative impacts from water-related challenges in the past five years. Two years ago, 39 percent of the companies that responded reported negative impacts. Water can be a significant driver for innovative and sustainable economic prosperity but its mismanagement can result in business failure[2] .

In November of 2012, TERI-BCSD convened the first ever Chief Sustainability Officers' (CSO) Forum to provide further impetus to the corporate sustainability journey. This knowledge paper is a product of the 'Water' Special Interest Group (SIG) of the CSO Forum 2012-13. Recognising the need for a dependable ready-reckoner or a guidance document for the corporate sector to refer to, the Water SIG members along with experts from TERI have pooled in resources to create a knowledge paper that lays out a step-by-step approach with case studies for

We acknowledge and appreciate the efforts and contributions of all the Water SIG members – BASF India Ltd, CLP India Pvt Ltd, DNV (Det Norske Veritas) India Pvt Ltd, HCC India Pvt Ltd, and AkzoNobel India Ltd- as well as experts at TERI for taking the initiative to lead the way.

[1] https://www.cdproject.net/CDPResults/CDP-Water-Disclosure-Global-Report-2012.pdf
[2] http://www.bluetechresearch.com/no-water-no-business-the-importance-of-water-stewardship/

# The Context

Water sector today faces major challenges with declining per capita water availability in many Asian countries and stands stressed with rising water demand mainly from the competing agriculture, domestic and industrial sectors. The freshwater withdrawals are expected to rise the world over (by 2025), by around 50% in developing countries and by 18% in developed countries. Domestic and industrial water demands in Asia are growing rapidly at rates projected to range from 70 to 345 % between 1995 and 2025. During the past 50 years, per capita availability has declined by 60% in North Asia and 55% in Southeast Asia[3] . Worldwide, the volume of water used by industries is estimated to rise significantly from 752 km3/ year (1995) to 1170 km3/year by 2025. Besides, the low & middle income countries expected to follow the growth pattern of high income industries increasing their industrial water use over agricultural use[4] .

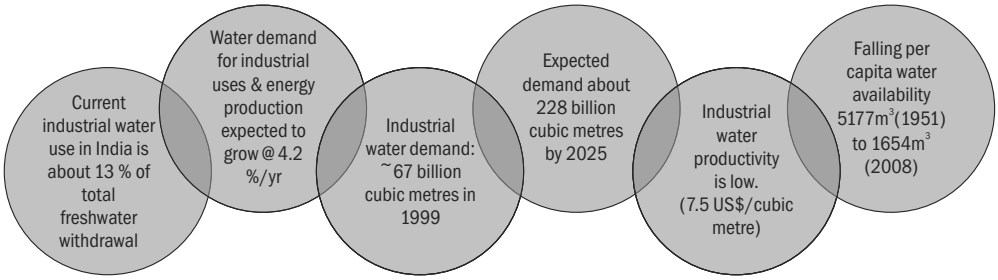


*Figure 1: Identifying the significant challenges with regards to water availability*

# Need for an integrated water management framework

Given the state of resource availability, use and competing demand, the critical challenge lies in foresight of the issues and preparedness to respond to them for sustainable business operations. Management of water resources need a multifarious approach of not only improving the in-plant water use efficiency, but also to look beyond the paradigm of in-situ water management. This involves critical extrinsic factors such as source vulnerability, climate, allocation, access, competing use (irrigation, domestic & industrial), regional water quality & availability, regional policies & regulations, socio-economic setup, and importantly the stakeholders (Govt. agencies, local community, etc.) including the industrial value chain.

[3] Source: Water For All: The Water Policy of the Asian Development Bank, ADB
[4] Source: UNESCO World Water Assessment Programme, WWDR

With growing demand, competing use and scarcity scenarios in a region, there may not be enough water to meet societal, environmental, agricultural, or industrial needs. Besides, with the growing awareness, industries have a reputational stake if perceived as mismanaging their water resources or impacting on others directly or indirectly. Thus, there is a need of holistic approach to management of water resources necessitating formulation of an integrated water management framework, as a first step, with responsive corporate water policies and programs in order to respond to the potential challenges related to water within and outside the plant boundaries.

# How to Use this Framework

This framework was prepared by leading business enterprises along with the collective inputs of water management experts at TERI to enable corporates across industries to better manage their water use. This integrated water management framework will serve as a ready reckoner for streamlining the processes of the enterprises to achieve their respective water management goals. The approach given below provides a methodical step wise structure to the corporates to implement this framework effortlessly in their respective organizations for effective water management.

# The Approach to the Framework

An integrated approach with a larger perspective covering the watershed should be adopted to comprehensively cover all the aspects related to water

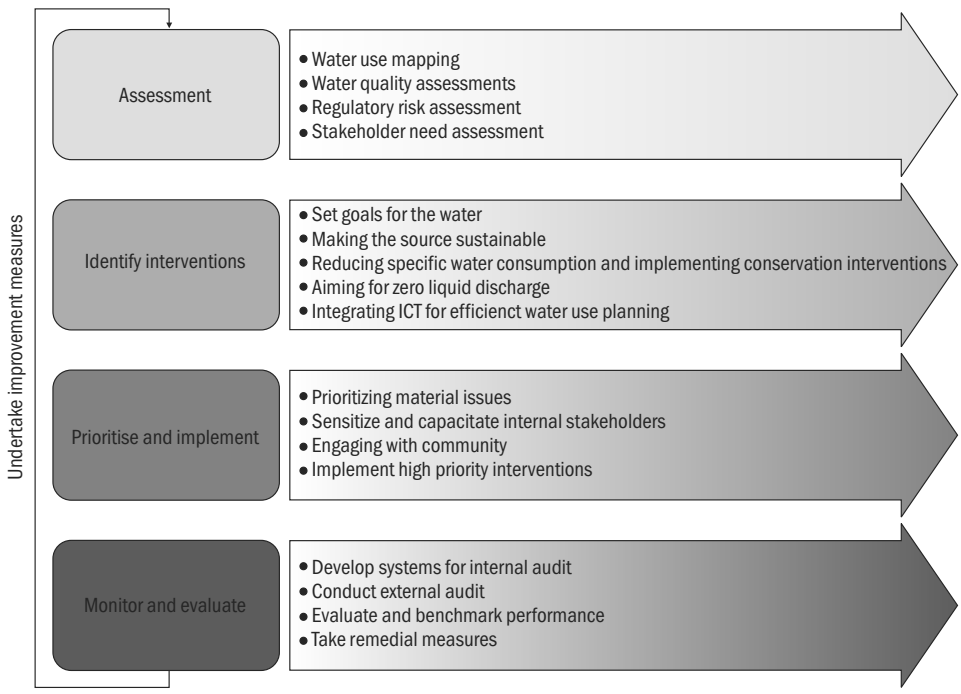


*Figure 2: Approach for institutionalising an integrated water management framework*

for industries. The approach given in this framework will help companies to work on four main strategies for effective water use management as shown in the Figure 2.

This integrated framework starts from assessment and ends at monitoring with a continuous mode of operation. Post evaluation, it is important for the organization to incorporate feedback and undertake improvement measures, which must be incorporated within this framework.

Any industry has to first start with identification of issues to mitigate it. Section below describes the detailed steps to be taken up for all the strategies adopted for the integrated approach.

# Following the approach

For any industry to adopt this framework needs to follow the step in the order as given in Figure 2. The very first step is to know your system well, which actually leads to assessment of resources, gaps and need of intervention. This is followed by identification of interventions.

Every industry is unique and hence needs specific tailored solutions. These solutions in the form of interventions will be based on the objective of reducing water consumption and increasing efforts for water conservation, so that the industry ultimately becomes 'Water Positive', which means giving back to ecosystem and community more water than taken from their source. So, therefore it becomes more important for industries to prioritize the intervention in the next step. Since, not all interventions can help to achieve the goal in efficient manner, choosing the best of solutions is of utmost importance.

Lastly, it is equally or rather more important to monitor and evaluate the implemented interventions. This exercise helps to recourse the direction of the industry on the path of water security.

## *Assessment*

### Water Use Mapping

To begin with, industry should map the water use from source till the end point which is generally the discharge point. This information should include all possible information related to the type, capacity, source, infrastructure type, age, leakage if any, and storage structures. This will also include documenting information related to water treatment and effluent treatment plants of the industry, including the type of treatment options, capacity, O&M (Operations and Management) schedule, etc.

This exercise should also include identification of alternate source of water

for the industry and all the pertinent information related to the available sources of water. All this information should be well mapped and well recorded for the industry

## Water Quantity and Quality Assessment

Industries should document the overall water consumption in the industry, based on the inflow to the industry and outflow from the industry. Similarly water quality of the inflow and outflow (wastewater) should be assessed and documented by the industries.

For detail assessment, specific water use for the various process or products manufactured in the industries will be assessed to understand the water cycle of the industries. Based on this, a baseline for the water consumption should be established for the year of assessment and recorded properly. This will be helpful to assess the future water needs of the industry.

The water availability should be considered at the watershed level. The surface and groundwater availability in the watershed should be assessed. Also future water availability considering the effects of climate change should be considered.

Besides this it is important to assess the water footprint of the industry as well. A water footprint is a way of assessing potential environmental impacts related to water. It also helps in iidentifying opportunities to reduce water-related potential impacts associated with products at various life-cycle stages, and with processes and organizations. To carry out this exercise, once can follow ISO 14046 standard, which will specify principles, requirements and guidelines related to the water footprint assessment of products, processes and organizations, based on life-cycle assessment. It can be used to conduct and report a water footprint assessment.

## Regulatory Risk Assessments

Industry should list down all the applicable regional regulatory and policy framework and programs. Besides the applicable standards and norms specific to the industry, they should consider the applicable regional regulations, restrictions, notifications, as well as government policies and programs crosscutting various sectors such as water, land use, agriculture, urban/ rural development, industrial development, sensitive zones, environment & ecosystem etc. Also the effectiveness of the policies on groundwater extraction, wastewater disposal, capacity building should be assessed.

## Stakeholder Need Assessment

Industry should assess their relationship with the following important stakeholders to understand their water related concerns:

- **Local communities:** There are several areas of concern for a community when an industry is set up in their vicinity. Critical issues such as adequate availability of clean water for drinking, sanitation and cooking are all very important considerations for the communities operating around the facility. Community becomes non-cooperative if the industry operating in the region, depletes, or pollutes, the ground water tables. Therefore, gauging the needs of the local communities, while engaging with them is critical to the operations of the organization.

- **Regulators:** The regulators are also an important stakeholder, therefore it is quintessential for organizations to engage with regulatory bodies while staying abreast with the latest regulatory and compliance related developments for the industry.
- **Water provider (if any):** A relationship must be established with the water provider to ensure that the industry gets a sustained source of water supply for its processes.
- **Other competing industries:** It is important to build a rapport with the other competing industries operating in the same watershed and sourcing water from the common resource. As such the competition for water increases many folds as generally all the industries are water intensive units. This can also lead to decrease in availability of water share and also may cause pollution into the common source by discharging un-treated effluent. If the source of water is ground water for all the industries in the watershed then the situation becomes more serious as groundwater is a limited source and as per the hydro-geological setup of the area, yield can be a limiting factor.

Therefore it is important, to know the water demand, use and discharge practise of competing users in the same watershed and accordingly adopt sustainable practices.

## *Identify Interventions*

Based on the aforementioned step towards assessment of various issues which need urgent attention in order to sustain an industry in terms of water, some specific options can be adopted from the following as a package or as an individual remedy as the case may be. The main aim of the framework is to reduce the overall water footprint of the industry with the following specific objectives:

- To make the water source sustainable
- To lower the specific water intake through water conservation and reducing losses
- To make an effort to ensure zero liquid discharge from the facility
- To enhance water use planning by adopting the latest economically feasible ICT (Information and communications technology) tools and engaging stakeholders.

All these efforts will lead to increase in water use efficiency of the industry and help to enhance the water security of the watershed.

To progress towards these objectives, it is important for organizations to establish and work towards defining a framework or policy document which is supported by the top management as the immediate next step. The water policy document or framework so developed must be in line with the company's environmental objectives and must address the concerns of all stakeholders.

## Source Sustainability

The most important aspect for a plant's operation is sustainability of the source. A source should be able to provide good quality and quantity of water to sustain the plant's operation. Depending on the source type, plant can take necessary actions to enhance its sustainability. Also it is important to know if the source is shared with some other user or not. If the source is common and shared with more stakeholders in the watershed, a common responsibility to protect the source and to enhance its sustainability can be taken up by industries in lead.

Industry should ensure that the source of water for them is well maintained, is cleaned and all the important aspects of it like level, quality are recorded regularly. An alternate source of water for the industries should also be identified and characterised as a contingency measure. An important exercise in this regard is to conduct Source Vulnerability Assessment (SVA).

SVA is a systematic examination process to assess a water system's sensitivity to potential threats (un-checked exploitation, pollution, etc.), which would further help in identifying the crucial challenges to the system in managing these risks that arise as a consequence of such threats. Usually, an assessment of this sort takes into account the water balance of the system at the watershed scale (water supply/allocation and demands), the policy and legal framework to support water resources conservation

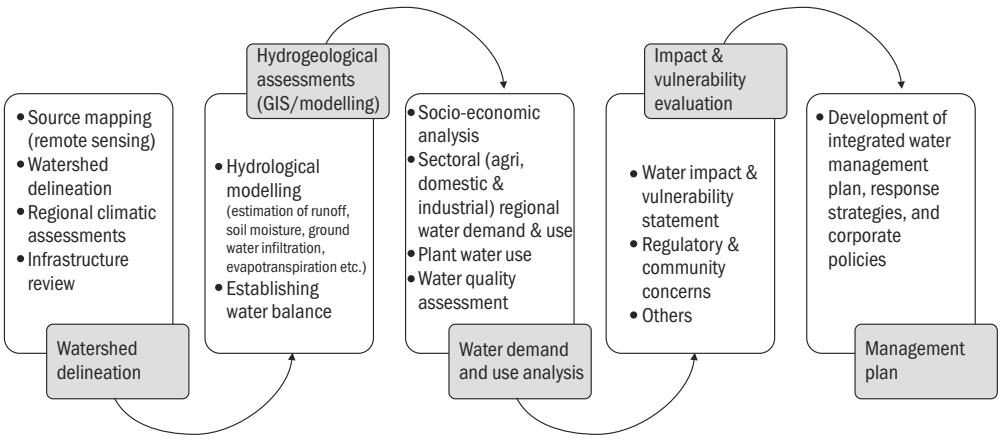


*Figure 3: Approach methodology towards Source Vulnerability Assessment*

and management; it would also include the hydrological variations under changing climate and other environmental factors.

The typical approach methodology followed towards source vulnerability assessment is depicted in the diagram below. This assessment can be carried out by industrial water management experts.

## Reducing specific water consumption & implementing water conservation interventions

Reduction of specific water consumption is very important to reduce the water footprint and this can be done by adopting various water conservation measures which follows the priority order of potential options at industry level as shown in the figure below. This will help to reduce the water stress at watershed level ultimately by reducing the intake of fresh water by industries. Specific water consumption level should be brought down using various techniques to a level which can be set as a benchmark level for future reference of the industry. Step wise targets should be set in chronological manner to achieve the target of reducing water consumption at each step.

Water audit is one of the key processes to be taken up by the industries to identify the leaks, water flows, and then take necessary measures to reduce losses and increase efficiency. Regular water audits should be taken by industries to ensure prevention and mitigation of leakages and unnecessary water loss.

Specific water conservation measures like rainwater harvesting, groundwater recharge, installation of water efficient devices can help reduce the fresh water intake from the common watershed. This will reduce the competition with other users and help to build a positive water cycle for the industry and improve the relationship with stakeholders.

Apart from reducing water losses, it is important to focus on the aspects of water conservation. Below are some of the interventions that can enable in-situ or ex-situ conservation of water.

**In-situ conservation:**

- Rooftop Rainwater harvesting -it is both an economical and eco-friendly technique of collecting rainwater and utilizing it for immediate and future use, there-by helping in reduction of the stresses on the public water supply and other sources. The implementation of this intervention involves site assessment, estimation of rainwater harvesting potential, designing the harvesting system, implementation and operation & maintenance.
- Wastewater recycling-This involves setting up of a system for recycling of wastewater generated in the industry through appropriate treatment methods. This water can be reused for different purposes in the industry. Wastewater recycling can be planned in a centralized or decentralized manner depending on site conditions. Recycling provides an opportunity

for zero discharge or even positive water balance for the plant. Wastewater recycling system should approach to recycle wastewater at source and thus reduce the pollution load at the ETP (effluent treatment plant), ensure material recovery and reduction in treatment costs besides reduce the 0verall water demand of the plant.

- Reduction in leakages/losses and process optimization: -Often a significant scope lies for potential water savings by optimization of water use in various processes such as cooling towers, boilers etc. Besides in many cases leak detection coupled with, metering and regular water audits help reduce leakages/losses in the network or process thus saving water and reducing freshwater intake.

**Ex-situ conservation:**

- Watershed-level rainwater harvesting -This involves the setting up of surface water harvesting interventions or watershed structures such as check dams, gabions, bunds, percolation tanks, storage ponds etc. In addition to storing rain water during monsoons, it also helps groundwater recharge.
- Artificial recharge of groundwater - Water from surrounding streams and drains are collected through constructed streams and further run through a man-made filtration system from where it flows into a shallow aquifer thus recharging the groundwater. There are several groundwater recharge technologies such as shafts etc.

## Zero liquid discharge

The effluent discharged from industries is equally or even more important than inflow to industries as it can be a challenge or an opportunity for the water security. If discharged untreated it can lead to pollution of water and land bodies but if treated and re-used it can decrease pressure on the existing water sources in the watershed. Therefore, it is important to ensure that a multiple stage ETP (Effluent Treatment Plant) is installed in the Industrial facility for treating the industrial waste so that the river / water bodies remain free of contamination.

## Efficient Water Use Planning

For effective water use it is important to integrate ICT tools in with planning which will include Management Information System, Decision Support System, etc. ICT system can be used for controls and monitoring. They can be simply put to use for avoiding wastage of water and for providing regular information for better management of the resource, automation of systems, etc. In addition, ICT is the driving force behind innovation, and also helpful in transforming business models and value chains. With the growing technological advancements, economically feasible options are available. All the industries should integrate ICT tools for management of water resources in their plant.

In addition to the technical part, regulatory part is also important in water use planning. Industries should roll out a 'water charter' inclusive of the regulations imposed by the government and guideline for integrated water management framework as policy directive to be implemented at the plants.

## *Prioritize and Implement*

Based on the need of industries, and specific issues, above mentioned action points can either be taken in a package or as an individual remedial option to initiate the process of increasing water use efficiency, reducing the load on environment and building a positive relation with other stakeholders. Industries can prioritize these options before implementing to set the right course of their action oriented plan.

### Prioritizing Material Issues

It is important for organizations to earmark and identify specific issues within the ambit of water management which are of higher relevance to them. After identification, organizations must be able to assign them priority in accordance to their impact on the business. In this way, it becomes easier for organizations to align themselves towards the higher priority tasks first, while being able to mitigate the risks associated with them.

### Sensitize and Capacitate Internal Stakeholders

The engagement and involvement of the employees is critical towards successful implementation of the effective water management and conservation interventions. Employees must be sensitized on the relevance of the subject and must be trained towards implementation of the measures.

### Engaging with community

One of the foremost elements of efficient water management planning involves engaging communities and other stakeholders regularly. All the water positive actions taken up by industries should be showcased to locals and with them responsibility of ensuring water security at watershed level should be shouldered as a lead. It is important to return back to nature what is taken so making an efficient use of water by avoiding losses, and conserving water through different methods, the ultimate goal can be achieved for both plant and surrounding watershed.

### Implementing high priority interventions

Once all the aforementioned issues are addressed, the highest priority interventions should be with the involvement of the internal stakeholders and the community at large.

# *Monitor & Evaluate*

After taking the necessary actions it is equally important to monitor and evaluate the implemented actions regularly to learn from their benefits and weaknesses and to fix the issues, if any, on time. This will help to strengthen the system further and help to understand the overall benefits accrued by the industry.

It is suggested that Industry can hold an internal audit to evaluate the implemented plans twice a year and hold an external third party assessment for evaluation once a year.

Evaluating and benchmarking the water performance on a regular basis is the key to a successful and integrated water management plan.

Remedial measures from the evaluation and monitoring must be then undertaken to sustain continual improvements in the system while the organization tries to optimize its water use and management performance.

# Appendix

## *Case Examples of Enhancing Water Use Efficiency in Industrial Sector*

### Water Audit of Heavy Engineering Industry (Larsen and Toubro Ltd.)

TERI conducted water audit of L&T's heavy engineering plant at Surat covering all major water consuming units including workshop areas (LMS, PFS, MFS, & HFS area, Shipyard, Hydro-testing etc.), offices and administrative blocks, canteens, housing complex, toilet blocks, Sewage Treatment Plant & residential colony. Water usage at all major locations were assessed to establish the water balance for the entire plant and residential area. The study revealed a total water saving potential to the tune of 47% of the total water intake by the plant.

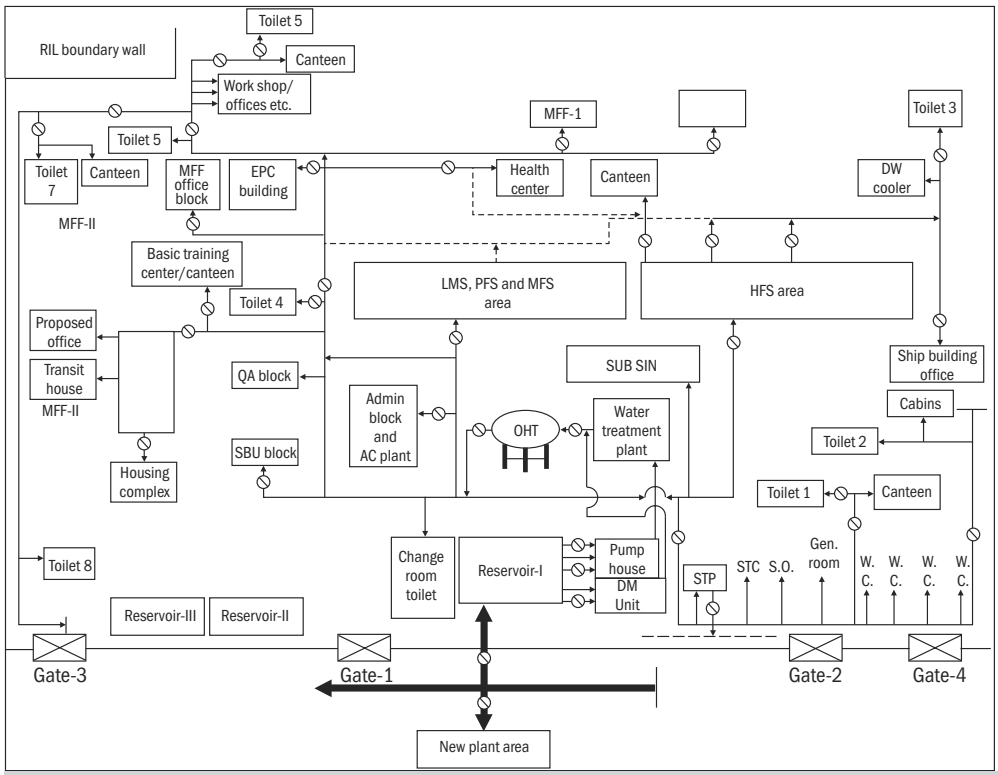


*Figure 4 Water flow and quality monitoring at various locations*

Additionally, the potential of saving treated water at the township was assessed to be about 157 m3/day. Various areas of improvement identified included effective disinfection at the raw water treatment plant, reuse of hydro-testing water, as well as collection, treatment and reuse of about 600 m3/day of water otherwise being drained at various locations. Besides above the study also identified leakages in the system as well as various

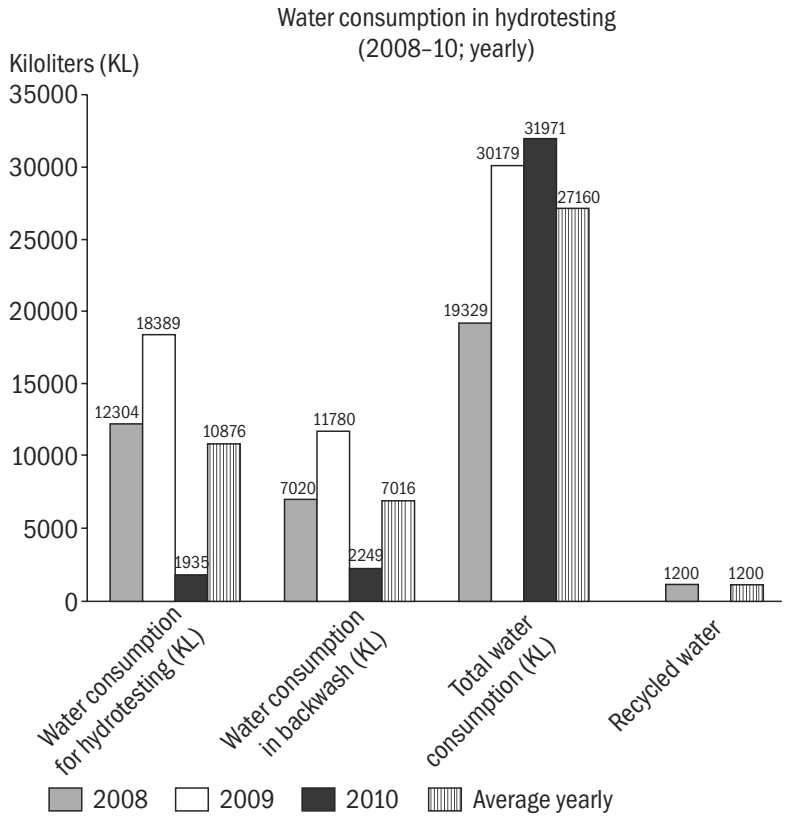


*Figure 5: Water flow and quality monitoring at various locations*

interventions to improve water use efficiency including complete metering plan with revival of identified non-functional meters, rooftop rain water harvesting plan etc.

## Development, Rehabilitation and Outreach Project (DROP): On integrated watershed & catchment area treatment and management

The project involved watershed modelling based assessments of water availability and water use in the selected region, and based on the outcomes

*Figure 4 Water flow and quality monitoring at various locations*

water conservation interventions were designed and implemented at Neelamangla (Karnataka) with an aim for ensuring long-term availability of groundwater resources in the studied watershed through eco-restoration water conservation measures such as artificial groundwater recharge, drip irrigation, rainwater harvesting and demand management measures. It thus aimed at improvement in the quality of life of the community by undertaking interventions in areas of water supply, sanitation, hygiene, health, and education.

## Third party independent groundwater resources assessment of PepsiCo India Holdings operations

The general objective of the project was to undertake an independent assessment of impact of groundwater utilization by PepsiCo on the water sources of local area. The project involved watershed level and plant level assessments through development and application of GIS & modelling based Decision-Support-System (DSS). The study used a combination of field assessment and technical evaluations including modelling to understand the water availability and water balance in the watershed, sectoral water withdrawals particularly agriculture, and impact of water withdrawal by the plant, both in terms of water quality and quantity.

## Detailed project report for rain harvesting at BEL estate

Rainwater Harvesting could be considered as a possible alternate source for supplementing existing sources of water supply at least partially. During Jan'99, BEL had entrusted TERI to carry out the pre-feasibility studies for storing rainwater runoffs at their premises. TERI's preliminary findings indicated a good potential for developing "rain harvesting system' at BEL estate. It is in this background BEL has retained the services of TERI to prepare the detailed project report for development of rain harvesting site at their estate.

The purpose of this detailed project report (DPR) is for development of rain harvesting system BEL estate. The study covers for identification of storing rain water runoff at identifiable storage place, integrating in the present system and to workout overall benefits of the project.

## Source Vulnerability Assessment

TERI carried out extensive Source Vulnerability Assessment (SVA) exercise for 4 plants of Coca Cola India, at different watersheds. The exercise was carried out to understand the susceptibility of the water source of the industry to various threats like competing use, community relationship, and quality and quantity concerns. The outcome of the study was plant specific Source Water Protection Plan, which provided detailed management plan for the sustainable operation of the plant. The exercise was carried out by engaging the plant's staff to make them understand the process and build their capacity to further implement the Source Water Protection Plan.

# References

For more information on specific water management topics, please refer to links below :

**Source Vulnerability Assessment**
http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Source%20Vulnerbilty%20Assessment%20&%20Social%20Engagment.pdf

**Zero Effluent Discharge**
http://learncivil.weebly.com/uploads/8/6/1/0/8610525/_zero_discharge_eff.pdf

**Enhancing water use efficiency of thermal power plants in India**
http://www.teriin.org/policybrief/docs/TERI_Policy_Brief_Dec_2012.pdf

**Water conservation activities at watershed level**
http://edugreen.teri.res.in/explore/water/conser.htm

**Role of ICT in water sector**
www.teriin.org/projects/nfa/pdf/TERI-NASSCOM_Green)_ICT_Report_Dec_2011.pdf –pg. 43-62