



Water Footprint Assessment

- Tata Chemicals • Tata Motors
- Tata Power • Tata Steel

RESULTS &
LEARNING

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Tata Chemicals: Alka Talwar, Neha Bhandari, DD Chaturvedi

Tata Motors: Mohan Baburao Kulkarni, Shamal Mukherjee, Peter D'Souza, B B Patil, N Sharma

Tata Power: Avinash Patkar, Prashant Kokil, Sanjay Neve

Tata Steel: Arunava Das, Ragho Singh

Tata Quality Management Services: Arunavo Mukerjee, Alka Upadhyay, Manish Vaidya

IFC: Bastiaan Mohrmann, Mohan Seneviratne, Rochi Khemka, Sattyakee D'com Bhuyan

Water Footprint Network: Guoping Zhang, Kurt Unger, Ruth Mathews

Primary Authors: Kurt Unger, Guoping Zhang, Ruth Mathews

Photo Credits: Sattyakee D'com Bhuyan

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FOREWORD

Availability of water resources has become a key concern for companies as population growth, changing lifestyle patterns, rapid urbanization and industrialization, and climate change place unprecedented pressure on limited water supplies. Seasonal changes in water availability and long-term water shortages due to unsustainable use have already constrained growth in select geographical areas and threaten to dampen economic growth. In the context of these water challenges, there is an urgent need for efficient and sustainable use of the world's limited water resources.

Four companies of the Tata Group – Tata Steel, Tata Chemicals, Tata Motors and Tata Power – together with Tata Quality Management Services (TQMS), partnered with International Financial Corporation (IFC) and technical partner Water Footprint Network (WFN) to develop a corporate water sustainability framework and promote sustainable water use at the companies' twelve plants across India. A water sustainability roadmap was developed for the Tata Group to help it respond to the world's pressing water challenges based on Water Footprint Assessment, using Water Footprint Network's globally recognized methodology. The roadmap is based on a comprehensive approach to accounting of water consumption and pollution inside the plants and in the supply chain, the assessment of sustainability, efficiency and equitability of that water consumption and pollution, and a strategic response plan.

This publication documents the Water Footprint Assessment results, the approach taken by the four companies, and the knowledge developed during the Tata-IFC Corporate Water Partnership. Its purpose is to outline a paradigm to identify water sustainability measures within other industries, and contribute to the global knowledge pool on corporate water stewardship. As a pioneering effort globally in conducting a comprehensive Water Footprint Assessment for industrial products, this work highlights both successes and challenges faced, as well as lessons learned, and facilitates the journey for others who wish to take strategic action to improve sustainability, efficiency, and equitability in the use and management of precious water resources.

The Tata Group is an international diversified set of businesses that is committed to the goal of sustainable management of resources through demonstrated leadership. IFC provides financial and advisory support to its clients to promote environmentally and socially sustainable performance and practices. This joint partnership, in collaboration with Water Footprint Network, a global multi-stakeholder initiative focused on sustainable, fair, and efficient use of freshwater resources, has provided valuable insights on actionable response strategies for corporate leadership in water management.

We hope you find this document of value.

Prasad Menon

Chairman

TQMS

Thomas Davenport

Director

IFC South Asia

Ruth Mathews

Executive Director

Water Footprint Network

EXECUTIVE SUMMARY

The Tata Group partnered with IFC and technical partner Water Footprint Network (WFN) to develop a corporate water strategy for twelve industrial facilities based on Water Footprint Network's globally acknowledged Water Footprint Assessment methodology. The aim of the partnership was to develop an integrated water sustainability framework and create a common language on corporate water stewardship among internal stakeholders ranging from senior management to facility staff. Water Footprint Network's Water Footprint Assessment methodology was selected because it provides detailed analysis of the amount of water consumed and polluted, and highlights improvement action areas that cannot be identified through the use of traditional water use statistics and discharge permits.

Water footprint is an indicator of appropriation of freshwater resources, measured in terms of amount of water consumed and polluted. It has three components:

1. **Blue water footprint** refers to consumption of surface and groundwater through evaporation, incorporation into the product or return flow to a different water body than from where it was drawn.
2. **Grey water footprint** refers to pollution and is defined as the volume of freshwater required to assimilate the load of pollutants to meet local ambient water quality standards.
3. **Green water footprint** refers to evapotranspiration by plants of rainwater stored in the soil as soil moisture.



Water Footprint Assessment is a four step process which includes:

1. Setting the goal and scope of the assessment;
2. Calculating green, blue, and grey water footprints;
3. Assessing sustainability, efficiency, and equitability of the water footprint; and
4. Strategic response formulation.

The **Tata-IFC Corporate Water Partnership** applied this methodology to enable the Tata Group to:

- Calculate the water footprint within direct operations and supply chain of twelve industrial facilities across Tata Steel, Tata Chemicals, Tata Motors, and Tata Power^[1].
- Understand the efficiency of facility water footprints and their impact on sustainability of local water sources.
- Formulate comprehensive response strategies to reduce water footprint, address water scarcity and pollution in the local watershed and assume a leadership role in corporate water stewardship.

The partnership served the dual purpose of addressing water challenges of a leading corporate group, while simultaneously contributing to the global repository of knowledge on corporate water footprints and reduction response strategies.

The partnership developed a knowledge base in three areas - Water Footprint Assessment results, corporate water sustainability framework and global water footprint knowledge. The highlights of these are summarized below:

1 Water Footprint Assessment Results

The partnership provided valuable insights on water footprint accounting, sustainability assessment, and response formulation for twelve facilities in the steel, chemicals, automotive, and power sectors.

Water Footprint Accounting

This phase of the assessment calculated operational and supply chain water footprint for each facility. It detailed type and magnitude of water consumption and pollution at different stages of the manufacturing process.

- **Tata Steel Ltd.** (TSL) Jamshedpur is the dominant industrial water user in the watershed, with an overall blue water footprint of 24.9 million m³/year. Most of its water use is concentrated in direct operations (81 percent), with iron and steel

[1] See Annex for details on facilities

making being the most water-intensive manufacturing processes. The product blue water footprint of steel is 4.21 m³/ton. TSL-Jamshedpur aims to increase production but within existing regulatory limits of water withdrawal. The Water Footprint Assessment showed how much water was being used to produce a ton of product (steel). It helped establish an internal benchmark, and it identified where water was not used as efficiently as it could be.

The critical pollutant that required the largest assimilation volume was identified as total suspended solids (TSS). The total grey water footprint of the facility in 2012 was 15.2 million m³.

- **Tata Chemicals Ltd.** (TCL) water footprint varies by facility and type of product.
 1. TCL-Mithapur manufactures soda ash, cement, caustic products, and salt. It uses seawater for 97 percent of its water requirements and discharges its effluents into the sea, thereby substantially lowering its blue water footprint. TCL-Mithapur has a zero grey water footprint because it does not discharge effluents into freshwater bodies. The bulk of its supply chain blue water footprint is the water footprint of imported coal.
 2. TCL-Haldia produces a variety of chemicals and fertilizers. Its blue water footprint is concentrated in its supply chain, specifically phosphoric acid production, comprising 81 percent of its total blue water footprint. Phosphate and organic waste, which resulted in biological oxygen demand (BOD₅), were used to calculate the plant's grey water footprint.
 3. TCL-Babrula, which produces urea, has a direct manufacturing blue water footprint for urea of 4.9 m³/ MT.^[2] Natural gas and naphtha account for 96 percent of this plant's supply chain blue water footprint. The critical pollutant identified to determine the grey water footprint was organic waste.

**Water Footprint Assessment has given us more direction
for our product stewardship efforts which will support our
overall business sustainability.**

Neha Bhandari, Tata Chemicals Limited

- **Tata Power Ltd.** (TPL) facilities presented widely differing scenarios: TPL-Trombay had a smaller product blue water footprint than TPL-Jojobera due to its extensive use of seawater for cooling; in 2012, blue product water footprints were 3 m³/million MWh and 4.275 m³/million MWh respectively. The study also showed that the choice of fuel influenced indirect water footprints, with oil having a higher blue water footprint than coal and gas. Both facilities do not have grey water footprints; TPL-Trombay discharges to the sea and TPL-Jojobera has a very high quality effluent treatment plant.

[2] Adding the blue water footprint of raw materials, energy and packaging, the urea product blue water footprint is calculated as 7.31 m³/MT.

- **Tata Motors Ltd.** (TML) has around 1,000 suppliers, accounting for the majority of its product water footprint. The highest inside-the-fence water consumption in all six facilities is from the paint shop and forging. TML-Pune CVBU (commercial vehicle business unit) had the highest blue and grey water footprint. TML-Pune PCBU (passenger car business unit) had the lowest blue water footprint and TML-Lucknow had the lowest grey water footprint.

Because of the challenge in identifying blue water footprints of its suppliers, TML calculated the direct blue water footprint of its product (equivalent vehicles)^[3]. TML-Lucknow had the highest product direct blue water footprint (for 2012: 5.46 m³/equivalent vehicle); the plant manufactures heavy and medium commercial vehicles. TML-Pune PCBU had the lowest product direct blue water footprint (for 2012: 1.69 m³/equivalent vehicle).

Sustainability Assessment and Response Strategy Formulation

The sustainability assessment addressed both process efficiency and sustainability in the watershed. Each facility's impact and risk situation is unique depending on the local context; the project helped the facilities understand their vulnerability to water scarcity and/or decreasing water quality.

- Jamshedpur, where TSL, TML and TPL each has a facility, becomes a water scarcity hotspot from February to May when the River Subarnarekha is at its lowest levels. A dam upstream of the facilities stores water that is released during the dry season. The sustainability assessment highlights the facilities' dependence on water stored in the dam. TSL along with TPL, TML and their vendors are the largest water users in the watershed. Together, they can implement efficiency measures and invest in water/wastewater technologies within the fence to reduce dependence on freshwater. In the longer term, the Tata Group's presence in the basin can be leveraged for a watershed-based response strategy in tandem with other local actors.
- TPL-Trombay, located in a coastal area on the outskirts of Mumbai, relies on seawater for once-through cooling purposes and on reservoirs built in the ecologically sensitive watersheds of the Western Ghats for its freshwater supply. Competing demands for freshwater from the Mumbai metropolitan area has prompted TPL-Trombay to consider desalination as a potential response to secure its water supply in the future.
- TCL-Babralla has identified efficiency measures such as reduction in cooling water blow-down/make-up inside the plant. TCL-Mithapur can reduce its operational water footprint by addressing energy use, while TCL-Haldia should target reducing the water footprint of its raw materials. All three facilities focus on watershed sustainability through, for example, collective action outside-the-fence in consultation with other industry players in Babralla, and efforts to reduce salinity ingress and construct check dams in Mithapur.

[3] The concept of an equivalent vehicle is used for productivity measurement in terms of standard man hours (SMH) needed to manufacture a base model (a standard vehicle model produced in significant numbers). The SMH for the selected base model is then converted into factors for other models manufactured at that location.

-
- The TML facility in Lucknow relies on groundwater, and is facing the problem of water pollution and depleting groundwater tables. TML-Pune draws water from the River Pavana, some of which is lost through transmission losses from the river to the plant and within the facility. The river is heavily polluted by industrial effluent and untreated domestic sewage. Opportunities for efficiency improvement exist across TML plants through reverse osmosis, ultrafiltration, and softening plants to reduce blow-downs. The Pune plant could also consider multi-stakeholder action focused on grey water footprint reduction in the river and reduction of leakages in water transmission to the plant.

2 Corporate Water Sustainability Framework

Water Footprint Assessment provides a structured approach for companies to develop corporate water strategies. The success of the partnership shows that the four phases of Water Footprint Assessment provide a clear, useful, and structured way for a company/facility to initiate and/or strengthen water sustainability action plans.

In addition, corporate water sustainability requires that knowledge about and responsibility for water sustainability be embedded across all levels of a company. The partnership followed an engagement process with staff, from facilities to CEOs, that sought to ensure competency in Water Footprint Assessment and commitment to water sustainability.

Key steps undertaken by the partnership are outlined below:

- **Nomination of facility level “Water Champions”:** At the facility level, each company identified two or three operational staff members per plant to be trained in conducting Water Footprint Assessment and to champion the water stewardship agenda for that facility, including implementation of response strategies. These staff members were nominated by the leadership team of each company and were incentivized to take initiative on completing Water Footprint Assessment through commitment from senior management.
- **Capacity Building of Tata Quality Management Services (TQMS):** TQMS supports Tata Group companies in business excellence and improvement. Three TQMS staff members were trained in Water Footprint Assessment methodology to provide direct support to the water champions. TQMS staff facilitated internal relationships within the Tata Group by liaising with facility staff and championing the process of replicating Water Footprint Assessment in other Tata Group companies.

We had previously created climate change champions and used them successfully as an internal team of consultants to execute the carbon footprint exercise and greenhouse gases abatement strategy. We decided to replicate the same process in water management.

**Arunavo Mukerjee,
Vice President, Tata Cleantech Capital Limited**

-
- **Site Visits for Plant-Specific Engagement:** The joint TQMS-IFC-Water Footprint Network team visited each of the twelve facilities with the aim of:
 - Determining the scope of the Water Footprint Assessment (details of process water footprints, supply chain, and watersheds)
 - Gaining a technical overview of the plant through a guided tour of key industrial processes
 - Identifying issues specific to each plant and addressing challenges in conducting the Water Footprint Assessment
 - Engaging with site-specific management teams to explain the significance of water in an industrial context and transfer ownership of the water sustainability agenda to facility staff
 - **Technical Training Workshops:** Three workshops were organized during the course of the partnership with the water champions. The objectives were to impart training on Water Footprint Assessment, facilitate peer learning, continuous feedback and validation, and to stimulate thinking on efficiency improvement. The workshops covered direct water footprints, indirect water footprints, sustainability assessment, and response strategy formulation.
 - **Development of Water Cost Curves:** Each facility developed a water footprint reduction cost curve, mapping the unit cost of water use efficiency, pollution reduction measures and technology investments against incremental water footprint reduction. These cost curves looked at the total cost of water, where feasible, including direct water tariffs, water treatment costs, energy/labour requirements, and other operations and maintenance-related expenses. The aim of this exercise was to identify priority water footprint reduction strategies and develop a business case for good housekeeping measures and more intensive water-related investments.
 - **Interaction with the Leadership Team:** Leadership commitment was critical to the success of the engagement process. A kick-off workshop introduced the project and its deliverables at the start of the partnership and confirmed leadership's support. A closing workshop allowed facility water champions to present the results of the Water Footprint Assessment to the leadership team, secure management commitment to implementation of water saving measures and technology investments, and discuss next steps to build corporate water sustainability into the company's business strategy.
 - **Presence of an External Catalyst:** The collaboration with IFC leveraged its strengths as an honest broker and its expertise in mobilizing global best practices. As a founding member of Water Footprint Network and an international development organization focused on private sector development, IFC's involvement in the project mobilized globally recognized Water Footprint Assessment methodology. The focus remained on the business case for water through total systems cost of water, water-energy-chemical nexus, and the significance of the water risk and security.

The Tata Group is replicating the Water Footprint Assessment methodology for other group companies. More than 60 executives across 13 Tata companies have been trained by TQMS till date to sustain the Tata water stewardship journey.

3 Contributions to Global Water Footprint Knowledge

The partnership has contributed to global water footprint knowledge by conducting Water Footprint Assessment at twelve facilities across four companies. Key learning occurred in the following five areas.

- **Water Footprint Assessment as a Framework for Corporate Water Sustainability:** The partnership presented an opportunity to test whether the four phases of Water Footprint Assessment - setting goals and scope, water footprint accounting, sustainability assessment and response formulation - provide a framework for corporate water sustainability. The results demonstrated the usefulness and utility of Water Footprint Assessment in guiding companies in their journey toward water sustainability.
- **Toward an Industrial Water Footprint Database:** There is no publicly available database for the water footprint of industrial products and processes. This highlights the critical importance of developing a water footprint database for industrial products and gathering data to develop benchmarks for specific processes and products. In the absence of this, the Tata facilities used their current water footprint as a benchmark against which to improve performance in the future.
- **Estimating the Impact of Effluent Discharged to the Sea Using Grey Water Footprint Methodology:** A seawater pollution volume was calculated with the same methodology used in calculating the grey water footprint for the two facilities that discharged effluents directly into the sea. While seawater pollution volume cannot be directly compared to a grey water footprint due to the differences in freshwater and ocean ecosystems, it can provide insight into reducing pollution impact on freshwater ecosystems resulting from discharging effluent to the sea.
- **The Importance of Determining Supply Chain Water Footprints Despite Challenges with Data:** Completing the indirect water footprint of a facility's supply chain can be challenging. Despite data issues, it is still worth estimating blue product water footprints based on direct blue water footprint calculations and best available data for indirect blue water footprints. These water footprints provide a coarse view of the relative values of direct and indirect water footprints of a product. With this information, facility managers can prioritize response strategies based on relative importance of the supply chain's blue water footprint versus that of the facility itself. Engagement with suppliers positions the facility as a leader and, ultimately, moves all parties toward collective and sound watershed management.
- **Response Formulation: Can a Company Offset its Water Footprint?:** Prior to this engagement with Water Footprint Network, the Tata Group, like many other companies, had completed the carbon footprint of its facilities. Based on the Tata Group's experience of carbon offsets, the question was whether a company could offset its water footprint. The impact of a water footprint occurs in a specific place at a specific time. Hence, the response must also occur so that it reduces the impact within the time period and location of the water use. Broadly speaking, with the goal of sustainable water use, companies can engage with others to reduce overall water footprint in local watersheds or aquifers, and bring it down to a sustainable level. This approach will lend credence to a company's claim that its water footprint is sustainable in that watershed.



1 INTRODUCTION

The Tata Group is an international diversified set of businesses with over 100 operating companies in seven business sectors: engineering, energy, consumer products, chemicals, materials, communications and information technology, and services. The Tata Group has operations in over eighty countries across six continents and is committed to the highest standards of environmental and social sustainability.

This report captures the results of the Water Footprint Assessment for four Tata Group companies, namely Tata Steel, Tata Chemicals, Tata Power, and Tata Motors, across twelve industrial facilities^[4] in India. It also provides an overview of the process undertaken for developing a corporate water sustainability framework for the four companies, and the learning and knowledge that emerged during and after the industrial Water Footprint Assessment.

The four Tata companies and Tata Quality Management Services (TQMS) collaborated with International Finance Corporation (IFC) in this endeavour, with support from Water Footprint Network as technical partner. IFC focuses on delivering value for its clients by assisting them in managing water-related risks, and supporting development and implementation of good environmental and social standards and practices. As a founding member of Water Footprint Network, a global network of partners from business, academia, government, international organizations and civil society, IFC promotes the Water Footprint Assessment methodology. The assessment methodology provides a common language on water that can be used by all stakeholders, and helps businesses measure and manage water-related risks and impacts. The Tata Group's interest in Water Footprint Assessment stems from the methodology's comprehensive approach to water sustainability inside the facility and in the supply chain, while offering response strategies to manage sustainability of water use in the context of local watersheds. The Tata Group is replicating the methodology across its companies, and so far 13 group companies have been trained by TQMS to sustain the Tata water stewardship journey.

This was the maiden global effort to undertake a comprehensive Water Footprint Assessment for industry. This report focuses on the results of the Water Footprint Assessment, and highlights learning, successes, and challenges faced while conducting the assessment. In addition, it offers insights to other stakeholders into the process of developing a corporate water sustainability roadmap.

1.1 Partnership Goals

The goal of the partnership was to assist the twelve facilities of the Tata Group companies measure and manage their water footprint, and understand the sustainability of their water use. The joint Tata-IFC partnership also aspired towards developing a corporate water sustainability framework that could provide insights on the process of undertaking water sustainability initiatives in an industrial context.

India's fortunes in this century will be dictated by how well it can manage its water resources.

**Prashant Krishnan, Divisional Manager
Environment & Effluent Management, Tata Motors Limited**

^[4] See annex for details on the facilities

The partnership's overall scope was defined as:

1. Measuring water consumption volumes and pollution for each of the twelve facilities,
2. Accounting for the indirect water footprint of raw materials,
3. Identifying the sustainability of facility water consumption in the context of local water resources, and
4. Formulating short and long-term response strategies to reduce water footprints by understanding the total systems cost of water^[5], and the associated risk and return implications.

The partnership had four specific goals:

- The Water Footprint Assessment would be done with enough quantitative rigor for the results to be used to develop a corporate water sustainability strategy for each of the twelve facilities.
- The Water Footprint Assessment would be done interactively, engaging facility staff, Tata Quality Management Services, and senior management to build internal capacity in the methodology and its application.
- Water Footprint Assessment would be tested within the industrial context to build new knowledge.
- Resulting action plans would include prioritized investments and follow-on activities where Tata companies could demonstrate leadership in corporate water sustainability.

1.2 Methodology

The Water Footprint Assessment includes four phases:

- **Setting goals and scope:** Identification of the objectives and scope of the assessment, including geographical/temporal and process/supply chain boundaries.
- **Water footprint accounting:** Calculation of operational (direct) and supply chain (indirect) water footprint, including quantity and quality parameters.
- **Water footprint sustainability assessment:** Assessment of environmental, social, and economic impacts of the water footprint.
- **Water footprint response formulation:** Identification of strategic action to reduce the water footprint or improve its sustainability.

[5] This includes direct water tariffs, treatment costs (including chemical usage), operations and maintenance expenses and energy costs associated with water usage.

The water footprint is a spatially and temporally explicit indicator of freshwater consumption, measured over each phase of the production process and value chain. It accounts for both water consumption volume and pollution, and includes three components:

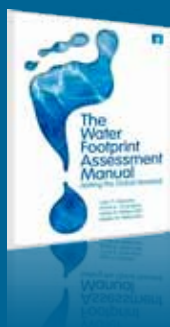
- The **blue water footprint** is an indicator of the amount of fresh surface or groundwater consumed in producing goods and services. The blue water footprint is the amount of water evaporated, incorporated into the product or returned to a different location or in a different time period from where it was withdrawn. The direct water footprint can include water footprint of manufacturing activities and overhead, such as water footprint of offices, canteens, and horticulture.
- The **grey water footprint** is a measure of pollution and is expressed as the volume of water required to assimilate the pollutant load to meet ambient water quality standards. The pollutant that requires the largest assimilation volume is referred to as the critical pollutant and is used to calculate the grey water footprint. If there are both surface and groundwater discharges, the grey water footprint for each discharge is calculated, then summed together to determine the total grey water footprint.
- The **green water footprint** is relevant for agricultural and forestry products (products based on crops or wood), and refers to the total rainfall or soil moisture lost through evapotranspiration by plants plus the water incorporated into the harvested crop.

In addition, there are specific types of water footprints:

- The **product water footprint** is the sum of all direct and indirect water footprints required to produce that product. A full product water footprint could not be calculated because of lack of data on the supply chain's green and grey water footprints. Thus, blue water footprints of the product were calculated.
- The **direct facility water footprint** applies to direct operations (no supply chain water footprint) so that the relative contribution of blue, green and grey water footprints can be gauged. This aids in prioritizing “within the fence” response strategies.

More information about water footprint methodology can be found in the Water Footprint Assessment Manual (Hoekstra et al., 2011).

The manual can be downloaded for free online at
<http://www.waterfootprint.org>



For sustainability assessments, blue water scarcity was based on Water Footprint Network's global water footprint database, WaterStat (Hoekstra and Mekonnen, 2011). Blue water scarcity in a river basin is defined as the ratio of blue water footprint to blue water availability, in which the latter is defined as natural runoff (through groundwater and rivers) from the basin, minus environmental flow requirements (Hoekstra et al. 2012). When this ratio is greater than 1, the basin is deemed to be in a water scarcity hotspot.

Sustainability assessment also addressed the efficiency of water use. Potential water footprint reduction measures were identified from the output of the water footprint accounting and sustainability assessment. To assist in identifying priority water footprint reduction strategies, each facility developed a water footprint reduction cost curve, mapping the unit cost of water use efficiency, pollution reduction measures, and technology investments against incremental water footprint reduction. These cost curves looked at the total systems cost of water, where feasible, including direct water tariffs, water treatment costs, energy/ labour requirements, and other operations and maintenance-related expenses, and developed a business case for both good housekeeping measures and more intensive water-related investments.

The following sections present the results of the Water Footprint Assessment for Tata Steel, Tata Power, Tata Chemicals, and Tata Motors (section 2), the engagement and capacity building process adopted for introducing corporate water sustainability (section 3), and contribution to global knowledge from completing these industrial Water Footprint Assessment (section 4).



2 RESULTS OF INDUSTRIAL WATER FOOTPRINT ASSESSMENT

This part of the report presents the key results of the project: facility direct blue, green, and grey water footprints, indirect blue water footprints, and product water footprints.

Water Footprint Assessment provides a structured approach that can be used by companies to develop corporate water strategies. The water footprint as an indicator of water consumption and water pollution provided new insight into water issues at the facilities, which was not earlier available through traditional water statistics or through reporting on effluent discharge permits. Additionally, determining the water footprint by process and on a monthly time scale provided insights into which processes were contributing the most to water consumption and water pollution at the facility. This led to a deeper understanding of water-related problems and highlighted strategic opportunities for improvement.

The scope of the Water Footprint Assessment was:

- To calculate water footprints within direct operations and the supply chains of twelve industrial facilities across Tata Steel, Tata Chemicals, Tata Motors, and Tata Power^[6].
- To understand the efficiency of facility water footprints and their impact on the sustainability of local water sources.
- To formulate comprehensive response strategies to reduce water footprints, address water scarcity and pollution in local watersheds and assume a leadership role in corporate water stewardship.

This was the first comprehensive industrial Water Footprint Assessment. While successfully demonstrating the value of Water Footprint Assessment in the industrial context, the results presented here, in some cases, represent firm measurements using direct data. In other cases, the data should be taken as first or literature-derived estimates.



[6] See Annex for details on facilities

2.1 Tata Steel Ltd.

Introduction to Tata Steel Ltd.

Established in 1907, Tata Steel is among the top ten global steel companies with an annual crude steel capacity of over 28 million tonnes per annum (MTPA). It is one of the world's most geographically-diversified steel producers, with operations in 26 countries and a commercial presence in over 50 countries. Tata Steel's larger production facilities include those in India, the UK, the Netherlands, Thailand, Singapore, China, and Australia. Operating companies within the Tata Group include Tata Steel Limited (India), Tata Steel Europe Limited (formerly Corus), NatSteel, and Tata Steel Thailand (formerly Millennium Steel). The Tata Steel Ltd. (TSL) plant under study is the Jamshedpur facility (TSL-Jamshedpur) in the Subarnarekha river basin.

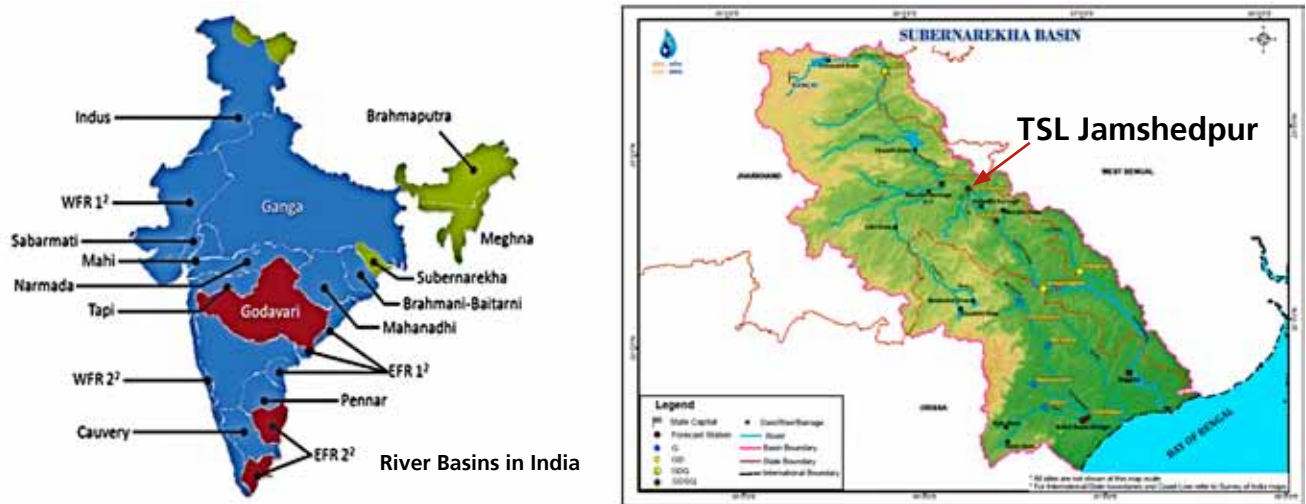


Figure 1. Location of the Subarnarekha River Basin and TSL-Jamshedpur-Jamshedpur (Figure courtesy of Amarasinghe et al., 2005 and India-WRIS Wiki, 2012)

TSL-Jamshedpur's source of water is the River Subarnarekha, which is also the main source of drinking water for most of Jamshedpur as well as of industrial water use in this area (Hota and Suresh, 2010). The data used in the water footprint accounting for TSL-Jamshedpur come from fiscal year 2012 and the first five months of 2013. This time period was selected to provide a preliminary analysis of the impact on the water footprint of various investments in new equipment made prior to 2012. Results for 2013 are not reported here to avoid the suggestion of trends that may or may not exist in reality due to the relatively short data set.

A schematic of TSL-Jamshedpur's manufacturing process is shown below.

Tata Steel India - Schematic Diagram

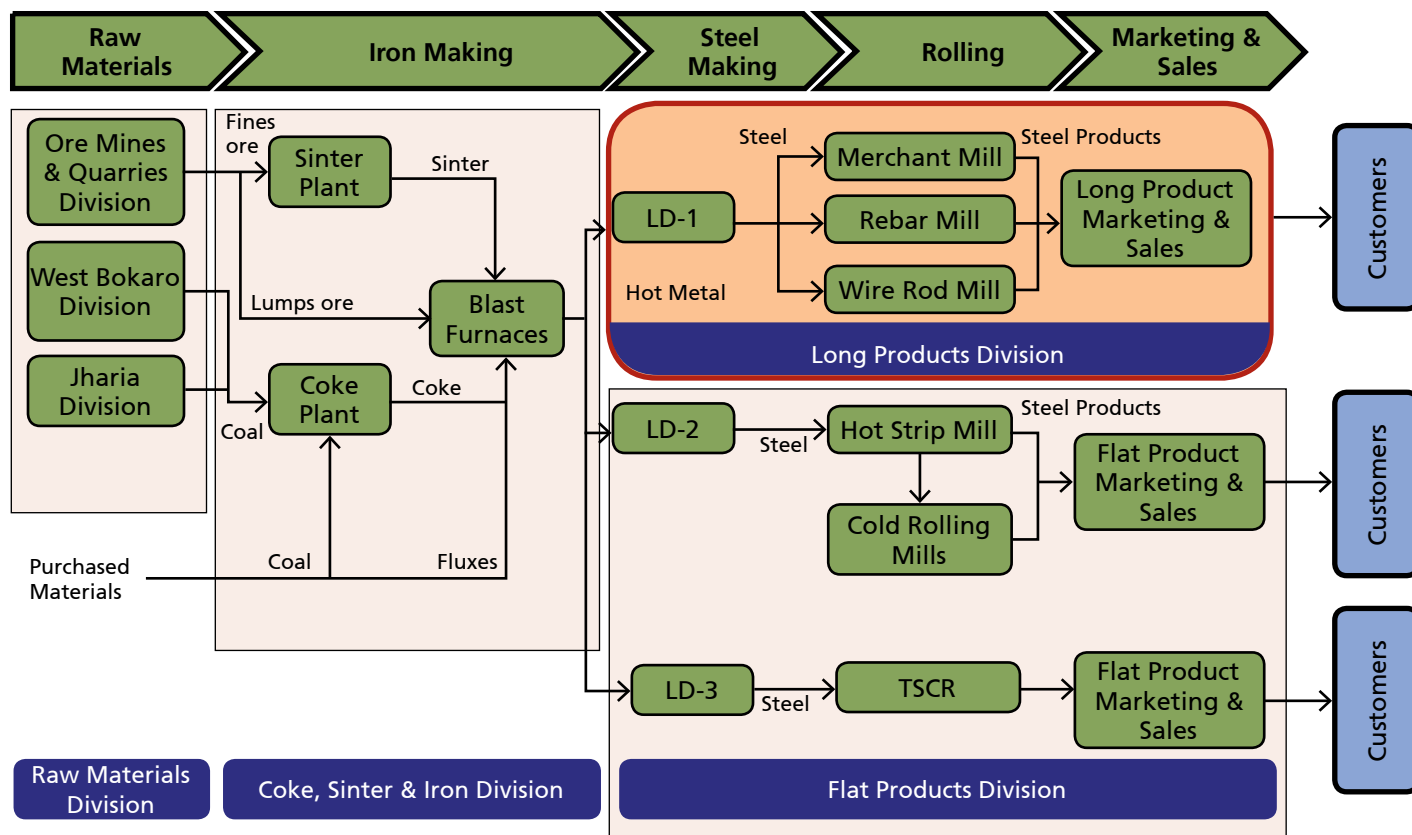


Figure 2. Schematic diagram of TSL-Jamshedpur

Sinter Making

- Steel production starts with iron ore. A mix of proportioned iron ore fines, fluxes, and coke breeze is prepared in granular form in mixers. Heat generated through combustion within the mass itself produces large lumps of hot sinter. This sinter is cooled, sized, and stored for use in the blast furnace. Evaporation losses occur through cooling.

Iron Making (Blast Furnace)

- The blast furnace is a ceramic refractory lined tall reactor used for production of liquid iron called hot metal. Iron oxide, present in the iron bearing raw materials, is reduced inside the reactor by coke and carbon monoxide. Significant evaporation losses occur primarily through the quenching (cooling through direct spraying of water) of iron ore, coal dust, and slag.

Coke Oven

- To make coke, metallurgical coal is baked in coke ovens at 900 to 1100 °C to eliminate water and impurities resulting in coke, an almost pure form of carbon. This coke needs to be structurally strong as iron ore is piled on the coke in the blast furnace. Coke is used for combustion to attain the high temperatures required for reduction of the iron ore. Coke on combustion generates carbon monoxide, which acts as the reducing agent and converts iron oxides into molten iron. Evaporation losses occur through the quenching of coke. The effluent water contains aromatic hydrocarbons and other hazardous substances.

Steel Making

- Hot liquid iron (commonly called hot metal in TSL-Jamshedpur) is converted to steel in the steel melting shops. Hot metal from the blast furnace is stored in mixers in the Linz and Donawitz (LD) converter shop, commonly called the LD1 shop. The hot metal is converted to steel in LD converters by removing its carbon, silicon, sulphur, and phosphorous contents. Most of the water loss occurs via quenching; cooling tower evaporation is also a contributor.

Hot Strip Mill (HSM)

- After leaving LD, the slab goes into the HSM where its thickness is reduced. It is then wound in a down coiler into coils. Evaporation occurs through cooling of the hot strips and from the cooling towers.

Cold Rolling Mill (CRM)

- After pickling (shallow bath pickling using hydrochloric acid), the coils are cold rolled in the 5-Stand 6-High Universal Crown Mill CRM. Evaporative losses are due to the cooling of hot strips, and to a lesser degree, from cooling towers.

Power Houses

- Water losses in the power houses are associated with cooling tower evaporation, blow-down losses from cooling towers, and losses associated with process steam (consumed and/or lost during various processes).

Overhead

- Overhead at TSL-Jamshedpur consists of water use associated with the canteen, miscellaneous construction, a waste recycling plant (WRP) for iron recovery, the Shavak Nanavati Technical Institute, the raw materials and handling yard (RMH yard), and the raw materials bedding and blending plant (called the RMBB yard). Evaporative losses occur during the WRP slag quenching, dust suppression at the RMH yard and WRP, road washing, and construction.

Tata Steel Ltd. Water Footprint Accounting

The direct blue and grey water footprint of TSL-Jamshedpur includes water footprints for all of the above processes.

TSL-Jamshedpur Direct Blue Water Footprint

TSL-Jamshedpur's direct blue water footprint is 24.9 million m³/year. Figure 3 shows the contribution from each process in 2012.

Tata Steel FY 2012 Blue Water Footprint by Process

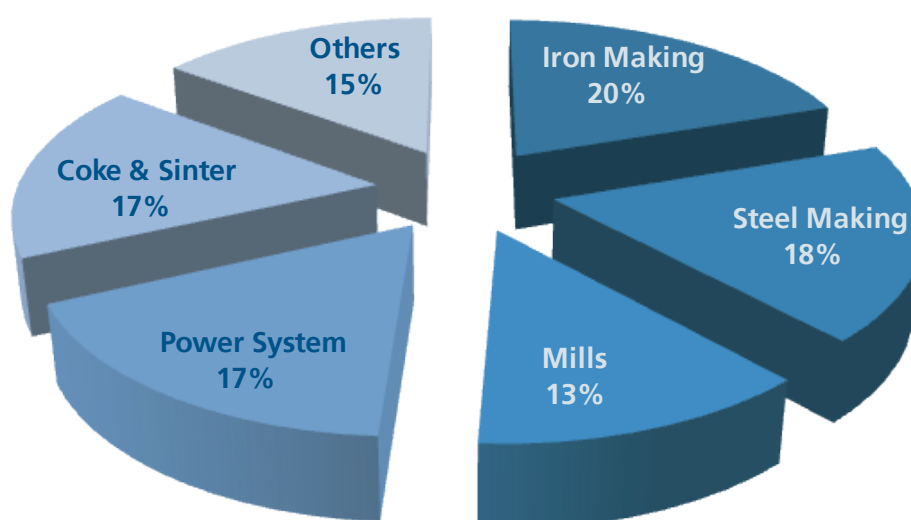


Figure 3. Process Contribution to Blue Water Footprint for 2012 in Percentage

Iron and steel making are the dominant manufacturing processes, accounting for 38 percent of TSL-Jamshedpur's blue water footprint.

TSL-Jamshedpur Direct Grey Water Footprint

Five different pollutants - total suspended solids (TSS), ammonia (NH_3), cyanide (CN), phenol, oil and grease - and the two indicators of oxygen demand - biological oxygen demand (BOD_5) and chemical oxygen demand (COD) - were analysed to determine TSL-Jamshedpur's facility grey water footprint. TSS is the critical pollutant for Tata Steel. The total grey water footprint of the facility was 15.2 million m^3 in 2012. Figure 4 shows the TSS contributions to the grey water footprint from different processes.

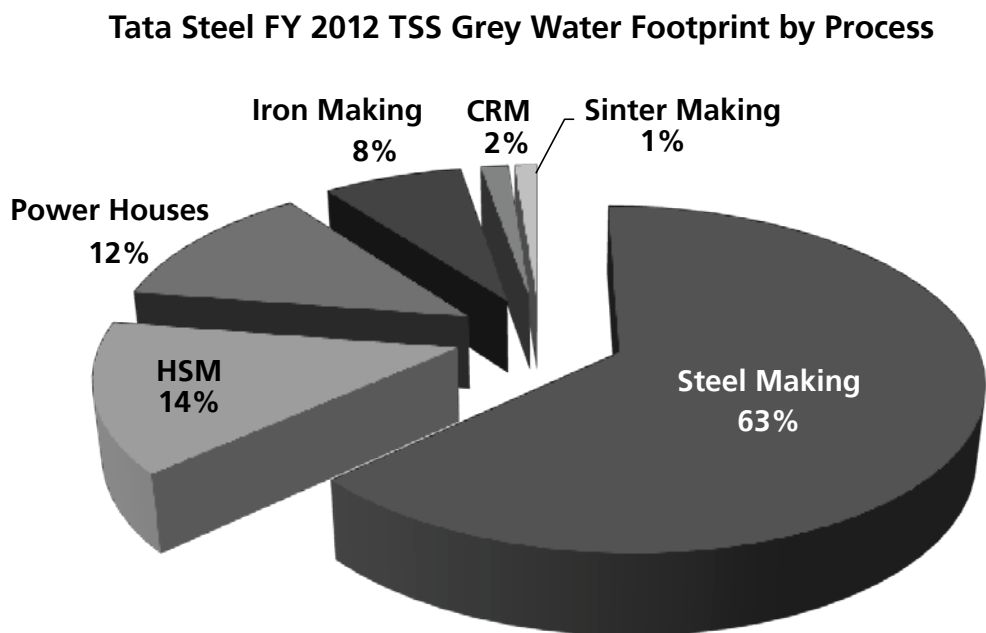


Figure 4. Process Contribution to Grey Water Footprint for FY 2012 in Percentage

The process of steel making is, by far, the dominant contributor to TSS pollution. Cyanide and oil and grease are secondary pollutants. These pollutants must also be considered in the sustainability assessment and response formulations phases as they may have different impacts on the environment and human health. In 2012, the steel making process was responsible for nearly half of oil and grease pollution. HSM, iron making, and power house processes were almost equally responsible for most of the remaining 50 percent of TSS. Cyanide is derived from just one process, coke making.

TSL-Jamshedpur Green Water Footprint

While TSL-Jamshedpur does not have a direct green water footprint associated with production, the green water footprint of onsite horticulture was calculated as part of the facility's overhead. The green water footprint of approximately 18 hectares of greenery is 122,500 m^3 /year.

TSL-Jamshedpur Indirect Blue Water Footprint

Three raw materials that contribute most to TSL-Jamshedpur's indirect blue water footprint: iron ore, coal, and limestone. TSL-Jamshedpur's source of iron ore and coal are five captive mines: two iron ore mines in Noamundi and Joda and three coal mines in Jhariya, Jamadoba, and West Bokaro. All these mines are located in India. The blue water footprint (m^3/tonne) of coal (specific per mine) and iron ore was calculated using data collected from these mines. The blue water footprint of limestone was estimated via information obtained from the Potash Corporation's Aurora mine. TSL-Jamshedpur's total indirect blue water footprint was approximately 5 million m^3 for 2012.

For FY 2012, the blue water footprint of the mines is below:

Noamundi (iron)	496,000 m^3
Joda (iron)	607,000 m^3
Jharia (coal)	1,271,000 m^3
West Bokaro (coal)	2,613,000 m^3
Lime (outsourced)	43,000 m^3

Not including overhead, approximately three quarters of TSL's total blue water footprint is associated with plant operations, reflecting the high water consumption during steel making.

TSL-Jamshedpur Blue Water Footprint of the Product

TSL-Jamshedpur's product blue water footprint includes both direct and indirect blue water footprints. The plant produced 7.13 million tonnes of crude steel during FY 2012. The sum of TSL-Jamshedpur's direct blue and indirect blue water footprint in 2012 was 30 million m^3 , resulting in a product blue water footprint of 4.21 m^3/tonne of steel.

Tata Steel Ltd. Sustainability Assessment

TSL-Jamshedpur's source of water is the River Subarnarekha, which is also the main source of drinking water for most of Jamshedpur as well as for industrial use (Hota and Suresh, 2010). Tata Group facilities in the region are responsible for a significant portion of the withdrawals from the river. The Subarnarekha is one of the longest east flowing inter-state rivers in India, flowing into the Bay of Bengal with a total length of approximately 395 km. Its major tributaries are Kanchi, Kharkai, Karkari, and Dulang (Central Water Commission, 2012).

On an average, around 100 million gallons per day (MGD) is drawn from the Subarnarekha. Of this, approximately 30 percent is consumed by TSL-Jamshedpur, 42 percent is supplied to the township and the remaining 28 percent is used by other companies (including TELCO, Tata Power, Tata Motors, TRF, Tubes Division, Lafarge Cement, and Tinsplate Co.). Groundwater is the main source of water and most domestic wastewater is untreated outside the TSL-Jamshedpur township area.

TSL-Jamshedpur completed a preliminary blue water footprint sustainability assessment using local data. The study analysed the relationship between runoff and water availability in the

catchment of the Chandil dam in the Subanarekha river basin and water footprint and water withdrawal at Jamshedpur. This analysis confirmed the potential of Chandil dam to mitigate water scarcity during the dry season.

This TSL-Jamshedpur sustainability assessment based on local data highlights the importance of Chandil dam for continuous access to water supplies. The industry and the township in Jamshedpur do not currently experience water scarcity due to the dam. However, over time as the dam supplies water to an increasing number of users, including to agriculture and households that rank higher in priority than industry, this dependency could lead to water scarcity.

Tata Steel Ltd. Response Strategies

A water footprint reduction cost curve was developed to prioritize short and longer term response strategies for blue water footprint reduction. This mapped unit cost of water responses against incremental water footprint reduction. A total of eight response strategies were detailed for the water footprint reduction cost curve. The cost curve showed that five of the identified response strategies plus the installation of new drains would result in cost savings. Short-term, low payback period responses included projects aimed at recirculating more water, treating more water for subsequent reuse, and metering all intake and discharge points to capture and track water data.

Long-term responses include converting wastewater to clarified water, converting a once-through system into a recirculating system, and installing “coke dry quenching” for a new coke oven. The latter project has a very long payback period but is, nonetheless, planned for 2014. Installing an “INBA slag granulation system” that reduces water associated with slag quenching has also been planned. A common effluent treatment plant will provide the most water savings.

A total water savings opportunity of 27 million m³/year can be realized if all response strategies are eventually implemented. This is water savings from TSL-Jamshedpur’s total withdrawal, not from its blue water footprint. If most or all of these response strategies are implemented, significant reductions in TSL-Jamshedpur’s blue and grey water footprints will likely be realized, the former primarily due to more reuse and the latter due to more treatment. These are important findings for TSL-Jamshedpur, given its plans to expand production while meeting the local authorities’ requirement of no added water withdrawal.

Response strategies at the watershed level were also developed. Short-term responses within the local watershed seeks to implement rain water harvesting (RWH) projects in all new housing colonies and at three school premises. Long-term responses within the local watershed will implement RWH in rural areas like Patamda, and increase water storage capacity of a nearby reservoir.

Short-term supply chain responses focus on assisting iron ore mines at Noamundi and Joda to develop RWH potential, and implement an iron ore dry crushing facility. Iron ore is now crushed using water, which results in this water being absorbed by the iron ore (and later evaporated from it). Dry crushing will eliminate the blue water footprint currently associated with iron ore crushing. Long-term supply chain responses include RWH projects at the Khondbond and Kutre Basantpur mines.

2.2 Tata Chemicals Ltd.

Introduction to Tata Chemicals Ltd.

Three Tata Chemicals Ltd. (TCL) facilities were chosen for the study: chemical plants in Babrala, Haldia, and Mithapur.



Tata Chemicals, Babrala (TCL-Babrala) is located in Uttar Pradesh – a state in north central India that borders Nepal. Babrala is situated approximately 150 km east of New Delhi and just a few kilometers east of the River Ganges. TCL-Babrala produces urea, ammonia, and customised fertilizer. However, urea is its main product accounting for more than 95 percent of its total production. TCL-Babrala has an installed capacity of 864,600 tonnes per annum (TPA) of urea, which constitutes nearly 12 percent of the total urea produced by the country's private sector.

TCL-Haldia is located in West Bengal – a state in the eastern region of India that is bordered by Bangladesh in the east and the Bay of Bengal in the south. Haldia is located approximately 50 km southwest of Kolkata near the mouth of the River Hooghly, a distributary of the River Ganges. TCL-Haldia has an installed capacity of over 1,200,000 TPA, producing sulphuric acid, phosphoric acid, sodium tri-polyphosphate^[7] as well as the fertilizers di-ammonium phosphate (DAP), nitrogen-potash-phosphorus (NPK) complexes and single super phosphate (SSP).

TCL-Mithapur is located in Gujarat, India – a state that is bordered by the Arabian Sea in the west and Pakistan in the north. TCL-Mithapur produces soda ash, chloro-caustic group and marine chemicals, and cement. TCL-Mithapur also produces consumer products: salt and cooking (or baking) soda. TCL-Mithapur has an installed capacity of 875,000 TPA, which constitutes about 34 percent of India's installed capacity for chemical production.

Tata Chemicals Ltd. Water Footprint Accounting

Water footprint accounting of the three TCL facilities was conducted for three years, 2010 to 2012. The direct blue, green, and grey water footprints for the three TCL facilities are shown in figure 5. For 2012, the blue footprint was 85 percent, grey 8 percent, and green 7 percent.

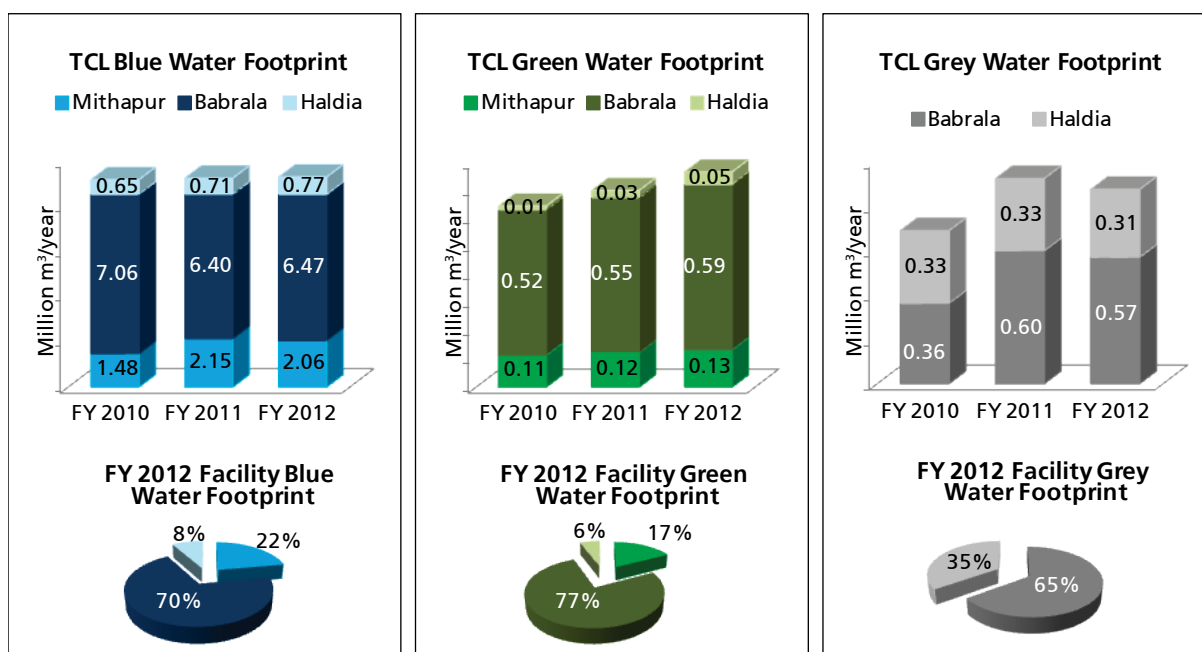


Figure 5. TCL blue, green and grey water footprints (FY 2010-12)

[7] Production of sodium tri-polyphosphate has stopped since January 2011

TCL-Babralla has the largest total direct facility water footprint of the three companies. TCL-Haldia has the lowest due to the low water intensity of its processes. TCL-Mithapur reduces its blue water footprint by using seawater for as much as 97 percent of its water requirements.

Domestic effluent accounts for 93 percent of TCL-Babralla's grey water footprint. Effluent from demineralization (DM) and cooling processes together account for almost two thirds of TCL-Haldia's grey water footprint. TCL-Mithapur does not have a grey water footprint because it discharges its effluent to the sea (grey water footprints are for freshwater discharges only). The green water footprint is from horticulture/landscaping activities within the facility and accounts for 7 percent of combined direct facility water footprint. However, since it is an overhead, it is not considered formally in the sustainability assessment and response formulation phase.

Tata Chemicals Ltd. Direct Blue Water Footprint

TCL-Mithapur has a comparatively low blue water footprint as only 3 percent of its water requirement is met through external freshwater sources. The remaining is met through seawater, desalinated seawater, and onsite generated water (rainwater, reused water). TCL-Haldia has the lowest blue water footprint. This is due to its less water-intensive production processes.

TCL-Babralla

Groundwater is the major source of water for TCL-Babralla. Here, water is primarily used for cooling, boiler feed, various production processes, and overhead. The facility supplies freshwater for domestic use of its employees and families in the township within the premises. Groundwater is also used for horticultural purposes. Water consumption in the township and for horticulture is a part of overhead, in addition to water used in offices and canteens.

The water footprint accounting results showed that cooling consumed the most water with nearly 70 percent share of total direct blue water footprint. Water polishing (for boiler feed) directly related to production, accounted for 13 percent of total direct blue water footprint. The blue water footprint of township domestic water supply accounted for about 14 percent. However, domestic water consumption is not directly related to production. The blue water footprint of other production processes and factory overhead water use accounted for the remaining 3 percent.

TCL-Haldia

TCL-Haldia uses freshwater mainly for cooling, demineralisation (DM) and various processes to manufacture phosphoric and sulphuric acids, and phosphate-based fertilizers such as DAP, NPK, and SSP. The water for this is supplied by the local water utility. Water is also used domestically and for gardening, which were considered as overhead in the facility water footprint accounting.

TCL-Haldia's freshwater resources are mainly consumed for cooling. This accounted for 43 percent of total direct blue water footprint over the three years. Demineralization was the second largest blue water consumer with 22 percent average, while the overhead blue water footprint was 19 percent. Water directly consumed in various production processes accounted for just 16 percent. TCL-Haldia had the lowest blue water footprint of the three facilities as its processes were less water intensive.

TCL-Mithapur

TCL-Mithapur has a comparatively low blue water footprint because only 3 percent of its water requirement is met through external freshwater sources. The remaining water demand is met through seawater, desalinated seawater, and onsite generated water (rainwater, reused water). The direct blue water footprint for production of soda ash, cement, caustic products, and salt accounted for 71 percent of the total direct blue water footprint on average for the three fiscal years studied. TCL-Mithapur also provides water for domestic use for a township that is located within the facility premises. Similar to TCL-Babralla, this blue water consumption was calculated and included in the facility and product water footprint accounts since it is regarded as a type of overhead water use. The blue water footprint due to domestic water use of the township amounts to 26 percent of the total on average. Some water is used to irrigate landscaping within the facility premise. Such water consumption is also regarded as an overhead component of the blue water footprint of the facility, which is about 2 percent of the total direct blue water footprint on average.

Tata Chemicals Ltd. Direct Grey Water Footprint

TCL-Babralla

TCL-Babralla discharges effluents into a seasonal stream and also for irrigation of horticultural areas. Domestic effluent is discharged into the seasonal stream after treatment. The critical pollutant to determine grey water footprint was organic waste resulting in biological oxygen demand (BOD₅). The grey water footprint of total suspended solids (TSS) was also calculated but this had a lower grey water footprint than organic matter.

In 2012, domestic pollution accounted for 93 percent of TCL-Babralla's grey water footprint while industrial pollution accounted for the remaining 7 percent. The domestic grey water footprint increased over the three years as a result of a 20 percent increase in the volume of effluent and an associated increase in BOD₅.

TCL-Haldia

Surface water discharge is a mix of treated industrial and domestic effluents discharged into the Green Belt Canal. Both effluents are treated separately before discharge. The canal carries the effluent from neighbouring industries to the River Hooghly near Patikhali.

Phosphate and organic waste resulting in biological oxygen demand (BOD₅) were used to calculate grey water footprint (grey water footprint of fluoride was also calculated). Demineralization is the main contributor toward TCL-Haldia's grey water footprint, accounting for an estimated 37 percent. Cooling is the next with 27 percent, followed by other production processes (18 percent), and domestic (17 percent).

TCL-Mithapur

Located along the coast, TCL-Mithapur discharges its effluent to a canal and immediately into the Gulf of Kutch. TCL-Mithapur has a zero grey water footprint because it has no effluent discharge into freshwater bodies.

Tata Chemicals Ltd. Green Water Footprint

The green water footprint associated with onsite greenbelts (landscaping) was considered an overhead.

Tata Chemicals Ltd. Indirect Blue Water Footprint

Raw material water footprint estimates from literature sources were used to develop indirect water footprint calculations.^[8]

TCL-Babralla

In 2012, TCL-Babralla's indirect blue water footprint was 3.09 million m³. Ninety-six percent of this was associated with natural gas and naphtha used in the production of urea. The remaining 4 percent was associated with packaging material, as well as other minor chemicals and raw materials used for customized fertilizers. One-hundred percent of TCL-Babralla's indirect blue water footprint fell within India. In 2012, this indirect blue water footprint was 35 percent of total blue water footprint (not including blue water footprint of the township).

TCL-Haldia

In 2012, TCL-Haldia's indirect blue water footprint was 3.11 million m³. Fifty-three percent of this was derived from phosphoric acid production. The remaining indirect water footprint contributors included ammonia (28 percent), muriate of potash, or MOP (8 percent), purchased power (4 percent), and rock phosphate (3 percent).

[8] Indirect blue water footprint data is based on estimates from Gerber-Leens (2008), Gleick (1993, 1994), and Katsoufis (2009)

Figure 6 presents source locations for TCL-Haldia's supply chain. TCL-Haldia's entire indirect blue water footprint lies outside India.

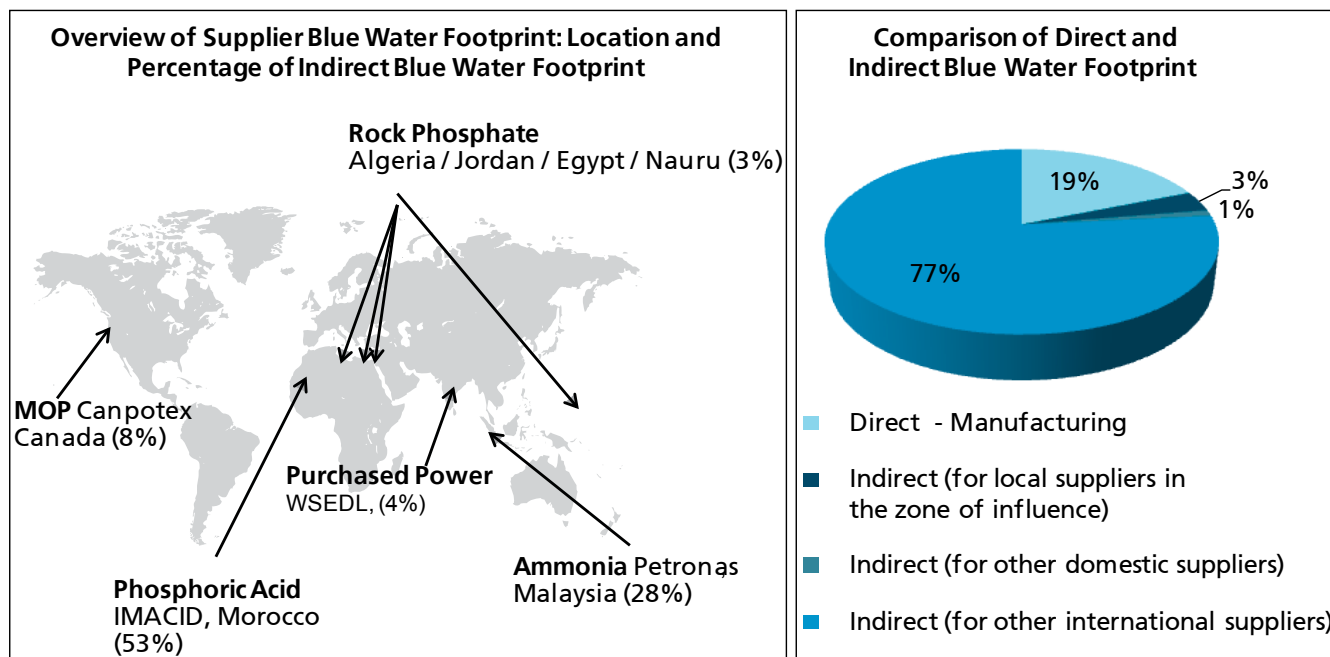


Figure 6. Location of TCL-Haldia's supply chain blue water footprint; comparison of TCL-Haldia's direct blue water footprint of manufacturing and indirect blue water footprint for local suppliers in the zone of influence, indirect blue water footprint for other domestic suppliers and indirect blue water footprint for international suppliers (average FY 2010-12)

The indirect footprint is useful to assess sustainability over the value chain and to identify key supply chain partners for further improved product sustainability.

Neha Bhandari, Tata Chemicals Limited

TCL-Mithapur

In 2012, TCL-Mithapur's indirect blue water footprint was 3.63 million m³. Ninety-five percent of TCL-Mithapur's indirect blue water footprint was associated with fuel sourcing. Sixty-two percent of inputs are sourced from outside India.

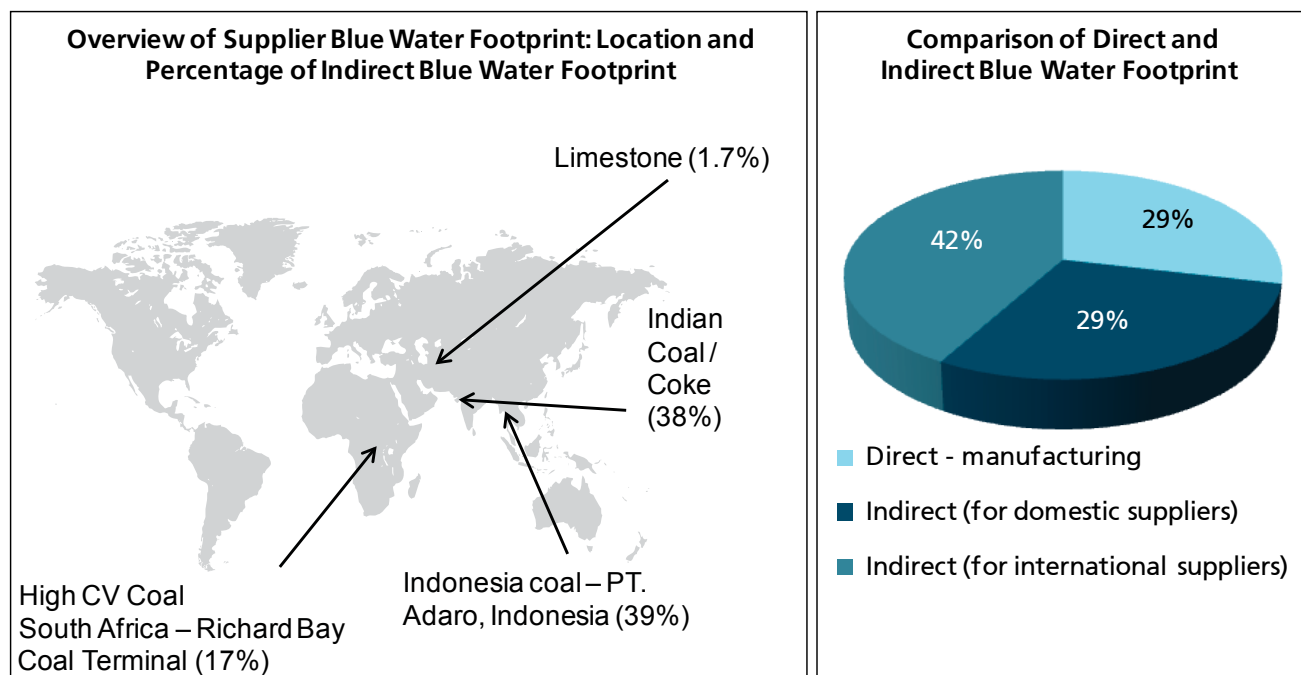
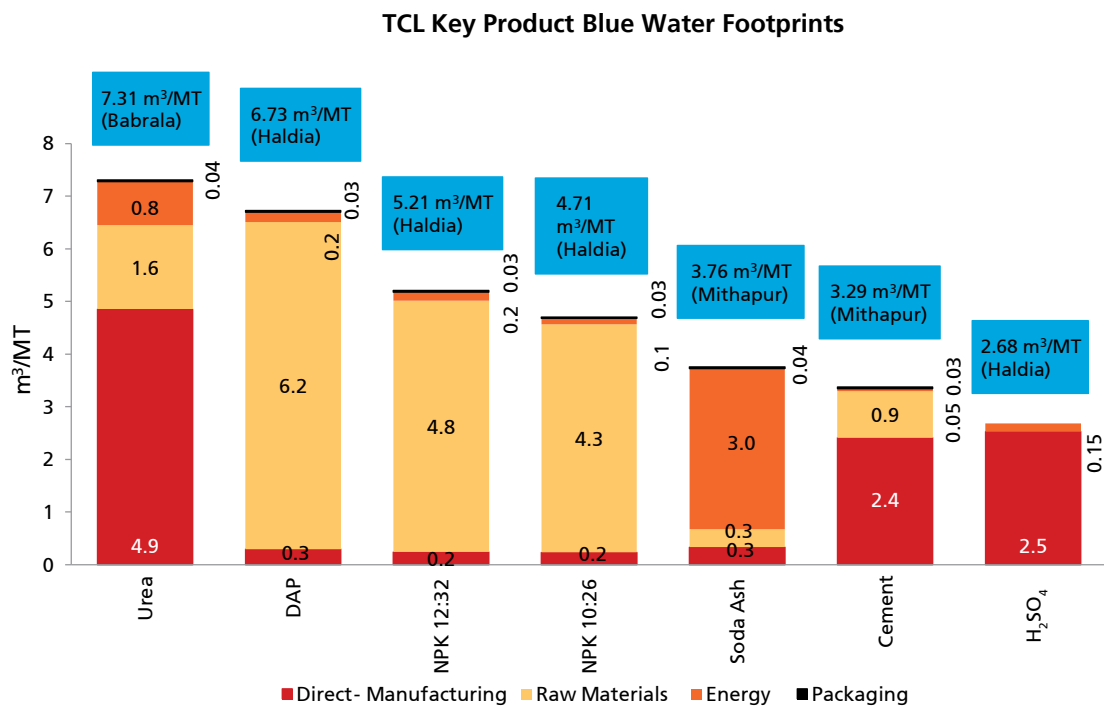


Figure 7. Location of TCL-Mithapur's supply chain blue water footprint; Comparison of TCL-Mithapur's direct blue water footprint for manufacturing (excluding township), indirect blue water footprint for domestic suppliers, and indirect blue water footprint for international suppliers (FY 2012)

Tata Chemicals Ltd. Blue Water Footprint of the Product

The highlights of the blue water footprint of TCL's products at its three facilities are shown below.



Note: Product Blue Water Footprint is average of FY 2010 - 12 Water Footprint

Figure 8. Tata Chemicals key product blue water footprints

Table 1. Tata Chemicals Product Blue Water Footprints, average FY 2010-12

Tata Chemicals Product Blue Water Footprints	
Facility/Product	Product Blue Water Footprint
TCL-Babrara	
Urea	7.31 m ³ /tonne
TCL-Haldia	
Phosphoric acid	23.5 m ³ /tonne
Di-ammonium phosphate (DAP)	6.73 m ³ /tonne
Nitrogen-phosphorus-potassium (NPK) fertiliser (12:32)	5.21 m ³ /tonne
Nitrogen-phosphorus-potassium (NPK) fertiliser (10:26)	4.71 m ³ /tonne
Sulphuric acid	2.68 m ³ /tonne
Single super phosphate (SSP)	1.73 m ³ /tonne
TCL-Mithapur	
Bromine	6.26 m ³ /tonne
Dense ash	3.96 m ³ /tonne
Soda ash	3.76 m ³ /tonne
Cement	3.29 m ³ /tonne
Bicarbonate	3.12 m ³ /tonne
Caustic	2.86 m ³ /tonne
Pure salt	2.27 m ³ /tonne
Vacuum salt	1.19 m ³ /tonne
Clinker	0.87 m ³ /tonne
Liquid chlorine	0.51 m ³ /tonne
Hydrochloric acid	0.1 m ³ /tonne

Tata Chemicals Ltd. Sustainability Assessment

TCL-Babralla

Groundwater is the sole source of water for TCL-Babralla. According to WaterStat (Hoekstra and Mekonnen, 2011), TCL-Babralla is in a hotspot from January through May due to very low natural runoff during the dry season. However, hotspots are based on surface water scarcity. No data was available to assess sustainability of the aquifer.

TCL-Haldia

TCL-Haldia's share of the total water supplied by utilities to local industry and other sectors like commercial and domestic is approximately 1.8 percent.

Although WaterStat (Hoekstra and Mekonnen, 2011) does not cover the Haldia area specifically, it does show that TCL-Haldia is adjacent to areas identified as hotspots from January through May. During this period, blue water footprint for the area exceeds blue water availability. Because of the Farakka Barrage, a dam across the River Ganges, the River Hooghly has consistent flows even during the dry season. Treated industrial effluent is discharged through the Green Belt Canal at Patikhali; this flows into the Hooghly and ultimately to the sea. The river from this zone is used for navigation and minor fisheries. Water quality issues are of more critical importance than availability in this basin.

TCL-Mithapur

TCL-Mithapur receives some of its freshwater (3 percent) from two rain-fed lakes: Lake Mithikhari and Lake Bhimgaja. The remaining water is somewhat equally derived from onsite generated water during manufacturing of salt through the make-up water plant, waste heat flash recovery, weak liquor distillation, and desalinated water through the reverse osmosis (RO) plant. Similar to Haldia, WaterStat (Hoekstra and Mekonnen, 2011) does not include Mithapur specifically. However, data does show that TCL-Mithapur is adjacent to areas identified as hotspots from January through May. Thirteen percent of stored surface water is used by industry. TCL-Mithapur's share of that is half. The remaining is used by other industries such as ice production, fisheries, and tourism. Because of on-going water scarcity issues, engagement with industries and the local community is a priority.

Tata Chemicals Ltd. Response Strategies

A number of company-wide and facility specific response strategies were identified through the development of water footprint reduction cost curves. These strategies are shown in figure 9.

Water Strategy		Present Status	Response Phase -1	Response Phase -2	Response Phase - 3
Establish Baseline and improve performance	Water Footprint Accounting -Direct	Direct completed	Identify projects for reduction of footprint	Zero discharge implementation to eliminate grey water footprint	Strive for being a benchmark in own sector
Establish Baseline and improve performance	Water Footprint Accounting -Indirect	Indirect Blue water footprint using secondary data sources completed	Identify key suppliers based on secondary data & engage with them	Supplier water footprint and sustainability assessment	Supplier performance improvement & sustainable sourcing strategies
Source Sustainability Assessment	Identify & address water related risk areas	Sustainability assessment completed	Multiple stakeholder engagement and awareness building	Collaborative projects for future sustainability and shared uses	Sustainability reporting through Water CDP, CEO Water Mandate, etc.
Product Stewardship	Value chain Engagement & innovation for sustainable products	Product water footprint baseline established	Identify key areas of improvement	Multiple stakeholder engagement	Projects for sustainable product uses; models for future organic & inorganic growth; benchmark in own sector

Completed
To be started
In-progress

Figure 9. Tata Chemicals Ltd. response strategies

Facility specific response strategies include TCL-Babrula reusing cooling tower water blow-down as well as treated water from the sewage treatment plant for cooling tower make-up after reverse osmosis (RO). TCL-Haldia is also planning to use treated effluent and ultrafiltration (UF) backwash for cooling tower make-up. TCL-Mithapur response strategies are focused on the watershed – in particular, the arrest of salinity ingress.

In addition, the three facilities have developed response strategies geared toward improving watershed sustainability. These include rainwater harvesting projects, check dam projects, recharging village ponds and tanks, training farmers, awareness drives, and drinking water and sanitation programs.



2.3 Tata Power Ltd.

Introduction to Tata Power Ltd.

Tata Power Ltd. (TPL) is India's largest integrated power company with a significant international presence. The company's thermal power stations are located at Trombay in Mumbai, Maharashtra, Jojobera in Jharkhand, Haldia in West Bengal, and Belgaum in Karnataka. TPL-Trombay and TPL-Jojobera participated in this project.



Figure 10. Location of Tata Power facilities

TPL-Jojobera is located near Jamshedpur where Tata Steel and Tata Motor facilities are also located. This facility has five thermal power generation units that use a combination of coal and light diesel oil as power sources. TPL-Jojobera provided 6,988 MU (million units, or 1 million kWh) of power in 2012. TPL-Jojobera receives freshwater from Jamshedpur Utilities and Services Company (JUSCO), a Tata Steel subsidiary, which withdraws water from the River Subarnarekha. JUSCO's withdrawal from the Subarnarekha is approximately 3.4 million m³/day of which TPL-Jojobera obtains 35,000 m³/day.

TPL-Trombay is located just outside Mumbai. TPL-Trombay supplied 9,211 MU of power in 2012. It has five thermal units of 150 MW (oil and gas based), 500 MW (oil and gas based), 500 MW (oil, coal and gas based), 180 MW (gas based), and 250 MW (coal based). The first unit (Unit 4) was built in 1965, the last (Unit 8) in 2009. This power station uses both seawater and freshwater in its operations. Seawater is used for cooling (once-through system) while freshwater is used for steam generation and overhead (domestic and landscaping). TPL-Trombay's freshwater source is the Bhatsa reservoir, approximately 100 km to the north. Using seawater for cooling greatly reduces TPL-Trombay's blue water footprint.

Tata Power Ltd. Water Footprint Accounting

The period for which accounting was carried out for the two TPL facilities was the three years from 2010 to 2012. A comparison of the two facilities is shown in figure 11.

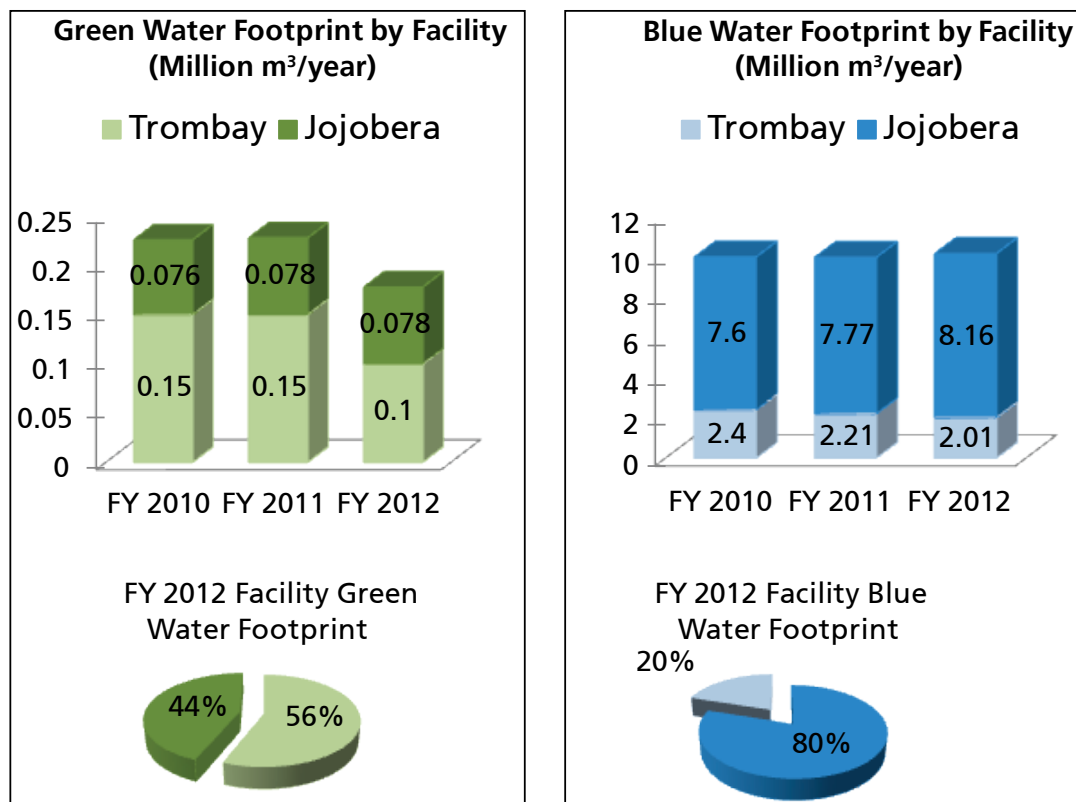


Figure 11. TPL blue and green water footprints (FY 2010-12)

Grey water footprints are not displayed as TPL-Trombay discharges into the sea while TPL-Jojobera has a high quality effluent treatment plant.

Tata Power Ltd. Direct Blue Water Footprint

TPL-Jojobera

Cooling is the main contributor to the blue water footprint (99 percent). Demineralisation contributes 1 percent, while overhead is negligible. TPL-Jojobera's blue water footprint is higher than TPL-Trombay's as Jojobera uses freshwater for its cooling towers while Trombay uses seawater.

TPL-Trombay

Seawater is used for cooling at TPL-Trombay, significantly reducing its blue water footprint. Freshwater consumption in this facility is mainly due to steam generation and in-plant domestic services, as well as overhead for horticulture. Horticulture contributes more than 50 percent of the water footprint, because demineralization is not water intensive. Figure 12 details TPL-Trombay's blue water footprint by process and correlates that to power generation.

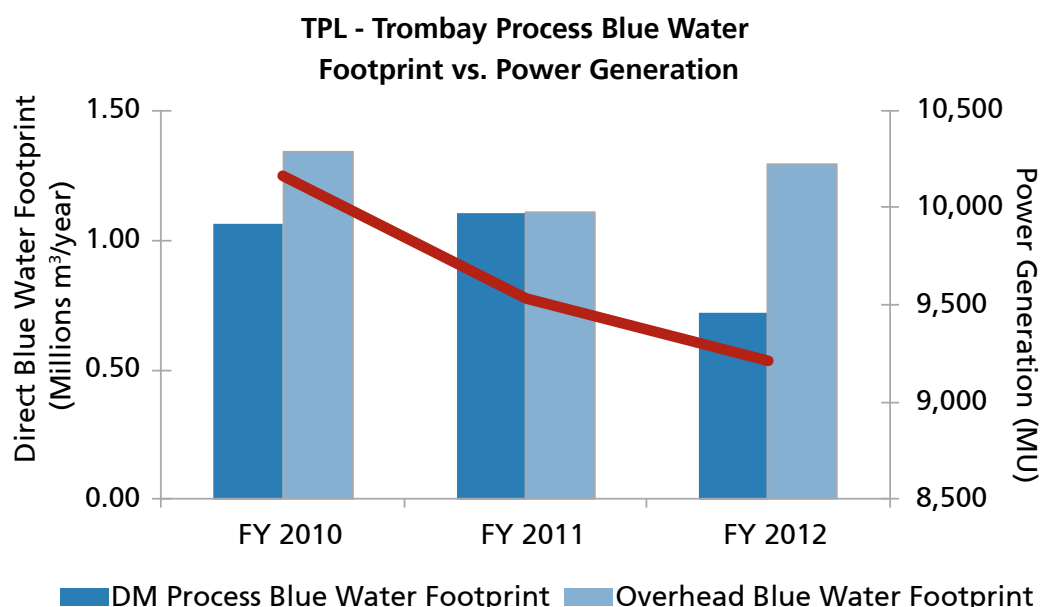


Figure 12. TPL-Trombay process blue water footprint vs. power generation (FY 2010-12)

Seawater is used for cooling, which is why overhead is such a high percentage of the blue water footprint. Effluent discharges are directed to the sea.

One can see that TPL-Trombay's blue water footprint is trending down, which is related to the decreasing power production. Factors other than direct electricity generation also influence the blue water footprint. These include age of units, climatic conditions, unit maintenance/management practices, and overhead. Overhead consumption is not directly related to generation and as such, it does not correspond to declining power generation. While a certain amount of overhead water use exists regardless of power generation, there is variability due to external causes such as maintenance practices, size of workforce, number and duration of shutdowns, and duration of partial production capacity.

Water consumption for demineralization does follow power generation trends more closely, although there is a minor increase in 2011. This is because a variety of other factors also have an influence on this.

Tata Power Direct Grey Water Footprint

As noted, neither facility has a grey water footprint.

Tata Power Green Water Footprint

TPL's green water footprints associated with onsite greenbelts (landscaping) was calculated. This footprint is considered as part of overhead.

Tata Power Ltd. Indirect Blue Water Footprint

The indirect blue water footprint was calculated for TPL's fuel materials, coal, oil and gas, based on literature estimates.^[9]

According to this, oil has a blue water footprint of 1.06 m³/GJ. Coal has 15 percent of the blue water footprint of oil: 0.16 m³/GJ, and gas has 10 percent: 0.11 m³/GJ. While only an estimate, this information can help understand the magnitude of indirect blue water footprint when compared to direct. In addition, it can help guide decision making about fuel sources, while considering pertinent data such as varying carbon footprints of energy sources.

TPL-Jojobera

TPL-Jojobera uses coal and oil for electricity generation. Coal is the dominant source, and it comes from two locations in India: Ib Valley and West Bokaro. In 2012, coal accounted for 97 percent of TPL-Jojobera's indirect blue water footprint. Oil, on the other hand, also sourced within India, accounted for just 3 percent.

The indirect blue water footprint for TPL-Jojobera was an estimated 4.8 million m³ in 2010, 5.7 million m³ in 2011 and 6.8 million m³ in 2012. This represents an increase of 19 percent from 2010 to 2011, and another 19 percent increase the following fiscal year. While the use of oil increased from 2011 to 2012, the amount is extremely small in comparison to coal which is primarily responsible for the increases in both years.

[9] Indirect blue water footprint data is based on estimates from Gerber-Leens (2008) and Gleick (1993, 1994)

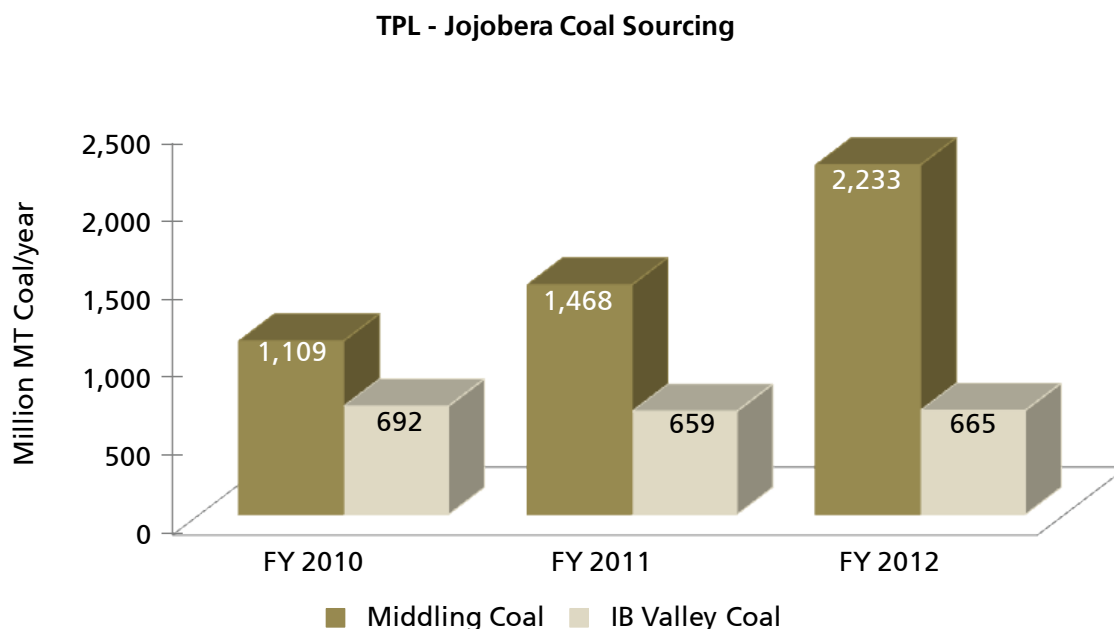


Figure 13. TPL-Jojobera trends in coal sourcing (Million MT/year) for FY 2010-12

TPL-Trombay

TPL-Trombay uses a mixture of oil, gas and coal for electricity generation. TPL-Trombay's use of coal and gas increased in 2011 followed by a decrease in 2012. Oil use followed the opposite trend - it decreased in 2011 and then increased. Since the water footprint of oil is approximately seven times that of coal and ten times that of gas, the trend in blue indirect (figure 14) water footprint follows that of oil, not coal and gas.

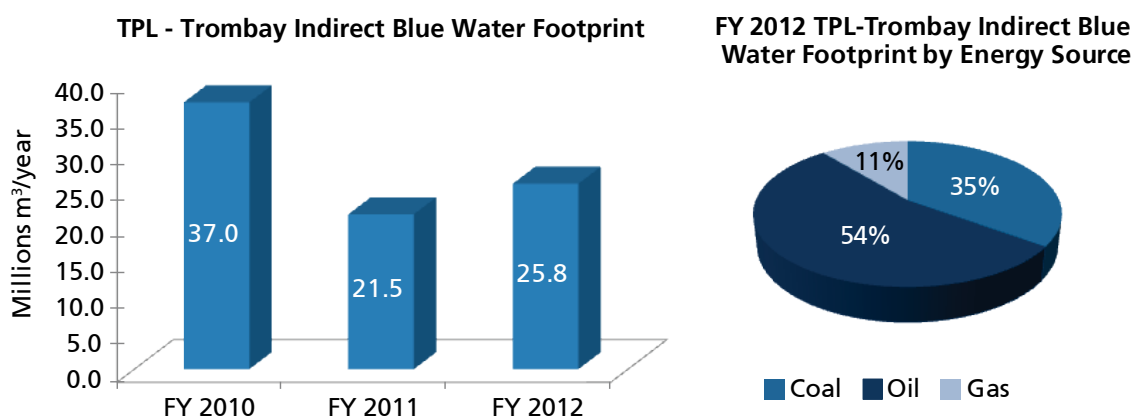


Figure 14. TPL-Trombay annual indirect blue water footprint (FY 2010-12) and indirect blue water footprint by energy source (2012)

In 2012, more than half of TPL-Trombay's indirect blue water footprint came from oil from India and the Gulf, while a third came from Indonesian coal and the rest from gas sourced from India. Because of TPL-Trombay's extensive use of seawater, its indirect blue water footprint is 93 percent of its total blue water footprint.

Tata Power Ltd. Blue Water Footprint of the Product

For TPL-Jojobera, the 2010 to 2012 average product blue water footprint was 4,250 m³/MU; 57 percent of which was direct water footprint and 43 percent indirect. For TPL-Trombay, the 2010 to 2012 average product blue water footprint was 3,135 m³/MU; 7 percent of which was direct water footprint and 93 percent was indirect. The indirect footprint dominated TPL-Trombay's product blue water footprint because of extensive use of seawater. However, the difference is muted because of Trombay's extensive use of oil as a fuel source, which has a much higher blue water footprint than coal or gas.

Tata Power Ltd. Sustainability Assessment

TPL-Jojobera

TPL-Jojobera is located in the Subarnarekha river basin near the Tata Steel facilities. The sustainability assessment for this watershed has been discussed earlier.

TPL-Trombay

TPL-Trombay receives freshwater from the Municipal Corporation of Greater Mumbai (MCGM). MCGM supplies approximately 3 million m³/day to Mumbai from six reservoirs situated on the western slopes of the Western Ghats. Bhatsa reservoir, one of these six reservoirs, supplies all freshwater received at the facility. The Bhatsa reservoir, fed by seasonal rivers, is situated roughly 100 km northeast of the facility. Water is transported to the facility through pipelines. TPL-Trombay consumes approximately 5,000 m³/day of freshwater on an annual average basis, accounting for 2 percent of the MCGM's supply capacity.

Even though the freshwater consumption of TPL-Trombay is a small proportion of the total water supplied by MCGM, this still contributes to the pressure on water resources of related watersheds. Due to competing uses (domestic, agriculture, industry, ecosystem, and environment) TPL-Trombay could become vulnerable to water scarcity due to governmental prioritization of water allocation.

Tata Power Ltd. Response Strategies

Water footprint accounting and sustainability assessment have led to numerous possible response strategies that TPL-Jojobera could apply in the future. These strategies include recycling blow-down water, redesigning the slurry system, rainwater harvesting, cooling tower and condenser improvements, changing from wet to dry cooling systems for air conditioning cooling towers, and minimizing water use for ash management. The first two of these were analysed with a cost curve approach. This showed that total blue water savings for TPL-Jojobera could be up to 2.56 million m³/year. Plans to improve sustainability of the watershed jointly with other Tata facilities and suppliers are also in the pipeline.

TPL-Trombay is considering a number of response strategies. These include reuse of condensate to suppress coal dust and recycling boiler blow-down water. A cost curve reveals that desalination can substantially reduce blue water consumption; however the cost is significantly high. Cost is not the only factor, however, in determining what response strategies to pursue. This strategy, despite the high cost, is being considered due to the risk of water scarcity in the future arising from increasing demand from other sectors as well as water allocation and supply priority by the authorities.



2.4 Tata Motors Ltd.

Introduction to Tata Motors Ltd.

Six Tata Motors Ltd. (TML) facilities were chosen for the study. These were all automotive plants, one each in Jamshedpur, Lucknow, Pantnagar, and Sanand and two in Pune. The two Pune plants were a commercial vehicle business unit (CVBU) and a passenger car business unit (PCBU).



TML-Jamshedpur is located in the industrial city of Jamshedpur in the Subarnarekha river basin. Established in 1945, the Jamshedpur unit was the company's first unit and is spread over an area of 822 acres. It consists of four major divisions - truck factory, engine factory, cab factory and cowl factory. The main assembly line has 20 work stations with a vehicle rolling out every 8 minutes. The other line is dedicated to special purpose vehicles and to meet requirements of the Indian Army.

The Pune unit is spread over two geographical regions - Pimpri (CVBU - 800 acres) and Chinchwad (PCBU - 130 acres). Established in 1966, it houses a vehicle manufacturing complex that produces a large variety of individual items and aggregates. It is engaged in design and manufacture of sophisticated press tools, jigs, fixtures, gauges, metal pattern and special tools, as well as models of new ranges of automobile products. Medium and heavy commercial vehicles, light commercial vehicles, utility vehicles, and passenger cars are all produced here.

TML-Lucknow is located in Uttar Pradesh. One of the youngest production facilities among all Tata Motors locations, it was established in 1992 to meet the demand for commercial vehicles in the Indian market. The plant is specialised in designing and manufacturing a range of modern buses. The plant is currently in an expansion phase and production at Lucknow is anticipated to grow by several times in the near future.

TML-Pantnagar is located in Uttarakhand. The plant began commercial production of its mini-truck Ace and the passenger carrier Magic in August, 2007. This is the company's fourth plant, after Jamshedpur (commercial vehicles), Pune (commercial vehicles and passenger vehicles) and Lucknow (commercial vehicles). The plant is spread over 953 acres, of which 337 acres is occupied by the vendor park.

Tata Motors' plant at Sanand in Ahmedabad district of Gujarat manufactures the Tata Nano. The capacity of the plant is 250,000 cars per year (to be achieved in phases), and with some balancing is expandable up to 350,000 cars per year. Provisions for further capacity expansion have also been incorporated in this location. Built in early 2010, this integrated facility is spread over 725 acres. There is an adjoining 375 acre vendor park to house key component manufacturers.

Tata Motors Ltd. Water Footprint Accounting

Data used in the water footprint accounting covered 2010 to 2012 for all facilities except TML-Sanand, which is a new facility with only two fiscal years of data. Figure 15 shows the direct 2012 blue, green and grey water footprints for the six TML facilities.

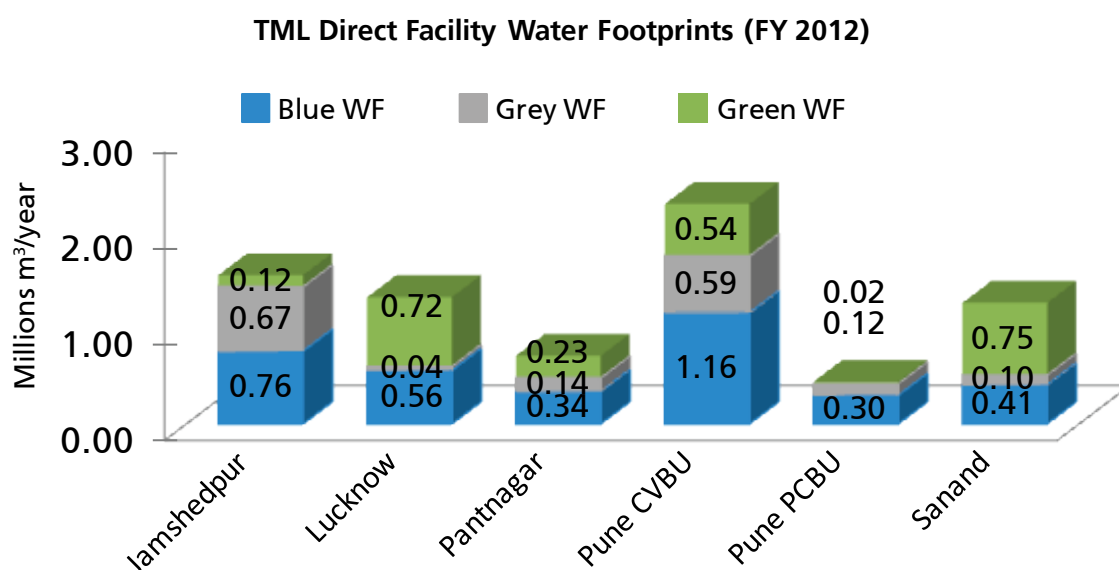


Figure 15. TML blue, green and grey water footprints (FY 2012)

TML-Pune CVBU has the highest blue water footprint and also the largest facility direct water footprint. TML-Jamshedpur has the highest grey water footprint. TML-Lucknow and Sanand each have the highest green water footprints.

Tata Motors Ltd. Direct Blue Water Footprint

Production at TML-Jamshedpur steadily increased over the three fiscal years by 17 percent from 2010 to 2011 and by 11 percent from 2011 to 2012. Water recirculation systems are an integral part of all cooling water use points. Both utility services (compressor house, generator house) as well as production areas (engine testing, centralized paint shop, and press shop of the forge) have water recirculation systems. Treated effluent is used in various industrial processes, notably the cooling towers.

TML-Jamshedpur's blue water footprint decreased by 22 percent from 2010 to 2011. While the blue water footprint decreased in 2011, production increased by 17 percent. This somewhat

surprising trend was also seen in TML-Pune and Pantnagar. One reason for this is that a certain level of overhead exists regardless of production, and this overhead can vary, sometimes considerably. Also, data relies on the assumption that consumption equals withdrawal minus effluent discharge. When there are water leakages or other anomalies, that simple equation creates imperfect data.

Rainwater harvesting (RWH) supplies approximately 15 percent of TML-Jamshedpur's needs. In 2012, 476,000 m³ was harvested and used throughout the facility. The site is essentially a large catchment area that drains to an infiltration pond in the southeast corner of the site. Water is withdrawn via an 18 m deep well in the middle of this pond. This semi-treated water is then transported, filtered, and reused.

TML-Jamshedpur expanded in phases. Because of this, knowledge on the water supply transmission system and associated leakages is incomplete. Recently a GIS mapping effort was introduced at TML-Jamshedpur to determine the pipeline layout plan and leakages. Potable water is currently used for irrigation, but the possibility of using harvested rainwater, where feasible, is being examined.

Tata Motors Ltd. Direct Grey Water Footprint

Seven different potential pollutants and indicators were analysed to determine TML-Jamshedpur's grey water footprint. These were total dissolved solids (TDS), total suspended solids (TSS), oil and grease, pH, dissolved oxygen (DO), and the two indicators of oxygen demand – biological oxygen demand (BOD₅) and chemical oxygen demand (COD). The pollutant that requires the largest assimilation volume on an annual basis is BOD₅. If BOD₅ is considered the critical pollutant, the 2012 total grey water footprint was 0.67 million m³ (other facility grey water footprints are shown in figure 15 above). TML-Jamshedpur has an effluent treatment plant with a capacity of 554 m³/day. A sewage treatment plant with a capacity of 150 m³/day is under installation.

Tata Motors Ltd. Green Water Footprint

TML's green water footprint is associated with onsite greenbelts/landscaping (figure 15). This footprint is considered an overhead.

Tata Motors Ltd. Indirect Blue Water Footprint

All large suppliers were contacted in an effort to better understand the indirect blue water footprint. Only a small percentage of suppliers responded. More work with suppliers was needed, so the partnership conducted a water footprint workshop in Pune on February 13, 2013 with fifteen representatives from eleven selected vendors. In addition, TML plans to identify a shortlist of vendors who have water intensive operations and are common to different TML locations, closely work with them on water footprint quantification, and replicate the Pune vendor roll-out exercise at other TML locations.

The Water Footprint Assessment of our operations and in our supply chain has been a very useful one and it has generated an enormous amount of realization and sensitization towards water as a critical resource for our business. Initiating a water footprint exercise with our major vendors and influencing them gives us additional assurances that we will manage water well through effective abatement measures.

**Suresh Tanwar, Corporate Head
Safety, Health & Environment,
Tata Motors Limited**

Tata Motors Ltd. Blue Water Footprint of the Product

Due to challenges in identifying blue water footprints of its suppliers, TML could only calculate direct blue water footprint of its equivalent vehicles, not both direct and indirect blue water footprints. For TML, the product is an equivalent vehicle. The concept of an equivalent vehicle is used for productivity measurement in terms of standard man hours (SMH) needed to manufacture a base model (a standard vehicle model produced in significant numbers). The SMH for the selected base model is then converted into factors for other models manufactured at that location. For example, at TML-Sanand it is the Nano.^[10] TML-Jamshedpur, Lucknow and Pune CVBU manufacture heavy and medium commercial vehicles and the base model used for equivalent vehicle calculations is the '1612' (load bearing capacity=16 tonnes, 120 HP; 12 is the abbreviation for 120 HP).

In 2012, TML-Jamshedpur produced 229,621 equivalent vehicles and the direct blue water footprint was 0.76 million m³. Thus, the direct blue water footprint of the product for 2012 was 3.30 m³/equivalent vehicle.

In 2012, TML-Lucknow produced 101,626 equivalent vehicles and the direct blue water footprint was 0.56 million m³. Thus, the direct blue water footprint of the product for 2012 was 5.46 m³/equivalent vehicle.

In 2012, TML-Pune CVBU produced 244,798 equivalent vehicles and the direct blue water footprint was 1.16 million m³. Thus, the direct blue water footprint of the product for 2012 was 4.75 m³/equivalent vehicle.

The base model used for equivalent vehicle calculations at TML-Pune PCBU is the diesel Indica. In 2012, TML-Pune PCBU produced 175,731 equivalent vehicles and the direct blue water footprint was 0.30 million m³. Thus, the direct blue water footprint of the product for FY 2012 was 1.69 m³/equivalent vehicle. The base model used for equivalent vehicle calculations at

[10] It bears mentioning that increased outsourcing means decreased SMHs. Therefore, the equivalent vehicle concept has no direct correlative linkage to the actual energy or water intensity of manufacturing operations carried out in-house. But, in the absence of any other metric to track performance ratios, the equivalent vehicle concept continues to be used for tracking specific water consumption in m³/equivalent vehicle or specific energy consumption in KWh/equivalent vehicle

TML-Sanand is the Nano. TML-Sanand only produces Nanos. Because the plant is so new and in the early stages of production, the blue water footprint of the product was not considered.

The base model used for equivalent vehicle calculations at TML-Pantnagar is the “ACE Goods Carrier” (The ACE model is a 1 tonne goods carrier, and its variants include a high torque version and a passenger version called Venture). In 2012, TML-Pantnagar produced 70,139 equivalent vehicles and the direct blue water footprint was 0.34 million m³. Thus, the direct blue water footprint of the product for 2012 was 4.90 m³/equivalent vehicle.

Tata Motors Ltd. Sustainability Assessment

TML-Jamshedpur

The sustainability assessment for Jamshedpur is detailed in the Tata Steel section.

TML-Lucknow

Lucknow is the capital city of Uttar Pradesh. It is located in the Upper Ganges Basin, approximately 180 km south of the Nepal border. The River Gomti, a major source of drinking water for the city’s 2.5 million population, meanders through the city, dividing it into the Trans-Gomti and Cis-Gomti regions. Based on WaterStat (Hoekstra and Mekonnen, 2011), TML-Lucknow is located in a blue water scarcity hotspot, with water scarcity occurring from January through May due to the very low natural runoff. Groundwater extracted from bore wells is the source of TML-Lucknow’s water supply.

According to a groundwater quality survey by the Central Pollution Control Board (2007), there are both surface and groundwater quantity and quality issues in the area. The Gomti is highly polluted, mainly due to the discharge of approximately 360 million litres per day (MLD) of mostly untreated wastewater through 28 unlined drains from the city. In addition, many areas deal with their waste through septic tanks, pit latrines and even open defecation. This percolates through the ground and pollutes the groundwater. Surveys conducted in 2002 revealed varying levels of groundwater pollution in and around Lucknow (Central Pollution Control Board, 2007).

In addition, according to the Central Groundwater Board (2009), Lucknow faces problems with urban and industrial water supply from the Gomti due to increased groundwater withdrawals that are lowering water tables and decreasing the amount of base flow into the river. These reports, together with WaterStat, suggest that TML-Lucknow needs to further study this issue to better determine how to reduce business risks associated with emerging water quantity and quality hotspots in the plant vicinity.

TML-Pantnagar

TML-Pantnagar’s water is supplied by groundwater from bore wells. Pantnagar is a town with an approximate population of 36,000. Based on WaterStat, TML-Pantnagar is located in a blue water scarcity hotspot, with water scarcity occurring from January through May due to the very low natural runoff.

However, WaterStat identified hotspots are a reflection of surface water scarcity. Given the location's proximity to the Himalayas and associated groundwater recharge, and because of the lack of pressure on groundwater by the small population, TML-Pantnagar groundwater supply does not appear to be in jeopardy.

TML-Pune

Pune is located in Maharashtra, and is home to approximately 3.11 million people. When other towns such as Khadki, Pimpri-Chinchwad and Dehu are included, the greater Pune area contains 5.05 million people. Central Pune is located at the confluence of the Mula and Mutha rivers in the Krishna Basin. The Pavana and Indrayani rivers, tributaries of the River Bhima, traverse the north-western outskirts of metropolitan Pune. TML-Pune gets its freshwater from the River Pavana. According to the WaterStat global data set, TML-Pune is in a hotspot from November through May. During this period, the total blue water footprint for the basin exceeds blue water availability. Because of the Pavana Dam and its operations, this river has reliable flows all year.

Polluted water from industries and untreated sewage from residential areas is dumped into the River Pavana. Installed sewage and effluent treatment plant capacity by the Pimpri-Chinchwad Municipal Corporation (PCMC) is inadequate as data shows that another 200 MLD capacity is needed. Water quality improvements can be taken up through collective action by NGOs, corporates, financial institutions, and others.

TML-Sanand

Sanand is located in Gujarat. It is a small town of 32,000 people 25 km southwest of Ahmedabad and approximately 280 km southeast of the Pakistan border. In addition to Tata Motors, it is home to many other automotive plants. A diverse set of industries are now moving into the area. Since Tata Motors built the Nano plant, the Gujarat government has focused efforts on improving environmental quality in Sanand. Precipitation averages nearly 800mm/year with nearly all of it falling between June and September. TML-Sanand's source of water is the Narmada Canal, which carries water from the Sardar Sarovar Dam. According to the WaterStat global data set, TML-Sanand is in a hotspot from September through June. During this period, the total blue water footprint for the basin exceeds blue water availability.

Tata Motors Ltd. Response Strategies

Several water use reduction strategies have already been implemented by TML facilities. This has led to significant improvements, over the course of decades in many cases. These strategies include testing of major valves for leaks, reusing treated effluent for toilet flushing and vehicle washing, and creating awareness by displaying boards with messages about water conservation. In addition, many devices/processes have reduced water consumption and/or relieved pressure on freshwater withdrawals. These include low flow fixtures, local softening plants for reduction of blow-down, recycling plants, and various rainwater harvesting projects.

A number of new company-wide response strategies have been developed. Planned efficiency improvement levers include increased use of reverse osmosis (RO) and ultrafiltration (UF), conducting more water audits to better understand where efficiency gains can be made, and increased use of localised softening plants to reduce blow-downs.

TML-Jamshedpur developed site-specific operational response strategies. These include carrying out a water audit to understand water mass balance, better understanding options to be adopted at various cooling towers to control water losses, decreasing process water requirement through more recycling options, and wastage minimization/elimination by using GIS and other methods to locate underground leaks. Further, TML-Jamshedpur plans to treat all wastewater and reuse that water where feasible.

While a preliminary assessment was done to begin to quantify the blue water footprint of the supply chain, the initial response was inadequate (less than 10 percent of suppliers responded). A thorough effort is planned so that a more accurate blue water footprint of the product can be determined. In addition, there are plans to promote supply chain metering and rainwater harvesting, and more generally, to create awareness by actively engaging with the supply chain through use of special supply chain oriented teaching sessions. There are also plans to obtain data from 20 percent of the vendor base after an initial prioritization effort.

Outside-the-fence activities are also planned: these include developing rainwater harvesting projects and assisting others in the watershed in improving efficiencies through a variety of projects. Eventually, some facilities would like to take a more active role in watershed management by engaging stakeholders in the watershed about water conservation and pollution reduction.



A PATHWAY TO CORPORATE WATER SUSTAINABILITY

Corporate water sustainability requires knowledge about and responsibility for water sustainability issues to be embedded within all levels of a company. The partnership followed an engagement process to ensure competency in Water Footprint Assessment and commitment to water sustainability in the companies by building overall water intelligence and capacity in staff from the facilities all the way up to the CEOs. In this way, Water Footprint Assessment and water sustainability become part of everyday business. This chapter discusses the different steps involved in conducting the Water Footprint Assessment by the partnership and describes a roadmap for other companies that want to conduct a Water Footprint Assessment of their own.

Steps

Step 1.	Goal and scope, project planning
Step 2.	CEO kick-off meeting
Step 3.	Water champions and practitioners technical training workshops
Step 4.	Site visits for Batch 1 ^[11] and 2 companies
Step 5.	Verification, quality assurance and facility reports
Step 6.	CEO feedback workshop and final report
Next Steps	Supply chain industrial water footprint database and collective action in the watershed

It is important to point out that this is but one approach for Water Footprint Assessment. It was designed to provide continuous exchange between Tata, TQMS, IFC, and Water Footprint Network with the intent to share knowledge and build capacity. The water champions' technical training workshops were spread over a six month period to allow for progress to be made on individual aspects of the Water Footprint Assessment between workshops. TQMS played an active role in these workshops, both learning the Water Footprint Assessment methodology and guiding its application at the twelve facilities. Data collection, water footprint accounting, sustainability assessment, response formulation and feedback/verification were addressed iteratively throughout the project.

Depending on specific circumstances, the steps detailed below could, and should, be tailored to meet the specific needs and context of individual companies.

[11] The twelve facilities under study were separated into two "batches" for efficiency and to promote learning from one batch to the other. Batch 1 consisted of the three Tata Chemical and two Tata Power facilities. Batch 2 consisted of Tata Steel and six Tata Motors facilities



STEP 1.

Goal and scope, project planning

A Water Footprint Assessment can be done for many reasons. For example, to support awareness raising, policy making, quantitative target setting or hotspot identification. Several goals were identified during project preparation phase:

- Water Footprint Assessment would be done with enough quantitative rigor for the results to be used to develop a corporate water sustainability strategy for each of the twelve facilities.
- Water Footprint Assessment would be done interactively, engaging facility staff, Tata Quality Management Services, and senior management to build internal capacity in the methodology and its application.
- Water Footprint Assessment would be tested within the industrial context to build new knowledge.
- Action plans would be developed to include prioritized investments and follow-on activities where Tata companies could demonstrate leadership in corporate water sustainability.

With those goals in mind, the scope was identified as:

1. Calculate the water footprint for direct operations, processes, products, and the facility and identify efficiency measures to reduce it.
2. Calculate the water footprint for the supply chain and its relative share of the product water footprint.
3. Deepen understanding of sustainability of the local water resources and efficiency of water use.
4. Integrate knowledge gained through Water Footprint Assessment in a comprehensive water sustainability strategy.

Key Questions to ask

Some key questions to ask while conducting a Water Footprint Assessment for a company are:

- Is there a focus on one particular phase? Focus on accounting, sustainability assessment or response formulation?
- What is the scope of interest? Direct and/or indirect water footprint? Green, blue and/or grey water footprint?
- How would you deal with time? Is the assessment for one particular year or the average over a few years, or trend analysis?
- For product water footprint, what product(s) to consider? One product, a range of products from one facility or all products sold by the company?
- For sustainability assessment, what are the area boundaries?
- What is the field of interest? Business risk, product transparency, corporate environmental reporting, product labelling, benchmarking, business certification, identification of critical water footprint components, formulation of quantitative reduction targets?

Adapted from the Water Footprint Assessment Manual: Setting the Global Standard (Hoekstra et al., 2011)

Project Planning

A detailed project plan mapped out weekly project milestones over the course of the project. These milestones defined activities (their locations, durations, and participants), roles and responsibilities, and periodic goals, deliverables and outcomes. Like with any project, the partnership's plans changed over time. The care that went into its development helped serve as a worthy guide to all parties and greatly assisted with understanding when adaptive management was necessary.

The project was to be implemented in a phased approach with two batches:

- **Batch 1** – Water Footprint Assessment for five facilities of two companies: Tata Chemicals and Tata Power;
- **Batch 2** – Water Footprint Assessment for seven facilities of the other two companies, Tata Motors and Tata Steel.

The phases allowed for an accelerated process for batch 1 plants (Tata Chemicals and Power) due to lower expected complexity when compared to batch 2 plants and by focusing resources better. Batching was also done because Tata Power and Steel water footprints could, for example, be used to calculate Tata Motor's water footprint (where steel and power are raw materials). In addition, it enabled TQMS to learn from Water Footprint Network during batch 1 assessments, so they could work more independently with batch 2. However, it became apparent that the batch 2 teams were eager to work on their facility Water Footprint Assessment so the staged approach was set aside and the process integrated so that all facilities worked simultaneously on their data collection, analysis, and reports. As a result, there was more cross-learning between teams and all water champions participated in every workshop.

Anticipating challenges and identifying solutions

Potential challenges were identified during project planning. These would need to be addressed during the implementation of Water Footprint Assessment. They included:

- **Direct water footprint:** Data availability both in terms of consumption and pollution; proxies for missing data for industrial processes; identifying water uses for inclusion in calculations.
- **Grey water footprint:** Pollutants to include and water quality standards to use in calculations.
- **Indirect water footprint:** Limited knowledge of supply chain and limited water consumption and pollution data of suppliers, possible unwillingness of suppliers to share water consumption and pollution data.
- **Sustainability assessment:** Lack of local data and/or difficulties in getting access to existing data; limited data availability for formulation of water footprint benchmarks.
- **Response formulation:** Difficulties in quantitative analysis of water footprint reduction related to response strategies.

Project benefits

In addition to conducting a Water Footprint Assessment, the partnership was envisioned as a key learning process for all involved parties. The knowledge development for various parties included:

- **Tata Quality Management Services:** Capacity building on Water Footprint Assessment.
- **Tata facilities:** Improved understanding on sustainability and efficiency of water use in their operations, supply chain, and in the context of the local watershed.
- **IFC:** Development and deployment of a comprehensive corporate water sustainability framework.
- **Water Footprint Network:** Experience in Water Footprint Assessment for industry.

The partnership would also serve as a demonstration for other companies wanting to conduct a Water Footprint Assessment.



Step 2.

CEO kick-off meeting

The partnership was officially launched with a kick-off meeting with CEOs and top management of Tata Steel, Chemicals, Power and Motors as well as IFC, Water Footprint Network, and TQMS. The meeting was meant to introduce the partners to water sustainability issues and how Water Footprint Assessment can address them, and to familiarize management with the project's scope and work plans. This interactive session also served to secure top management's commitment to the Water Footprint Assessment. Water champions, who would participate in the Water Footprint Assessment, were nominated for each facility and encouraged to complete the work through incentives and support of senior management.



Step 3.

Water champions and practitioners technical training workshops

Three technical workshops were held for the water champions over six months. Each water champion was responsible for completing the Water Footprint Assessment and steering the water stewardship agenda for his/her facility. Three staff from TQMS participated in the workshops as part of their training for the roll out of Water Footprint Assessment across the Tata Group companies.

These workshops covered each phase of the Water Footprint Assessment from setting goals and scope, to water footprint accounting, sustainability assessment and response formulation. The water champions presented background information and results from their facilities, which were discussed as a group to enable cross-learning. IFC provided the context and importance of Tata Group's involvement in water sustainability by highlighting the water-energy-chemicals nexus, the total systems cost of water, and the integrated water risk-return matrix through the development of water cost curves. IFC also supported work planning and implementation of the engagement process together with TQMS, and provided technical inputs on relevant water technologies. Water Footprint Network provided presentation templates, training materials, hands-on exercises and one-on-one guidance on the application of Water Footprint Assessment.

Water champions and practitioner workshop

A three-day technical training workshop for water champions and facility teams followed the CEO meeting. These individuals, along with key staff from TQMS, were trained in the Water Footprint Assessment methodology. The workshop included: 1) introduction to IFC and Water Footprint Network; 2) overview of Water Footprint Assessment; 3) presentations by water champions about their individual facilities via a general overview of operations, water use and pollution by process, intake and effluent discharge, supply chains, and current understanding of water issues related to their business; 4) detailed discussions of water footprint accounting with hands-on exercises; and 5) development of a work plan for each facility. Although all aspects of Water Footprint Assessment were discussed at the workshop, the main focus of this first workshop was direct water footprint accounting.

The underlying principle at TQMS has always been that learning happens not just by receiving knowledge but by interpreting and applying it in practice. This was the philosophy successfully adopted for creating water champions in TQMS.

**Alka Upadhyay, Senior Consultant
Tata Quality Management Services**



After presentations from facility teams, water footprint accounting specifics were discussed for each facility to help guide teams in their data collection and water footprint calculations. Some key issues were raised, such as how to account for effluent discharge to seawater (for TPL-Trombay and TCL-Mithapur) and how to address data limitations in an extensive supply chain (for Tata Motors). These were discussed further during site visits and refined over the course of the project.

Water footprint accounting workshop

The two-day event started with an overview of current project status and milestones ahead. Prior to the second workshop, the water champions completed their direct water footprint accounting and were ready to present the first results to other teams. Water Footprint Network reviewed the results and presented findings of common themes requiring clarification or further development. Each company presented its direct water footprint results and an open discussion followed to highlight key learning and to improve the group's understanding of direct water footprint accounting. TQMS staff then led a brainstorming session to assist in developing response strategies. The joint brainstorming exercises were a nice feature as they facilitated outside-the-box thinking and cross fertilisation of ideas.

The second day of the workshop focused on batch 1 indirect water footprint results and, to a lesser degree, sustainability assessments. Water champions presented their indirect water footprint results for the five batch 1 facilities. This was followed by discussion on further steps needed for completing indirect water footprint accounting. Another beneficial joint brainstorming session focused on ideas for response strategies pertaining to indirect blue water footprint reduction. The rest of the day concentrated on sustainability assessments, looking ahead to the CEO workshop and discussion of specific issues that had arisen. Batch 1 companies showcased their work to batch 2 companies. This led to a transfer of ideas and lessons learnt so that batch 2 could catch up with batch 1 companies and merge tracks.



The Water champions from a particular facility were actually required to compute the water footprint and develop the response strategy with the technical experts from Water Footprint Network serving as a coach. This ensured that what was taught was used immediately in a real life situation to internalize the learning.

**Arunavo Mukerjee,
Vice President, Tata Cleantech Capital Limited**

Sustainability assessment and response formulation workshop

Initially, two technical training workshops were planned for water champions and facility teams. A third workshop was added to the agenda to focus directly on sustainability assessment and response formulation phases of the Water Footprint Assessment. Water footprint sustainability assessment requires a facility to look beyond its fence to understand the local watershed context. This proved to be the most difficult step for the water champions: it required a basic understanding of hydrology and to understand their own water use and pollution relative to all water use and pollution in the watersheds.

Since the water champions were unfamiliar with principles of hydrology and sustainability of their watersheds, this additional workshop was required to build understanding of the fundamentals needed for the sustainability assessment. The companies needed to go beyond their corporate social responsibility programs and expand their understanding of the watersheds to get a more complete picture of the context of their company's blue and grey water footprints as they relate to other users' footprints in the basin. Because of the diverse locations, the companies thought about different issues for sustainability assessments and differing response strategies emerged. Approaches for filling data gaps were devised and work plans revised to accommodate the effort needed.

The sustainability assessment also included assessing efficiency of water use, most commonly through benchmarks. IFC's Climate Business Group industrial water specialist provided background on best available technology for key industries and identified literature sources for finding water footprint comparisons.

TQMS and IFC provided guidance and training in developing water footprint reduction cost curves for the response formulation phase. This tool helped water champions prioritize response strategies, identifying those which had a short payback period and others which were long-term financial investments. Cost curve development enabled the formulation of response strategies that incorporated the economics of water-related investments and sustainability measures. Because water has traditionally been an under-priced resource, water footprint reduction strategies based on cost curves often do not have a short payback period. But payback periods were not the only driver – many response strategies were prioritized due to sustainability concerns and the environmental benefits anticipated from the response.

The final agenda item focused on the upcoming presentations to the CEOs. The water champions would present to the CEOs the key learning and results from the Water Footprint Assessment process in order to secure management approval and commitment towards water sustainability.

**Through a Water Footprint Assessment, one can prioritize
and work on within the fence improvement, source
sustainability, and sustainability across the product life
cycle depending on the criticality of issues.**

Neha Bhandari, Tata Chemicals Limited

Step 4.

Site Visits

Batch 1 companies' site visits

Site visits were conducted directly after the water champions and practitioner workshop to the two Tata Power and three Tata Chemicals facilities. These visits were intended to obtain a technical overview of the plant, identify issues specific to each plant, and interact with facility staff to transfer ownership of the water sustainability agenda.





The site visits included three main events:

Part 1: Introduction workshop. This workshop consisted of a presentation on Water Footprint Assessment and water sustainability issues to senior management and operational staff. This helped them to better understand the relevance and significance of the project and the value of the water footprint concept and Water Footprint Assessment methodology. There were also presentations by facility staff on facility products, operations, and water use processes. This was followed by discussions defining the scope of the Water Footprint Assessment and how to handle data collection. While direct blue, green, and grey water footprint accounting was planned for all facilities, the scope of accounting was adjusted to the specific context of each facility. For facilities with extensive metering (blue water) and monitoring (grey water), the scope included obtaining quantitative blue and grey water footprint data at a process level and in some cases on a monthly time scale. Where detailed data was lacking, the scope reflected these limitations.

Part 2: Facility visit. An extensive tour of the facility was organized by the water champion for IFC, TQMS, and Water Footprint Network to gain first-hand knowledge of the production system, water use processes, and water management (such as water abstraction, treatment, and effluent discharge) within the facility. This enabled discussions and built a shared understanding about the processes and their relative contribution to the blue or grey water footprint. The team was also introduced to key department heads at the facility with responsibilities for specific operational processes or for relationships with the supply chain. Engagement with these middle managers was essential for the implementation of potential response strategies. IFC's industrial water expert gave detailed feedback to facility managers on potential technology and practice improvements.

Part 3: Field trip. At several sites, the team visited the local watershed to obtain an overview of the local water supply system and the watershed situation, as well as to learn how the facilities engage with the local watershed stakeholders (such as farmers) in managing water resources through their facility corporate social responsibility (CSR) programs.

Batch 2 companies' site visits

Tata Motors and Steel facilities were visited, including Tata Steel's captive iron ore mine at Noamundi, after the second technical training workshop.

These site visits enabled Water Footprint Network and IFC to better understand important issues such as facility operations and aging or new infrastructure, where and why water was being consumed or polluted, sustainability issues in the local watershed where the facility is located, and other water users/polluters in the basin. The site visits provided a shared understanding of the facilities' production processes, infrastructure, local watersheds, and other unique attributes that were necessary as background for completing the Water Footprint Assessment.



Step 5.

Verification, quality assurance and facility reports

Reports on the results of the Water Footprint Assessment for each of the four companies were completed. These are internal, technical reports which can be used as a basis for long-term engagement in corporate water sustainability at each facility. To reach this final product, all calculations were thoroughly reviewed and the appropriate use of the Water Footprint Assessment methodology was verified. Outstanding data gaps were assessed and remaining questions identified. This step involved many sub-steps: verification of assumptions, validation of calculations, gathering of missing data, comparing sustainability assessments based on local and global data, cost curve development, and response strategy formulation and prioritization. The water champions' knowledge and understanding of the Water Footprint Assessment methodology deepened and new insights into their facilities' water footprints were gained through this iterative process of refinement.



Step 6.

CEO Feedback Workshop and Final Report

Presentations to the CEOs marked the end of a long journey for the water champions. The purpose of this closing workshop was to have a forum where water champions could present results of the Water Footprint Assessment to the leadership team and secure management commitment to implementing strategic responses prioritized through the Water Footprint Assessment. Important water footprint accounting findings for the twelve facilities were discussed as were the sustainability assessments and response strategies. Presentations by the water champions stimulated lively discussions among senior managers, and strengthened their commitment to being leaders in corporate water sustainability.

A final report documenting the process and outcomes of the partnership was prepared following the completion of the facility reports. This final report pulled out highlights of the four internal reports and detailed new material, in an effort to guide other companies who wish to use Water Footprint Assessment as part of their corporate water sustainability programs. The report contributes to the growing global knowledge base of Water Footprint Assessment.

Water Footprint Assessment facilitates a holistic view of the risks and opportunities in water management within the plant fence, in the supply chain and in the watershed where this resource is shared with other users.

**Arunavo Mukerjee,
Vice President, Tata Cleantech Capital Limited**

Next Steps

Supply chain, industrial water footprint database and collective action in the watershed

While the partnership and the completion of the Water Footprint Assessment for the twelve facilities is a great accomplishment, several next steps were highlighted. Only initial estimates of the indirect water footprint, that is the water footprint of suppliers, were calculated. In some cases, these figures were based on literature and, in others, on a small sample of a large group of suppliers. Work with suppliers will need to continue, both to better calculate indirect water footprints and, importantly, to understand the sustainability and efficiency of the suppliers' water footprints. This will help direct engagement with suppliers on reducing water footprints or addressing local watershed sustainability issues, which are necessary next steps. This further engagement has already begun at Tata Motors.

As this was the first comprehensive industrial Water Footprint Assessment, the lack of water footprint benchmarks for specific industries and processes was highlighted. As more industries take up Water Footprint Assessment, data necessary to assess water footprint efficiency will be developed. Water Footprint Network has prioritized development of an industrial water footprint database.

Taking action within the local watershed can be one of the more fruitful strategies to improve sustainability of a company's water footprint. This has been prioritized by TCL-Babralla, which is working with farmers to reduce their water footprints, improve overall efficiency of water use in the watershed, and relieve pressures of water scarcity.



The partnership represented the first comprehensive Water Footprint Assessment for industrial facilities and has resulted in specific contributions to global Water Footprint Assessment knowledge, the key highlights of which are discussed below.

4.1 Water Footprint Assessment as a Framework for Corporate Water Sustainability

The partnership presented an opportunity to test whether the four phases of Water Footprint Assessment - setting goals and scope, water footprint accounting, sustainability assessment, and response formulation - provided a framework for corporate water sustainability. The results showed that the Water Footprint Assessment methodology provided a clear, useful, and structured way for a company/facility to initiate and/or strengthen its water sustainability action plans. The water footprint as an indicator of water consumption and water pollution provided new insight into water issues at the facilities which was not available through the use of traditional water statistics and effluent discharge permits. Calculating the water footprint by process and on a monthly time scale created a detailed picture of exactly where water consumption and pollution issues were occurring.

This led to a more focused approach to response strategy formulation. The investigation into the supply chain and the relative comparison between direct and indirect water footprint led some facilities to recognize the importance of engaging with their suppliers. The sustainability assessment introduced the facility staff to their local watershed and provided an understanding of local water scarcity and water pollution issues, including the importance of engaging with others for sustainable watershed management. Further, the partnership demonstrated that Water Footprint Assessment can be applied successfully in the Indian industrial context.

4.2 Toward an Industrial Water Footprint Database

WaterStat (Water Footprint Network, Enschede, The Netherlands) is a publically available global database which contains extensive water footprint statistics, primarily for agriculture. There is no comparable database for water footprint of industrial products. This limitation presented challenges to the partnership; there was no easy way to compare water footprint results to those from other companies or other regions.

Data that does exist often pertains to water abstraction, not water footprint (consumption), and in general, suffers from often being inaccurately estimated, outdated, and not geographically specific. This highlights the critical importance of investing in developing a water footprint database for industrial products and gathering enough data to be able to develop benchmarks for specific processes and products. In the absence of this, the Tata facilities used current water footprints as a benchmark against which to improve performance in the future. The Water Footprint Assessment results from the partnership are a significant contribution to the development of an industrial water footprint database.

4.3 Estimating the Impact of Effluent Discharged to the Sea Using Grey Water Footprint Methodology

The water footprint is a measure of appropriation of freshwater resources and does not directly address use of seawater since this is not a scarce resource. However, two facilities, TPL-Trombay and TCL-Mithapur, heavily rely on seawater for production processes and wanted a better understanding of their seawater use within the context of this Water Footprint Assessment. A seawater pollution volume was calculated for them, using the same methodology as is used in calculating the grey water footprint. In this case, consent values for temperature increase were used in place of ambient water quality standards.

Great care must be taken in using the results of the seawater pollution volume as calculated in this project. The grey water footprint methodology was developed as a measure of freshwater pollution and may not be applicable to assessment of seawater pollution. The seawater pollution volume cannot be directly compared to a grey water footprint due the differences in freshwater and ocean ecosystems. Further, there is no sustainability assessment of seawater pollution volume, so it is not possible to determine the impact this effluent discharge is having on the sea environment. However, calculating seawater pollution volume resulting from discharging effluent into the sea can provide insight on reduction of pollution impacts on freshwater ecosystems.

4.4 The Importance of Determining Supply Chain Water Footprints Despite Challenges with Data

Completing the indirect water footprint of a facility's supply chain can be challenging. In many cases there are no direct relationships with suppliers and, where these exist, information needed to complete the green, blue, and grey water footprint is not commonly exchanged. An alternative to collecting direct data from suppliers is to use numbers reported in published literature. However, water use, when reported at all, is often represented as water intake as opposed to water consumption (intake minus local discharge), which is the basis of the blue water footprint. Where there is consumption data, it is typically sparse, outdated, and not region specific. Even more difficult can be locating data to estimate grey water footprint of the supply chain.

Despite data issues, the partnership revealed that blue product water footprints, based on direct blue water footprint calculations and best available data for indirect blue water footprints, are still worth undertaking. These water footprints provide a coarse view of the relative values of direct and indirect water footprints of the product. Armed with this information, facility managers can then prioritize response strategies based on relative importance of the supply chain's blue water footprint versus that of the facility itself. In addition, not all supply chain water footprint data is based on literature – obtaining supply chain water footprints is possible, it simply necessitates making direct contact with suppliers and can have an important side benefit of developing better relationships with them. This engagement with suppliers positions the facility as a leader and, ultimately, moves all parties toward a paradigm of collective and sound watershed management.

4.5 Response Formulation: Can a Company Offset its Water Footprint?

Prior to this engagement with Water Footprint Network, the Tata Group, like many other companies, calculated the carbon footprint of its facilities. Based on experience with carbon offsets, the question was raised whether a company could offset its water footprint. In the case of carbon footprints, greenhouse gas emissions have a global impact: release in one part of the world is the same as release in another. Likewise, the location of mitigation of greenhouse gas emissions is unimportant. This differs greatly from the water footprint: the water footprint is an indicator which is spatially and temporally explicit to reflect the importance of when and where water is consumed and polluted. The impact of a water footprint occurs in a specific place at a specific time. Hence, the response formulation must also occur such that it reduces the impacts within the time period and location of the water use.

For companies, like those of the Tata Group, that wish to conduct their business sustainably, this presents a challenge and potential frustration. Once the company's water footprint has been reduced to meet the global benchmark or by using best available technology, what more can a company do to compensate for its remaining water footprint? Broadly speaking, with the goal of sustainable water use, companies can engage with others to reduce the overall water footprint in the local watershed or aquifer, and bring it down to a sustainable level. This requires companies to take action outside their own fence, together with others. Taking this step of convening, facilitating, funding or otherwise supporting collective action to improve sustainability of local water resources is the final step in the water stewardship maturity progression from improving direct water footprint to engaging with the supply chain and finally taking collective action in the local watershed. Through this engagement, the company can help the watershed or aquifer as a whole move toward sustainable levels of use or meeting water quality standards. In doing so, the company will no longer be operating in a hotspot. While this approach is not a direct offset of the company's water footprint, it will in the end allow the company to claim that its water footprint is both efficient and sustainable.

The partnership increased the Tata Group's water intelligence by providing a detailed investigation into the water footprint of processes, raw materials, energy, packaging, products, and the facility as a whole that went beyond the traditional approaches of measuring water withdrawal and meeting permit requirements. Water Footprint Assessment provided the foundation for developing a comprehensive sustainable water management strategy by examining the amount of water that is appropriated from surface and groundwater and for assimilation of pollutants within both direct operations and throughout the supply chain, and assessing the sustainability, efficiency and equitability of that water use.

A rich range of learning and results contribute to the Tata Group's on-going efforts in improving sustainability of its facilities and within the broader watershed. The project helped TSL-Jamshedpur focus its direct blue water footprint response strategies on the appropriate processes. TSL-Jamshedpur also learned that its grey water footprint response strategies should focus on three different pollutants, not just one. Tata Chemicals' Water Footprint Assessment in Babrala, Haldia, and Mithapur showcased how water footprints and response strategies are affected by the use of seawater, by diverse locations, by product lines and supply chains. Similarly, Tata Power's two facilities under study also emphasized the water footprint reduction potential of using seawater, and, in addition, highlighted the differences in the water footprints of energy sources. Tata Motors' Water Footprint Assessment provided an example opposite to that of Tata Steel, scenarios where facilities have a water footprint dominated by the supply chain rather than direct operations. Conducting a Water Footprint Assessment for three Tata Group facilities located in the Subarnarekha river basin emphasized the potential for the Tata Group to embark on a path of cooperative watershed management.

Water constraints pose potential risk for business globally.

Water is the critical resource which can enhance India's economic growth, improve the quality of life of its people, and ensure environmental sustainability. Tata has taken a proactive initiative to minimize / optimize use of water, recycling and reuse waste water for industrial usage, and ensure a higher degree of efficiency in the management of water - Water Footprint Assessment is the prerequisite tool to establish sustainable abatement strategies.

**Prashant Krishnan, Divisional Manager
Environment & Effluent Management, Tata Motors Limited**

The partnership has helped the Tata Group better understand its water footprint, both in its direct operations and in its supply chain, and where and how it is contributing to water scarcity and water pollution. Going forward, the information gleaned from this project can be further developed through improved measurement, monitoring, and reporting, and for tracking the water footprint over time. Continuous engagement with the supply chain is useful to better understand the embedded water footprint of a company's raw material use. Where existing or emerging scarcity and/or pollution trends present sufficient business risk, constructive dialogue on collective watershed management with other water users in the basins where a company operates will lay the foundation to ensure long-term water security.



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Facility Details

Company	Facility Name	Location
Tata Steel	Jamshedpur	Jharkhand
Tata Chemicals	Babrula	Uttar Pradesh
	Haldia	West Bengal
	Mithapur	Gujarat
Tata Power	Trombay	Maharashtra
	Jojobera	Jharkhand
Tata Motors	Jamshedpur	Jharkhand
	Lucknow	Uttar Pradesh
	Pune (PCBU)	Maharashtra
	Pune (CVBU)	Maharashtra
	Pantnagar	Uttarakhand
	Sanand	Gujarat



Contact Information

International Finance Corporation

Maruti Suzuki Building

3rd Floor, 1 Nelson Mandela Road,

Vasant Kunj, New Delhi - 110070

India

T: +91 11 4111-1000

F: +91 11 4111-1001

www.ifc.org



**International
Finance Corporation**
World Bank Group