WATER GOVERNANCE MAPPING REPORT: TEXTILE INDUSTRY WATER USE IN INDIA

Focus on the Faridabad-Ballabgarh Textile Cluster in the State of Haryana

Phillia Restiani, Stockholm International Water Institute

Aparna Khandelwal, Sustainability Outlook

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Executive Summary

Textile industry is one of the oldest as well most important industries in Indian economy. It accounts for around 2% of GDP, 8% of excise and customs revenue collections, 14% of the industrial production and 12% of the total manufacturing export earnings. The sector is the second-largest employment generating industry in both rural and urban areas with nearly 35 million workers. Since textile industry is highly water intensive and India had been identified as a highly water-scarce region, the long term viability of the Indian textile industry hinges heavily on sustainable water management.

To a large extent, the mismanagement of water resources has exacerbated the problems of water scarcity and variability, leading to critical situations of water quantity and quality in many parts of the country. Water governance is the key to ensure that beyond the technical engineering solutions, there exists enabling systems of coordinated regulations, institutions and incentives to balance various needs for water. With the focus on textile water use in India, especially in the Faridabad-Ballabgarh cluster in the state of Haryana, this report aims to: a) assess physical and regulatory water risks; b) investigate water governance landscape; and c) inform priority areas for capacity building in sustainable water management.

The Faridabad-Ballabgarh cluster was chosen as the focus of the report due to its high concentration of wet processing units within the STWI Projects in the National Capital Region and enormous environmental challenges with a high level of pollution from industrial sources and declining groundwater table due to overexploitation. At the same time, the Zero Liquid Discharge (ZLD) policy by the Central Pollution Control Board (CPCB), which regulates pollution and water abstraction by industries including the textile wet processing units, has driven some actions to adopt efficient water use and management in the cluster.

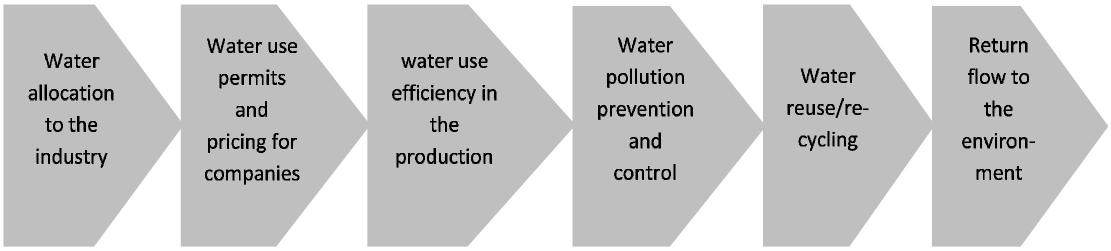
This report discusses two main background contexts: 1) the landscape of the textile industry at the national as well as state level: its economic significance, outlook to its sustainability, and specific water management challenges, especially water use intensity and effluent characteristics; and 2) the overall challenges of water resources management in India.

The report finds four major physical water risks of the textile industry, both at the national and state level:

a) Increasing gap between the supply and demand of freshwater that are required to underpin the growth and ambition of the textile industry.
   At the national level, most basins have a severe scarcity gap (20-80%) and most districts are prone to multi-year drought. At the state level, the stage of groundwater development is 127% in 2013-2014, which implies that the annual groundwater consumption is much higher than the annual groundwater recharge.
b) Declining groundwater table due to overexploitation of the resources.
   In Haryana state, 55 groundwater blocks were notified as over exploited, 11 blocks as critical and 5 blocks as semi critical. At the national level, most regions have groundwater development beyond 41% and a few regions have exploitation rate above 100%.
c) Degrading water quality both for surface water and groundwater.
   Over 70% of the water consumed by the rural population in India does not meet the WHO standards contributing to almost 80% of rural illnesses and 20% deaths among children age up to 5 years old. Only 31% of the total sewage water generated in 23 major cities is treated and the rest is disposed of into 18 major rivers in the country. Haryana state has three river stretches falling under priority 1, the highest risk of water pollution as indicated by a high level of Biological Oxygen Demand. The groundwater quality is also a grave problem with salinity, high fluoride, and arsenic as the major concerns.
d) Suboptimal performance of existing individual Effluent Treatment Plants (ETPs) or Common Effluent Treatment Plants (CETPs).
   The CPCB study in 2005 showed unsatisfactory performance for many CETPs due to poor operation and maintenance, as well as high Total Dissolved Solid (TDS) in raw water. In Haryana, the suboptimal

performance of the ETPs are attributed to the under capacity of the installed ETP, lower operation of ETP than prescribed, and the lack of skilled labours.

To understand how the current water governance landscape in Haryana state is prepared to address those physical water risks, this report maps the key actors, their roles, regulations and initiatives pertaining to six components of industrial water governance value chain. The key actors are shown in the figure below.



Key actor	Public Health and Engineering Department (PHED) Municipal Corporation of Faridabad (MCF)	Public Health and Engineering Department (PHED)	Industries	Haryana State Pollution Control Board (HSPCB) Department of Environment (DoE) Public Health and Engineering Department (PHED)

Key Actors for the Governance of Textile Water in Haryana State

The current water governance landscape has engaged a rather broad range of key actors with relevant responsibilities, existing laws and regulations, as well as progressive initiatives at the national and state level. Nevertheless, the main issues of industrial water governance that contribute to regulatory water risks are:

1) The gap between industry readiness in practice and the expected performance of the industry as required by the regulations, especially but not limited to the small scale industry.
2) Some regulations have not been able to keep up with the fast pace of degrading quantity and quality of water resources, which require timely adjustment of the regulations so as to provide incentives for improved water management by the industry.
3) Lack of good governance capacities, especially with regard to coordination across government agencies and lack of transparency and accountability in the implementation of the regulations and initiatives.
4) The ZLD policy as the most ambitious initiative that the Government of India has launched in terms of sustainable water management has been seen both as opportunities and risks by the stakeholders, especially the affected industry, under the implementation challenges regarding financing, technology and space availability.

The report suggests the following priority areas for capacity building in view of improving industry’s readiness toward the ZLD policy:

1) Assessment of appropriate financial instruments and mechanisms to catalyse faster adoption of cleaner technology for the industry, especially for the small scale industry considering its importance in generating employment.
2) Development of guidelines for selecting cost-efficient and appropriate technology for the industry with regard to the scale, characteristics, and production line of the textile units. The guidelines can facilitate a rapid development of customised or mixed solutions for textile units. The assessment shall employ Cost Benefit Analysis of potential solutions, including the construction of new ETPs or CETPs or improvement of existing ETPs/CETPs that are suitable to local conditions and current water risk challenges, especially in the view of limited space availability.

3) Improving the skills in operating cleaner production processes and effluent treatment plants, through capacity building activities across the industry. STWI Projects has undertaken such workshops but this needs to be replicated on a wider scale across the industry.
4) Improving communication and harmonisation of regulations across government agencies in order to expedite: a) learning of best practices from other states (e.g. Tirupur) or countries; b) enhance the efficacy of regulations.
5) Enhancing good water governance through better transparency and accountability of decision making processes as well as the implementation of various initiatives related to the ZLD policy.
6) Financially incentivize uptake of wastewater as make-up water.
7) Need to create standards for water consumption.
8) Test technologies on pilot basis and create a standard user manual to ensure usage of clean and efficient technologies.
9) Individual ZLD facilities are more preferable than common facilities.

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Abbreviations

BCM	billion cubic meter
BOD	Biological Oxygen Demand
CETP	Common Effluent Treatment Plant
CGWA	Central Ground Water Authority
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
CSE	Center for Science and Environment
CGWB	Central Ground Water Board
CWC	Central Water Commission
DO	Dissolved Oxygen
ETP	Effluent Treatment Plant
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
IIPDS	
INCCA	Indian Network for Climate Change AssessmentGSDP
MSE-CDP	Micro and Small Enterprises – Cluster Development Programme
MoEFCC	Ministry of Environment, Forest and Climate Change
MoWR	Ministry of Water Resources, River Development and Ganges Rejuvination
NAPCC	National Action Plan on Climate Change
NWM	National Water Mission
NWP	National Water Policy
PHED	Public Health and Engineering Department of Haryana
SITP	Scheme of Integrated Textile Park
SPCB	State Pollution Control Board
TUFS	Technology Upgradation Fund Scheme

Chapter 1 Introduction

1.1. Background

With over 1.2 billion people or 18% of the world's population[1], India is the second most populated country in the world and has the potential to be the world's second largest economy by 2050. This is a tremendous challenge considering that India has merely 4% of the world's renewable water resource. Population increase and economic growth imply greater demands for natural resources and even greater challenges to deal with increased pollutions and to mitigate environmental degradation. The Twelfth Five Year Plan (2012-2017) aims to reverse the observed deceleration in growth and return to nine per cent growth by the end of the period in order to realise the vision of 'Faster, Sustainable, and More Inclusive Growth'.[2]

Water risks will largely influence India's ability to realise its development vision. About 50 per cent of annual precipitation occurs only in 15 days in a year. Currently, one third of the region lies in water-scarce areas with water availability of less than 1000 m^3/person/year. By 2030, India will face 50% aggregate gap between water availability and water demand.[3] India's aspired growth will further strain water availability and brings about further challenges of allocating water among different types of users. Climate change and variability will render even more erratic distribution of precipitation over time and region in India and impose higher water-related risks, such as floods, droughts, and storms. The increasingly scarce resource will make water allocation a very sensitive issue. If trade-offs are not managed well, increasing conflicts among different groups of water users can take place.

To a large extent, the mismanagement of water resources has exacerbated the problems of water scarcity and variability, leading to critical situations in many parts of the country. Leakage and inefficiencies in the water supply system account for nearly 50 percent of municipal water use. Over 70 per cent of surface and groundwater resources are contaminated.[4] Low awareness about water scarcity and its social economic values as well a lack of a harmonised perspective in planning, management and the use of water resources underlie this mismanagement.[5]

Textile industry is one of the oldest as well most important industries in Indian economy. It accounts for around 2% of GDP, 8% of excise and customs revenue collections, 14% of the industrial production and 12% of the total manufacturing export earnings. The sector employs nearly 35 million employees and it is the second-largest employment generating industry in both rural and urban areas, after the agriculture industry. [6] Since textile industry is highly water intensive and India had been identified as a highly water scarce region, the long term viability of the Indian textile industry hinges heavily on sustainable water management in India.

Water governance is the key to ensure that beyond the technical engineering solutions, there exists supporting systems of coordinated regulations, institutions and incentives to balance various needs for water.

1.2. Objective

This report aims to:

a) Assess physical and regulatory water risks pertaining to the textile industry in India.
b) Investigate water governance landscape in relation to the textile industry in India.
c) Inform priority areas for the needs of capacity building in sustainable water management in the textile industry in India.

1.3. Methodology

The information, analysis and recommendation in this report are built on:

a) Comprehensive desk research and data review of international and local sources.
b) Interviews with a number of stakeholders, which include public actors (government agencies, researchers, experts, and civil societies) as well as private actors (business associations, suppliers and technology solution providers).
c) Inputs from the stakeholders gathered during the capacity building workshop held on 24 Nov 2016 in new Delhi.

1.4. Focus of the Report

Faridabad-Ballabgarh is one of the three clusters of textile wet processing units in the National Capital Region (NCR) where STWI projects conduct its work in the first phase. Due to the autonomy of the state government in India and how the regulation and policies vary across states, this report needs to have a specific regional focus that is more meaningful for the water governance analysis.

The Faridabad-Ballabgarh cluster in Haryana has been chosen as the focus area due to its industrial significance to STWI Projects and severe challenges of water issues as follows.

1. STWI has been closely associated with the textile wet processing units in this region in its earlier phases (SWAR project), which accounted for maximum concentration (almost 60%, i.e. 11 out of 18 units) of wet processing units in the NCR region.
2. Recent Zero Liquid Discharge (ZLD) policy currently drives action related to efficient water use and management in the Faridabad-Ballabgarh region.
   The ZLD policy, which requires the textile wet processing units amongst others to adopt practices to ensure complete recycling of the industrial effluent and concentration of the solute into a solid mass by means of evaporation by December 2016, is a major initiative taken by the Central Pollution Control Board (CPCB) to regulate pollution and water abstraction by industries.

   Faridabad and Ballabgarh are major industrial towns in Haryana, having almost 1500 registered factories, such as textile manufacturers, fertilizer, electroplating works that mostly generate hazardous waste. A decline in groundwater level and its pollution are major problems for the region that needs immediate attention. Pollution of the shallow groundwater has partly affected the district with high salinity (electrical conductivity >3000µS/cm at 250C), fluoride (>1.5mg/l), iron (>1.0mg/l), nitrate (>45 mg/l) and lead (above 0.01 mg/l).[7] Concentration of heavy metals in this area has been attributed to the discharge of industrial effluents.[8] Two blocks in the Faridabad district have also been notified as semi critical highlighting the problem of groundwater decline. In response to the current groundwater overexploitation, the Municipal Corporation of Faridabad and Ballabgarh have been notified by Central Ground Water Authority (CGWA) to regulate the state of groundwater development in the district[9], which was estimated to be 81% while the projected demand for domestic and industrial use by 2025 would be 27.46 mcm.[10]

Chapter 2 Textile Industry in India

2.1. India's Textile Industry

The significance of the Textile Industry

Globally, India is the biggest exporter of yarn in international market and has a share of 25% in the world yarn export market and has a share of 12% in yarn and textile fiber production in the world. India has the highest capacity of loom and has a share of 61% in the world loomage. India has seen the highest growth as the world's third largest textiles and clothing exporter (after China and EU28) with 23% growth 2013. [11] Export values of the textile and clothing industry has grown rapidly in the past 15 years from US$ 10.33 billion in 2000 to US$ 36.08 billion in 2014, contributing to 11.2% to the national total merchandise exports.[12]

A number of factors that make India outshine in textile industry are low cost skilled manpower, availability of cheap raw material, availability of numerous varieties in cotton fiber, a big and potential national and international market and independent textile industry (Dey and Islam 2015). Nevertheless, its environmental and social sustainability constitute the key challenges of the industry. With a long and complicated supply chain, the industry affects the environment adversely at each stage of the supply chain process. In terms of resource use, freshwater, energy, and other valuable resources are consumed during the manufacturing process. The most significant effects of the textile industry to the environment are air and water pollution.

Most of the water used in the manufacturing is returned to nature elsewhere; the demand affects local availability for other users. In most places where textile production takes place today, the competition for freshwater between different sectors in society increases rapidly. A large amount of wastewater is generated especially in the dyeing and bleaching processes resulting in polluted effluents that often end up in water bodies. The textile sector is one of the major industrial polluters, especially due to the many micro, small, and medium sized factory units.[13]

The Outlook for Sustainable Textile Industry

The government aims to increase textile export growth from currently 6-10% to 15-20% by 2019 and to increase export value of textile and clothing to around US$64 billion by 2017. This goal will be achieved through a number of key initiatives, such as improving competitiveness by upgrading infrastructure to increase labour productivity; Integrated Skill Development Scheme for capacity building of the textile work force; overall development of the industry through e.g. modernisation and technological upgrade and setting up integrated textile parks. Some incentive schemes have been established to support those key initiatives, for instance the Technology Upgradation Fund Scheme (TUFS). In essence, the government puts an emphasis on Skill, Scale and Speed – Make in India – Zero defect and Zero effect.[14]

The policy on Zero Liquid Discharge (ZLD) for the textile industry was already started in Tamil Nadu back in 2008. Many businesses were shut down by the order of the state's High Court due to their inability to meet compliance requirements. Surviving businesses set the benchmark on operating with very limited amount of water. ZLD policy has now been expanded to cover nine states along the Ganges basin and applied to five sectors – textile, pulp and paper, distilleries, tanneries, and sugar – with varying compliance timeline. For the textile industry, the sector is expected to meet compliance by December 2016.[15] Further details on the ZLD policy are discussed in Chapter 5 on water governance landscape.

India's textile sector needs a long term roadmap for sustainable growth and increasing competitiveness across each part of the textile industry value chain. The national textile policy should provide such a roadmap and have an integrated policy that improve the competitiveness and remove barriers across the diverse 113 textile clusters across the country. This competitiveness also entails environmental sustainability that meets international regulations for export markets as well as domestic regulatory requirements.

2.2. Textile Industry Water Use In India

Textile Industry as a Large Water User and Pollutant Source

The textile industry is a major contributor of water pollution and is also one of the most water intensive industries known. This issue of water pollution and scarcity, which tags along with the process of wet processing in the textile industry, is highlighted in a study by the Centre for Science and Environment (CSE). The study estimated that the water consumption by the Indian textile industry alone is about 200-250 m^3/ tonne cotton cloth of water in comparison to the global best of less than 100 m^3/ tonne cotton cloth.[16] As the textile industry has a fairly complex supply chain, it is important to understand this supply chain in order to address the water management challenges and to increase the sustainability of the production line.

In building the awareness regarding cleaner production in the textile industry, CSE has done a collaboration with the Swedish Environmental Protection Agency (Naturvårdsverket). This collaboration entails capacity building programme of government officers on environmental governance and producing a film on the Swedish experience in shifting to environmental-friendly textile production.[i]

The production of finished textile product from fibre involves a long, complicated process comprising of many processes and different permutation and combination of separate processes. Textiles can be broadly classified into three groups depending on the end use: 1) fashion and clothing; 2) industrial and technical; and 3) furnishing and domestic. Textile production can be vertically and horizontally designed depending on whether all parts of production are done by the one company or different companies specialized in specific aspects of the production. This specialisation is greatly influenced by the industrial history and geographical location of the companies.

The supply chain for the industry is sketched below. The wet processing unit of the industry is the most water intensive and has the highest pollution potential. This is the chain that requires most intervention to improve its water management.

[i] The film is available at https://youtu.be/DBwhptqEoFY

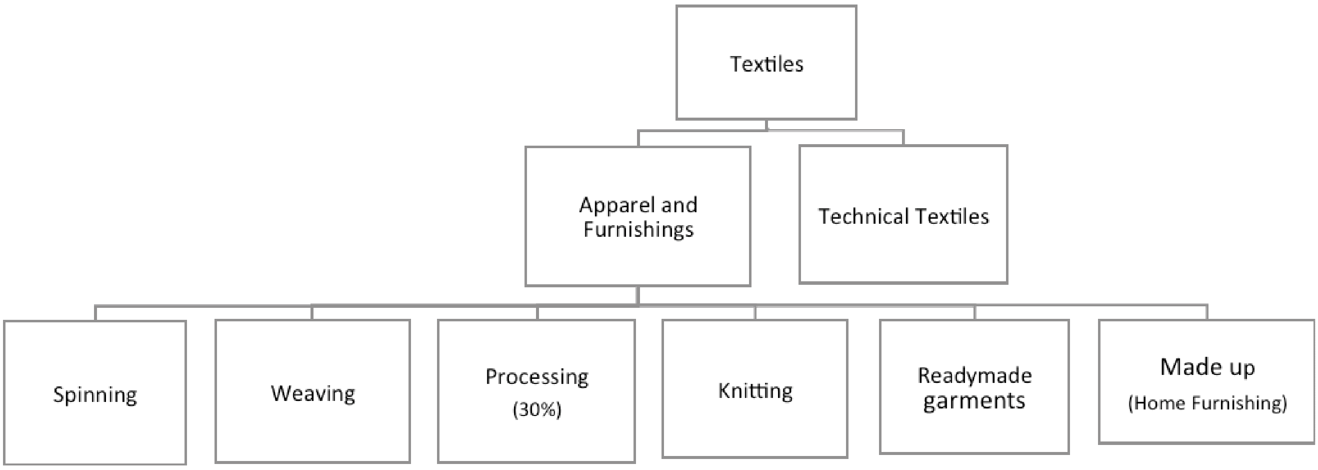


Figure 1 Supply Chain Components for Textile Industry

Textile Industry Wastewater Characteristics

The effluent characteristics for the industry varies based on many factors like the raw materials used, process involved, products manufactured, geographical conditions, and so forth. The average textile effluent characteristics as per the data available are tabulated below.

Table 1 Textile Industry Effluent Characteristics

Parameter	Units	Standard as per EPA, 1986	Average values
Colour	-	To be removed as much as possible	Colourless
Total Dissolved Solids	mg/l	-	1778
Total Chromium (as Cr)	mg/l	2	Not Detected
pH		5.5 – 9	7.3
Biological Oxygen Demand	mg/l	30	18
Chemical Oxygen Demand	mg/l	250	160
Oil and grease	mg/l	10	6
Total Suspended Solids	mg/l	100	25
Free Residual Chlorine	mg/l	1	Not Detected
Sulphide (as H_2S)	mg/l	2	Not Detected

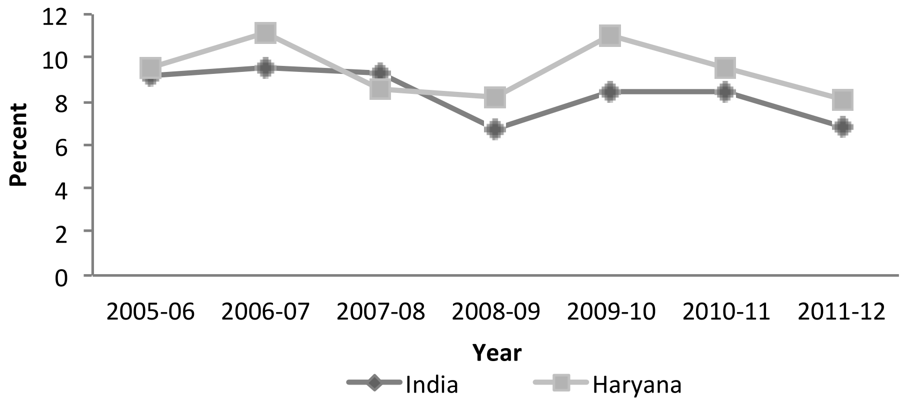
2.3. Economic Development Outlook for Textile Industry in Haryana

Industrial Growth in Haryana

Haryana has a progressively growing economy, with development not only in the primary but also secondary and tertiary sectors over the years. For a state, which accounts for a mere 1.34% of the total area of the country and 2.09% of India's population, Haryana has a fairly large contribution to the national GDP at more than 3.4% for the past few years. [17]

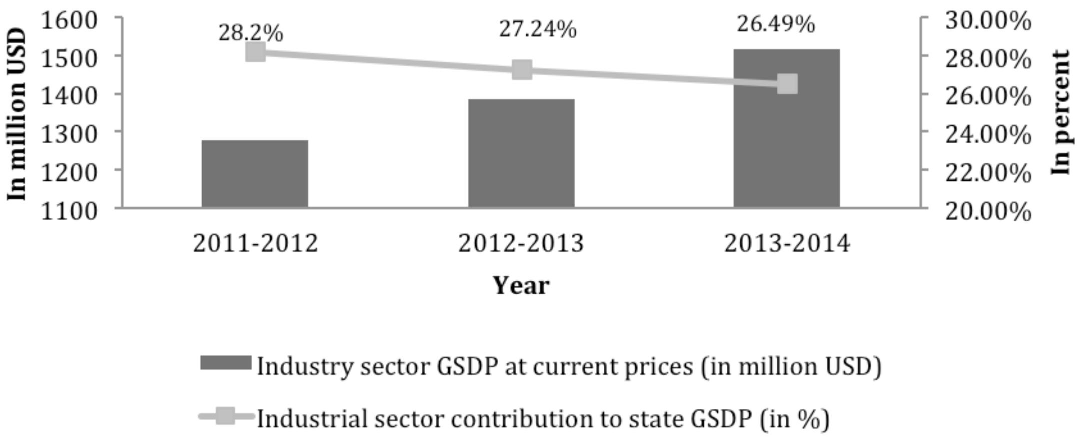
The state has a substantial presence in terms of industrial growth with more than 1670 large and medium enterprises that have generated employment for almost 3.36 lakh (336000) people and around 90,000 Micro and small enterprises providing employment to 8.9 lakh (890000) people.

The state has seen a fairly good economic growth over the years with an Average Annual Growth Rate of state Gross Domestic Product (GDP) of 7.8% for the year 2014-2015. The industrial sector contribution to state GDP has also risen over the years, underlining the high potential in Haryana for industrial growth.



Source: Department of Economic and Statistical Analysis, Haryana, 2012

Figure 2 Growth of state GDP (in %) of Haryana in comparison to India



Source: Department of Economic and Statistical Analysis, Haryana
Note: 1 USD taken equal to 67.9 INR

Figure 3 Share of industrial sector in Haryana state GDP at current prices

Textile Sector: A Key Engine of Growth in Haryana

Haryana saw a continuous growth in the manufacturing sector as shown by the Index of Industrial Production (IIP)[ii], which in general has increased steadily over the years (Table 2). Even though there was a decline in textile manufacturing sector in Haryana in 2011 – 2013 as a result of global slowdown of the industry, the sector picked up the pace and grew at a much faster rate in the last couple of years.

Table 2 Index of Industrial Production for manufacturing sector with base year 2004-2005

Industry group	Index			
	2011-2012	2012-2013	2013-2014	2014-2015
Manufacturing	165.9	173.6	177.8	187.6

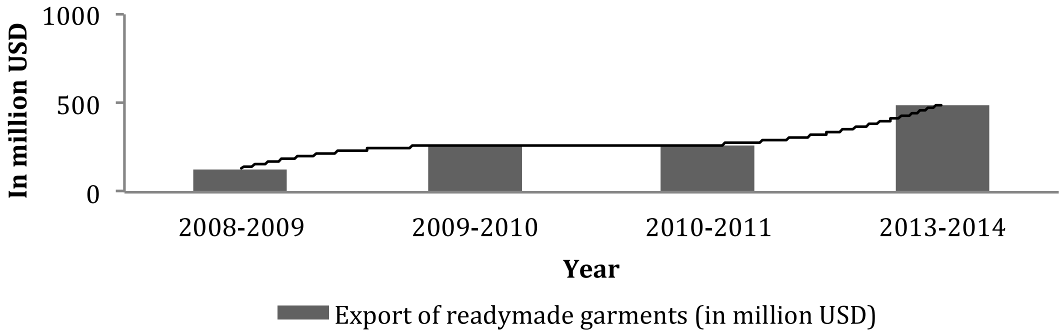
Source: Department of Economic and Statistical Analysis, Haryana

Table 3 Growth of textile manufacturing

Year	Annual growth of manufacturing sector	Growth of textile manufacturing
2011-2012	3.9%	-15.0%
2012-2013	4.6%	-10.7%
2013-2014	2.4%	19.5%
2014-2015	5.5%	22.1%

Source: Department of Economic and Statistical Analysis, Haryana

The textile industry saw a growth surge in the last few years. Not only did it become an important contributor in the total growth of the manufacturing sector of the state but it also played a significant role in the growth of the state economy as a whole. Rising production and exports of readymade garments resulted in export revenues increased exponentially from 266.21 million USD in 2010-2011 to 492.65 million USD in 2013-2014.



Source: Department of Industries and Commerce, Haryana
Note: 1 USD taken equal to 67.9 INR

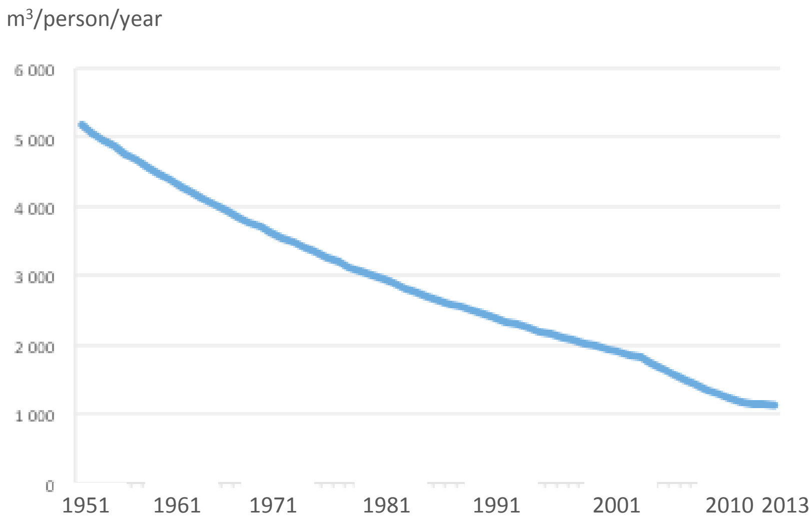
Figure 4 Increase in Export of Readymade Garments in Haryana

[ii] The Index of Industrial Production (IIP) is a key economic development indicator for measuring and analyzing the trend of industrial production for different sectors like manufacturing, basic goods, electricity, etc. over a period of time with reference to a chosen base year. It is an abstract representative number to measure the level of industrial performance and the growth of industrial sector in the economy. It shows the relative change in the volume of industrial production over time and is used by Government Departments, Research Institutes, Industrial Associations, Academicians, etc. for policy making and research.

Chapter 3 Water Resources Management in India

Water management in India is intricately woven into the cultural fabric of the country with its social, economic, political and ecological significance. Factors like caste-class differences, heterogeneity of farmers as the major sectoral water user, rural-urban dichotomy, and extremely varied ecological conditions, have often led to water management being a very contentious and tricky affair.[18]

After its independence, India has made large-scale water investments in water storage that have contributed considerable to sustain its economy. According to the World Bank[19], India has the capacity to store 200 BCM of water, an irrigated area of 90 Mha, and an installed hydropower capacity of about 30,000 MW. Nevertheless, rapid development, increasing population and mismanagement of water has rendered water demand to far outweigh its supply. Per capita water availability has shown a sharp declining trend, as shown in Figure 5, from 5177 m^3/person/year in 1951 to 1820 m^3/person/year in 2001, and now it stands at 1170 m^3/person/year in 2010. The latest figure from the World Development Indicator of water availability at 1130 m^3/person/year in 2013 is even lower than the government's prediction of water availability at 1140 m^3/person/year by 2050.



Source: Centre for Science and Environment (2004)[20], National Institute of Hydrology (2010)[21], World Bank (2015)[22].

Figure 5 Freshwater availability in India (m^3/capita/year) from 1951-2013

3.1. Current water resources situations

3.1.1. India's Water Budget

The country's water budget provides an understanding of a portfolio of available freshwater sources in India. There are two official estimates from the Ministry of Water Resources (MoWR) that differ in the assumption of evpotranspiration rate: MoWR's estimate of 40% evapotranspiration rate and the global evapotranspiration rate of 65%. Both provide more or less similar insight. The first one puts the annual utilizable water of 1,123 BCM, which is well above the current water use of 634 BCM according to the Planning Commission (2010); while the second estimate[23] gives the utilizable water at 654 BCM, which is nearly the same as the current water use. These second estimates invoke a very alarming situation and illustrate a spectrum of water availability that relates to temporal and spatial variation.

Table 4 India's Water Budget in BCM

Parameter	Analysis Based on Estimates of MoWR	Analysis Based on MoWR's Estimates on Worldwide Comparison
Annual rainfall	3,840	3,840
Evapotranspiration	3,840 – (1,869 + 432) = 1,539 (40 per cent)	2,500 (65 per cent) worldwide comparison
Surface runoff	1,869 (48,7 per cent)	Not used in estimate
Groundwater recharge	432 (11,3 per cent)	Not used in estimate
Available water	2,301 (60 per cent)	1,340 (35 per cent)
Utilizable water	1,123 (48,8 per cent of 2,301)[24]	654 (48.8 per cent of 1,340)
Current water use	634	634
Remarks	Current water use is well below utilizable water	Current water use is very close to utilizable water

Source: Narasimhan (2008)[23]; Narasimhan and Gaur (2009)[25].

3.1.2. Freshwater Resources

Freshwater resources in India comprise of river systems, groundwater and wetlands, in which each of them has a unique role and characteristic linkages to other environmental entities.[26] Rainfall and melting glacier are the main sources of supply for India surface water and groundwater resources.

Rainwater

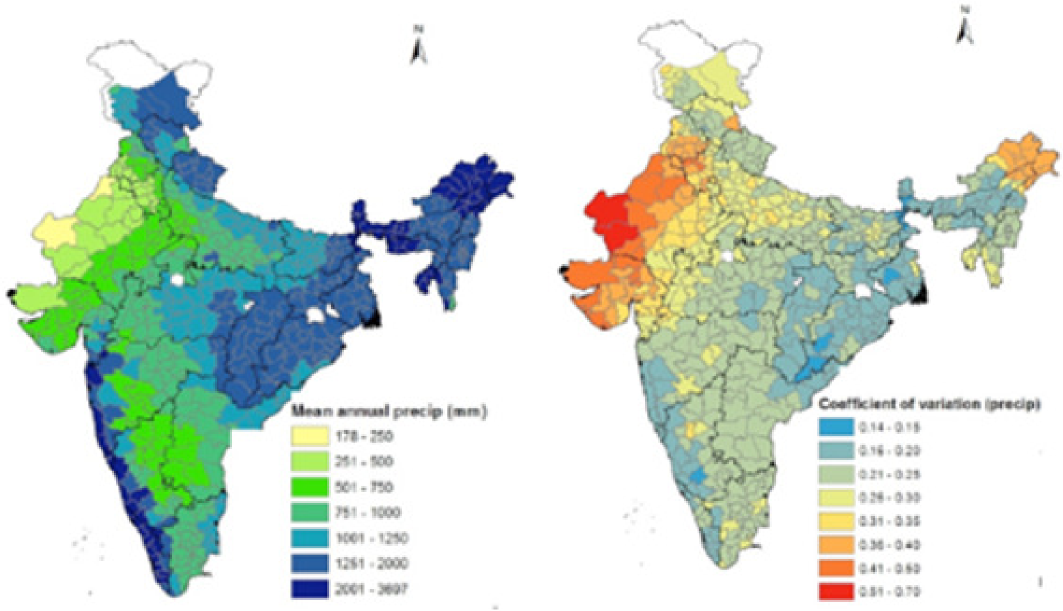
India has the highest long-term average precipitation in the world for its size with 1,160 mm, most of which occurs during 4-5 months of monsoon season (June to October). There is a high variability of rainfall across the country with excessive rainfall of 1250-2500 mm in the Western Ghats and the outer slopes of Himalayas; while arid and semi-arid western and north-western parts have 250-750 mm. The past 100 years meteorological data shows a very significant variation in precipitation across years and within the year as illustrated in Figure 6. A higher interannual variability is observed both in areas with very low average annual precipitation, i.e. the north and north-western India, and those with the highest average annual precipitation, e.g. some parts of Eastern India[27]. Rainwater harvesting is increasingly used by the industry to anticipate water cuts during shortages.

Surface water

Surface water system in India comprises of 20 major river basins (Figure 7), with seven rivers and their tributaries feeding into these river basins. Thirteen of them are large basins with an aggregate catchment area of 2.6 million km^2 and covering 81 per cent of the country. Fourteen of these 20 river basins are already water-stressed. [28]

Groundwater

India is the largest consumer of groundwater in the world with an estimated water use of 230 billion m^3/year, of which about 90% is for irrigation and the rest for industrial and domestic purposes. As the main source of water supply for more than 60% of irrigated agriculture and 85 per cent drinking water, groundwater is very important for rural communities. The urban and industrial reliance on groundwater is also increasing over time.[29] Most textile units rely on groundwater use, either through own wells or water tank sellers.



Source: Devineni et al (2011) in Perveen et al (2012).[30]
Notes: (a) mean annual precipitation and (b) variability in precipitation

Figure 6 Spatial Distribution of Precipitation across the Country

Source: Gaur and Amerasinghe (2011)

Figure 7 Major River Basins in India

The notion of groundwater as private resources, which are linked to land rights, has led to the exploitation of the resources with currently over 20 million users, which renders groundwater management a very challenging issue. The unsustainable use of groundwater resources has led to a drastic decline of the groundwater table and saltwater intrusion in many parts of India. The way

India will manage its groundwater resource will clearly have serious implications for the future growth and development of the water resources, agriculture, and food sectors in India, as well as the alleviation of poverty.

3.2. Key Impacts of Climate Change to India's Water Resources

There are numerous existing studies on the impacts of climate change on water resources in India and how it affects human lives, such as vulnerability assessment in Ganges basin[31] and the assessment of adaptation options and socio-economic consequences of climate-induced flood risks in Mumbai[32]. The National Water Mission (NWM), as one of the eight missions within the India's National Action Plan on Climate Change (NAPCC) that focuses on adaptation, has identified the key effects of climate change to India's water resources: a decline in the glaciers and the snowfields in the Himalayas, increased drought like situations due to overall decrease in the number of rainy days, increased flood events due to the overall increase in the rainy day intensity, effects on groundwater quality in alluvial aquifers due to increased flood and drought events, influence on groundwater recharge due to changes in precipitation and evapotranspiration, and increased saline intrusion of coastal and island aquifers due to rising sea levels [33]:

The Himalayas provides freshwater resources to India's three main river basins (the Indus, Brahmaputra and Ganges) and its water yield per unit area from the region is double that from the peninsular systems[34]. The Indian Network for Climate Change Assessment (INCCA) predicts an increase of annual temperature from $0.9\pm0.6^{0}C$ to $2.6\pm0.7^{0}C$ by 2030, resulting in increased water yield in the Himalayan region while the glacier remains, especially for Indus basin by 5-20%, which will be good for water supply and hydropower but aggravate flood risks.[35] Predicted changes in precipitation pattern across the country highlights the fact that climate variability will impose newer future challenges. For example, the shifts in southwest monsoon system in India can imply catastrophic effects in the form of floods, droughts and famines. Eventually, these hazards will increase the vulnerability of the communities through ecosystem degradation, reductions in water resources and food availability, and changes in livelihoods[36]. The main challenges for the water sector is to build the resilience to the increasing climate variability.

Coastal aquifers in India already experience degrading water quality due to pressure from anthropogenic activities, such as high population, intense land-based activities, overexploitation of freshwater aquifers, and lack of sustainable water management system. Salinity ingress is taking place in Tamil Nadu and Saurashtra, while inland salinity takes place in Rajashtan, Haryana, Punjab and Gujarat. Predicted sea level rise will exacerbate salt water intrusion.

In view of those impacts, the NWM identifies five main goals: 1) comprehensive water data base in public domain and assessment of impact of climate change on water resource; 2) promotion of citizen and state action for water conservation, augmentation and preservation; 3) focused attention to over-exploited areas; 4) increasing water use efficiency by 20%; and 5) promotion of basin level integrated water resources management.

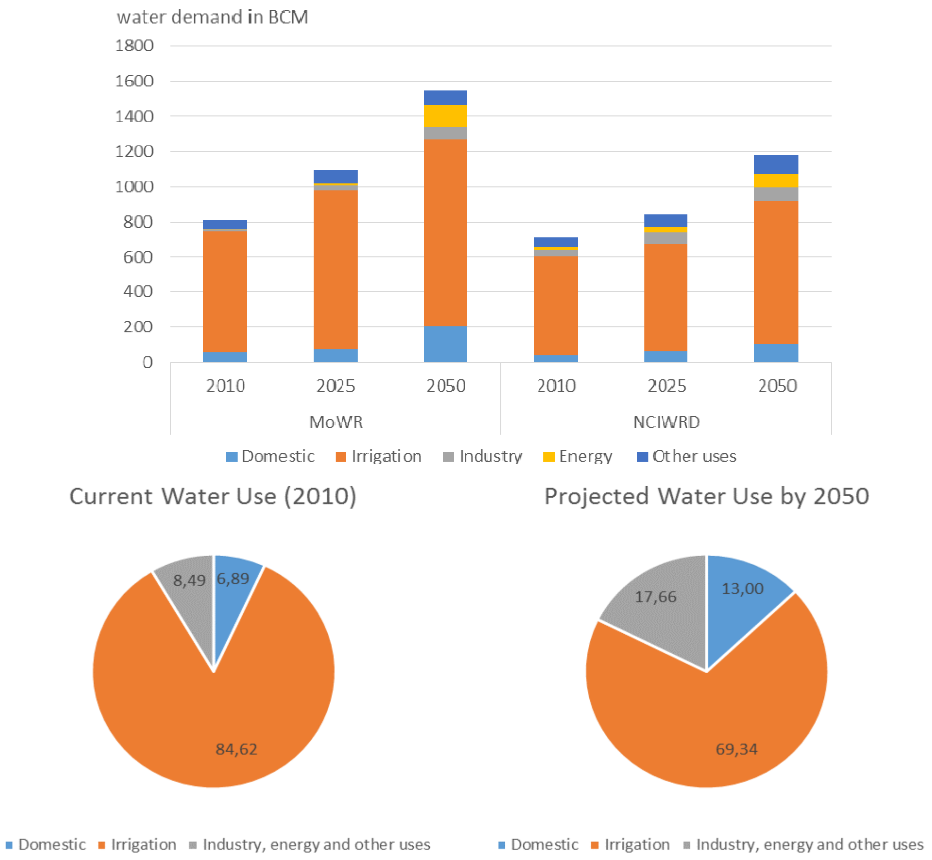
The NWM undertakes critical action points and timeline for each of the goal above and the latest timeline was scheduled in 2017 for rainwater harvesting and groundwater recharge programme, under goal (3). The critics underscored lack of attention to water sector in NAPCC compared to the energy sector. Moreover the goals have insufficient targets and actually require a significant paradigm shift in the institutional mechanism of how water resources are governed in India at different levels. Considering the vast geographical and socioeconomic profile across the region, the necessary adaptive decision making processes prove to be very challenging.

Chapter 4 Physical water risk outlook of the textile and leather industry

4.1. Physical Water Risks in India

4.1.1. The Growing Water Supply Demand Gap in India

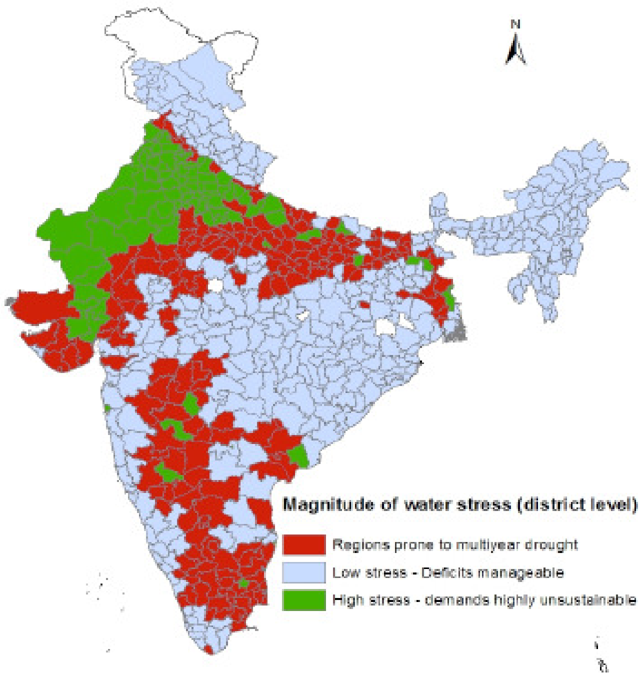
Water is a scarce resource for a lot of regions in India. The most serious concern is the growing population to 1.66 billion by 2050 that will increase the demand for food, energy and water. The main official estimates in water demand are provided by the Sub-committee of the Ministry of Water Resources (MoWR) and the National Commission on Integrated Water Resources Development (NCIWRD). The estimates provide consistent insights regarding the trends of water demand. MoWR estimates in Figure 8 shows that by year 2050 India needs to increase water supply by 5 times to industries (from 12 BCM to 62 BCM) and by 16 times for energy production (from 5 BCM to 130 BCM), while its drinking water demand will double (from 56 BCM to 102 BCM) and irrigation demand will rise by 50 percent (from 688 BCM to 1072 BCM). The proportion of water use for the industry, energy production, and other uses altogether will be more than doubled, while agricultural water use will be reduced by 15%. This national context is important is India's government plays more active role in re-allocating water across states to address scarcity issue.



Source: Government of India (2006) cited in ADB (2009)[37]

Figure 8 Sectoral Water Demand in India

Meanwhile, declining availability of freshwater resources at a much faster rate than predicted (Figure 5), resulting in an increasing gap between future water demand and water availability. The demand-supply gap at the basin level according to 2030 Water Resources Group indicate that merely a few basins will experience surplus, while the rest of the basins will mostly have moderate (0-20%) or severe (20-80%) scarcity gap.[3] Climate-induced water variability adds further water stress across spatial and time scale, especially at the district level. A study by the Columbian Center for Water produces water stress index that takes into account the variations of water demand and renewable water supply within and across the year (Figure 9). Considering increased competition of water use across sectors and different policy across states, this information will be most meaningful for the industry at a district level to better anticipate and manage water risks within a year and overtime.[27]



Source: Devineni, Perveen, and Lall (2011)[27]

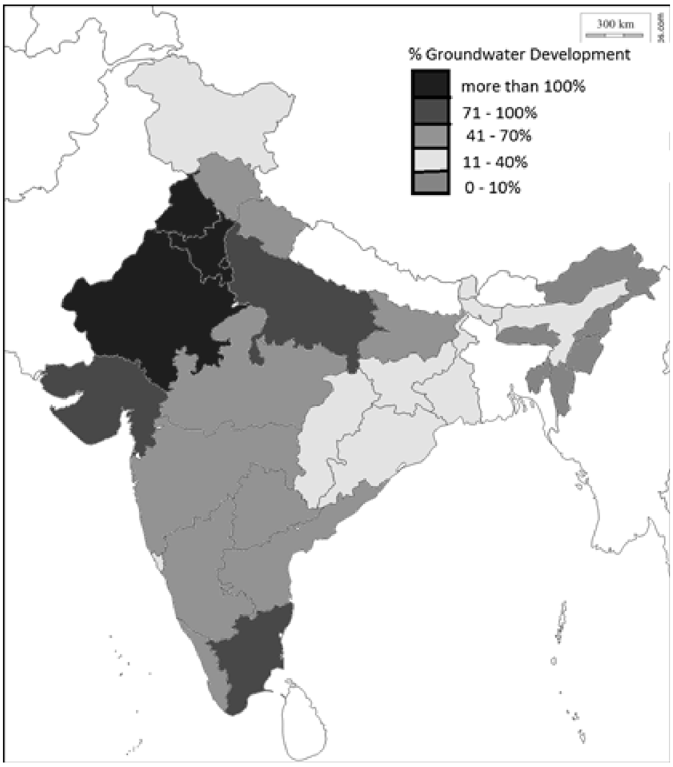
Figure 9 Magnitude of Water Stress at District Level

4.1.2. India's Declining Water Table

In India, groundwater data collection and analysis is done by the Central Ground Water Board (CGWB) at the national level and similar organizations at the state level. Monitoring is usually done on the basis of blocks, local-level administrative units between the *panchayat* (local government) level and the major districts into which each state is subdivided.[38] Out of a total of 5842 administrative units or block (2009 data), only 73.2% is safe or sustainable, 13.7% is overexploited and the rest are critical or semi critical. Complete saline groundwater was observed in 71 units.

The stage of groundwater development[iii] increased to 61% in 2009 from 58% in 2004 depicting increasing pressure on the groundwater resources[39]. The Indus-Ganges-Brahmaputra basin, covering the states of Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal and North Eastern Valley, has a relatively high replenishable groundwater recharge of 0.25m to more than 0.5m.[39] However, unprecedented exploitation has caused the development status to be higher than 100%, implying much higher annual groundwater abstraction than the recharge rate. As a result, the groundwater tables decline by 0.4m a year according to Delhi Jal Board, which is responsible for water supply.

[iii] Stage of groundwater development is defined as the annual gross groundwater draft divided by the net annual groundwater availability. http://planningcommission.gov.in/aboutus/committee/wrkgrp12/wr/wg_susgm.pdf



Source: Groundwater Year Book, CGWB, 2013-2014

Figure 10 Level of groundwater development in India

4.1.3. Water Pollution at the National Level and Ganges Basin

Water pollution is a major concern for India where over 70% of rural water consumed does not meet the WHO standards contributing to almost 80% of rural illnesses and 20% deaths among children age up to 5 years are. Within the urban contexts, the main sources of water pollution are untreated industrial and domestic wastewater discharge and overuse of fertilizer. Only 31% of the total sewage water generated in 23 major cities is treated and the rest is disposed of into 18 major rivers.[40] Rising water demand for industrial and energy due to rapid industrialisation will give rise to wastewater discharge and its associated potential surface and ground water pollution.[41]

CPCB monitors the water quality in the country under the National Water Quality Monitoring Programme through different monitoring units. This monitored data is analysed and categorized according to priority depending on the BOD levels at the monitoring stations.

The Ganges basin is the world's largest and most populous river basin that covers 9 states in India, (including Haryana), Bangladesh, Nepal and Bhutan. Water quality monitoring of the Ganges Basin is conducted by the State Pollution Control Boards of Uttarakhand, Uttar Pradesh, Bihar, West Bengal, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, Jharkhand, Central Pollution Control Board, Central Ground Water Board and the Central Water Commission.

Degraded Surface Water Quality of Ganges and its Tributaries

Total industrial water consumption in the Ganges basin is about 1123 MLD with wastewater generation as high as 45% (501 MLD) of the total water consumed[42]. The Ganges basin has 110 water quality monitoring stations of which 39 are along the main stream of Ganges and the rest are along the tributaries and sub-tributaries. Central Water Commission (CWC) stations carry out either monthly or quarterly observations for 68 parameters of surface water quality, while CPCB observes six quality parameters (pH, conductivity, Dissolved Oxygen or DO, Biological Oxygen Demand or BOD, total coliform and fecal coliform) at 233 locations. The monitoring results in 2009 show that organic pollution persists to be the predominant pollutant as indicated by high BOD and conductivity values.

Table 5 Places on the Ganges Basin which do not meet the criteria set by CPCB

Parameter	Desired range	Observed range	Places not meeting criteria
pH	6.5 – 8.5	6.5 – 8.9	Varanasi, Chapra, Rishikesh, Haridwar, Kannauj, Indrapuri, Bithoor, Trighat and Kanpur
DO	More than 4mg/l	4.3 – 9.2 mg/l	Kanpur, Varanasi, Dakshineshwar, Haridwar, Bithoor, Kannauj etc.
BOD	<3mg/l	0.2 – 16.0 mg/l	Kanpur, Varanasi, Dakshineshwar, Haridwar, Bithoor, Kannauj etc.
Conductivity	2250 µmhos/cm	68-4460 µmhos/cm	Criteria not met for irrigation
Fecal Coliform	2500 MPN/100ml	0-400000 MPN/100ml	Criteria not met for bathing- Dakshineshwar, Howrah-Shivpur and Garden Reach, Palta, Serampore, Uluberia and Diamond Harbour, Varanasi, Bhagirathi with Alaknanda at Devprayag, Mandakini Alaknanda at Rudraprayag

Source: Ministry of Water Resources, 2014.

Deteriorated Groundwater Quality of Ganges Basin

There are 571 groundwater quality monitoring sites according to India-WRIS database in 124 districts of the 10 states under the Ganges basin, with 47 sites in Haryana. Groundwater quality is annually monitored by the Central Ground Water Board (CGWB) and hotspots are identified based on six parameters: salinity (EC>3000 micro simen/cm), chloride, fluoride (>1.5 mg/l), iron (>1.0 mg/l), arsenic (>0.05 mg/l) and nitrate (>45 mg/l).

According to the CGWB, the Ganges basin is severely affected by arsenic, fluoride, nitrate, chloride and salinity. Haryana has higher than permissible levels of salinity, chloride, fluoride and nitrate. Salinity hotspots in Haryana are Faridabad, Gurgaon, Jhajjar, Panipat, Rewari, Rohtak, Sonepat districts of Haryana. Nitrate is the most common contaminant of ground water[43] and can cause serious health issues.

4.1.4. Sub Optimal Performance of Common Effluent Treatment Plants

Considering the high capital and operating cost of an effluent treatment plant (ETP), low investments access for small and medium enterprises and the increasing need to combat industrial pollution, the Ministry of Environment, Forest and Climate Change (MoEFCC) produced a directive for state governments to examine possible locations for common effluent treatment plant (CETP). The state governments then identified locations for CETP. This CETP was expected to provide the most appropriate solution to the issue at hand, yet it has not been a very successful model as expected.

Until 1990 India had just one Common Effluent Treatment Plant (CETP) in Jeedimetla, near Hyderabad. This number rose to 150 by 2011. The distribution of these CETPs across India is shown in Table 6. Eventhough these CETPs were built and even upgraded to the best available technology, the CPCB study of 78 operating CETPs in 2005 (Table 7) showed unsatisfactory performance for many of them. The sub-optimal performance of the CETPs could be attributed to the poor operation and maintenance. Furthermore, high TDS content in the influent compromised the efficiency of CETPs.[44]

Table 6 The Distribution of CETP and Its Capacity

No.	State	CETPs in 2005	Combined capacity (in MLD)	CETPs in 2011	Combined capacity (in MLD)
1.	Andhra Pradesh	3	12.75	4	13.5
2.	Delhi	11	133.20	13	211.8
3.	Gujarat	16	156.30	261	374.0
4.	Haryana	1	1.10	9	48.3
5.	Karnataka	2	1.30	7	7.0
6.	Maharashtra	11	63.25	252	186.9
7.	Madhya Pradesh	1	0.90	1	0.9
8.	Punjab	2	1.54	5	6.9
9.	Rajasthan	8	57.70	11	117.2
10.	Tamil Nadu	29	71.15	44	148.0
11.	Uttar Pradesh	3	44.40	7	56.3
12.	West Bengal	1	10.00	1	20.0
13.	Total	88	559.77	153	1191.0

Source: Central Pollution Control Board.

Table 7 The Summary of the 78 CETPs Assessed by CPCB

State	Number of CETPs assessed by CPCB	CETPs complying pH, BOD, COD, TSS and TDS standards		CETPs complying pH, BOD, COD and TSS but not complying TDS standard	
		Number	Name	Number	Name
Andhra Pradesh	2	0		0	
Delhi	10	3	Mayapuri, GTK, Badli	6	Wazirpur, Mangolpuri, Jhilmil, SMA, Nangaloi, Okhla I.A
Gujrat	15	0		2	Ankleshwar, Sachin (0.5MLD)
Haryana	1	0	Kundli-I	0	
Karnataka	2	0		1	Pai&Pai
Maharashtra	9	0		3	Thane-Belapur, Ambernath, PatalGanges
Madhya Pradesh	1	0		0	
Punjab	1	1	Phillore	0	
Rajasthan	5	0		1	Jodhpur**
Tamil Nadu	29	0		2	Thiruvai Karur***, TALCO Ambur Thuthipet
Uttar Pradesh	3	0		0	
Total	78	5 (6.4%)		15 (19.2%)	

*TDS not determined but likely to be within limits; **CETP was under trial; TDS not determined but Cl exceeded; ***TSS not determined
Source: Central Pollution Control Board, 2005

4.2. Physical Water Risks in the State of Haryana

4.2.1. Increasing Water Supply Demand Gap at the State Level

The state of Haryana spread over an area of 44,212 square km is majorly an agricultural state. However, the development of secondary and tertiary sector has risen over the decades and thus increasing the stress on its water resources. The state has an average rainfall of 615 mm, 9.31 BCM of annual replenishable groundwater resource and net annual groundwater availability of 8.63 BCM. The rate of groundwater abstraction is much higher than the rate at which it is replenished. The stage of groundwater development is 127% as per the CGWB report of 2013-2014. The 55 blocks were notified as over exploited, 11 blocks as critical and 5 blocks as semi critical, underlining the problem of overexploitation of the groundwater resource and the increasing gap between water supply and demand in the state.[9] The projected demand for industrial and domestic water use by 2025 as per reports is 0.79 BCM.[39]

Figure 11 Location of Faridabad District on the Map of Haryana State

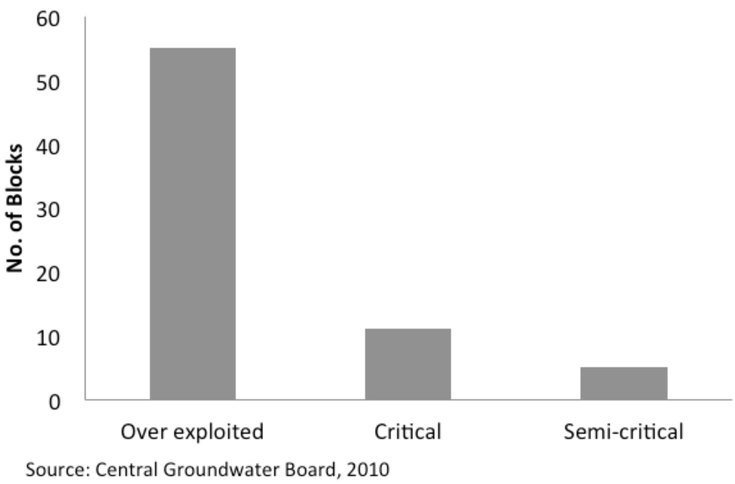


Figure 12 Categorization of Groundwater Blocks as Over Exploited, Critical and Semi-Critical

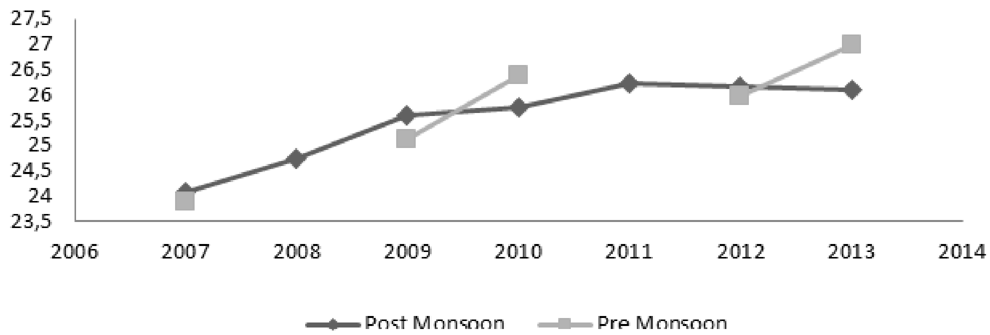
Faridabad and Ballabgarh are major industrial towns in Haryana, having almost 1500 registered factories like textile manufacturers, fertilizer, electroplating works, etc., of which many generate hazardous waste. Decline in the groundwater level and its pollution are major problems for the region, which needs immediate attention. STWI Projects in particular has been closely associated with the textile wet processing units in this region in its earlier phases through the SWAR project. Almost 60% (11 out of 18) of the participating factory units within SWAR Project are wet processing units in the NCR region. Therefore, the Faridabad- Ballabgarh cluster in Haryana been chosen as the focus area for the purpose of the study for the industrial water governance project.

Faridabad district, with two blocks notified as semi critical has a major problem of groundwater decline plaguing it. In response to the current overexploitation in the region, Municipal Corporation of Faridabad and Ballabgarh have been notified by CGWA to regulate the state of groundwater development. The annual replenishable ground water resource of Faridabad as on 2011 was 202.28 mcm. The stage of groundwater development in the district was estimated to be 81% and the projected demand for domestic and industrial use upto 2025 was reported to be 27.46 mcm.[9]

Table 8 The groundwater resource development potential of Faridabad district of Haryana

Block	Net annual ground-water availability (BCM)	Existing gross ground-water draft for all uses (BCM)	Existing gross ground-water draft for irrigation (BCM)	Provision for domestic and industrial requirement supply to 2025 (BCM)	Net annual groundwater availability for future irrigation development (BCM)	Stage of ground-water development (%)	Category
Ballabgarh	0.10004	0.07493	0.07759	0.00453	0.02058	78	Semi-critical
Faridabad	0.10224	0.06625	0.08591	0.02293	0.01306	84	Semi-critical
Total	0.20228	0.14118	0.16350	0.02746	0.03364	81	

Source: Central Ground Water Board, 2011



Source: India Water Tool

Figure 13 Groundwater Level of Ballabgarh

Irrespective of the increasing gap between the supply and demand for water, not much increase in the pricing of water by the Public Health and Engineering Department has been seen. The industrial water supply rate has increased merely from 0.05 USD/ kl in 2006 to 0.06 USD/ kl. The wastewater disposal charges in 2006 were 0.02 USD/kl (wastewater discharge was taken to be 70% of the water consumed), which was changed to 25% of the total water charges. Considering substantial increase in water demand for industrial use, it is necessary to have a revision of water pricing.

4.2.2. Increasing Water Pollution Problem of Haryana

Apart from water availability, the problem of water pollution also plagues the industrial belt of Haryana. Haryana state has three river stretches falling under priority 1 and one stretch each under priority 3 and 5.[45] Priority level of river stretches is set by CPCB based on the risk defined as a product of frequency of violation of criteria and magnitude. The degree of violation is with respect to water quality criteria for drinking water source with conventional treatment with respect to BOD.

Table 9 Categorization of Polluted Stretches of River in Haryana according to the BOD Level

River	Polluted stretch	Source/town	Monitoring location	BOD (mg/l)
Polluted River Stretches: Priority 1 (BOD>30mg/l and BOD exceeding 6mg/l on all occasions)				
Ghaggar	Interstate border of Punjab & Haryana to Ottu wier at Sirsa	Industrial & Municipal waste from Patiala, Derabassi, Sirsa	1. Before Ottu Weir (Before Mixing of Satluj Canal Water)	50
			2. Gh-1 At Road Brdg. Sirsa,Debwali Road	33
			3. Gh-2 At Chandarpur Syphon	40
			4. Near Bankarpur, Dera Bassi	22
			5. U/S Dhakansu Nallah	21
Markanda	Kala Amb to Narayan Garh	Industrial & Domestic waste from Kala Amb	1.Kala Amb D/S	590
Western Yamuna Canal	D/s of Yamuna Nagar	Yamuna Nagar Industrial & Domestic wastewater	1. 100 meter D/s after receiving Industrial & Sewage effluent	247
			2.At Damla d/s of Yamuna Nagar	188
Polluted river stretches: Priority 3 (BOD between 10 & 20 mg/l and BOD exceeding 6mg/l on all occasions)				
Gurgaon Canal	D/s of Delhi	Delhi	1. GC-1 Near Badarpur Border	24
Polluted river stretches: Priority 5 (BOD between 3 & 6 mg/l)				
Yamuna	Kalanaur to Sonepat	-	1. Hathnikund	3
			2. At Kalanaur	4
			3. At Sonepat	5
			4. U/s Paonta Sahib	3

Source: Central Pollution Control Board

River stretches having BOD more than 30 mg/l and more than 6 mg/l on all occasions is categorized as priority 1 because the associated risk is the highest. BOD of 30 mg/l is the criteria for sewage treatment plant and in the river without dilution. BOD beyond 6 mg/l greatly reduces the DO level and BOD greater than 5 mg/l forms complex chemicals on chlorination for municipal water supplies, thus the associated rivers are considered as high risk zones. Priority 3 has relatively less risk because the BOD ranges between 10 and 20 mg/l and exceeds 6mg/l on all occasions. Priority 5 is considered to have the least risk because the BOD level is much lower than the rest and only the areas having BOD greater than 3mg/l and less than 6 g/l.

River Yamuna is one of the most important tributaries of Ganges, having a catchment of 21265 km^2 in Haryana state alone. Almost 500 km stretch of this river is in deteriorated condition and unsuitable for designated best use.

Table 10 Observations for river Yamuna

Parameter	Value
pH	7.0-9.4
Conductivity	80-3040 µmhos/cm
DO	0.0-17.9 mg/l
BOD	0.2-103 mg/l
Fecal coliform	9- 21, 00,00,00,00 MPN/100ml
Total coliform	4- 23,00,00,00,000 MPN/100ml

Source: Ministry of Water Resources, 2009

Table 11 The Surface Water Quality Level in Haryana at Some Monitoring Stations

Parameter	Value		
	Gurgaon canal upstream	Gurgaon canal downstream	Yamuna river u/s at Manjhawali village
Fecal Coliform (MPN/100ml)	1100	1400	1700
Total Coliform (MPN/100ml)	3300	5000	7000
Dissolved Oxygen (mg/l)	1.6	1.2	2.3
Biochemical Oxygen Demand (mg/l)	2.04	2.95	1.82
Conductivity (microsiemens/cm)	922	952	1214
pH	7.04	7.08	7.17
Sodium Absorption Ratio	2.3	2.12	2.26
Chemical Oxygen Demand (mg/l)	98	112	134

Source: India Water Tool, 2013

The groundwater quality is also a grave problem with salinity, high fluoride, and arsenic as the major concern for the state.[9]

Table 12 Some of the Contaminants and Affected Districts

Contaminants	Districts affected (in part)
Salinity (EC > 3000µS/cm at 250C)	Bhiwani, Faridabad, Gurgaon, Hissar, Jhajjar, Jind, Kaithal, Mahendergarh,Palwal, Rohtak, Sonepat and Sirsa
Fluoride (>1.5mg/l)	Bhiwani, Faridabad, Gurgaon, Hissar, Jind, Kaithal, Panipat, Rewari, Sirsa and Sonepat
Arsenic (above 0.05mg/l)	Ambala, Fatehabad, Karnal, Sonepat, Mewat
Iron (>1.0mg/l)	Ambala, Bhiwani, Faridabad, Fatehabad, Gurgaon, Hissar, Jhajjar, Jind, Sonepat, Sirsa and Yamunanagar,
Nitrate (>45 mg/l)	Bhiwani, Faridabad, Gurgaon, Hissar, Jhajjar, Jind, Kaithal, Mahendergarh, Palwal, Sirsa and Sonepat
Heavy metals: Lead (above 0.01 mg/l) Cadmium (Above 0.003mg/l)	Lead: Bhiwani, Faridabad, Fatehabad, Gurgaon, Hissar, Jhajjar, Jind, Kaithal, Karnal, Mahendergarh, Panchkula, Rewari, Rohtak,Sonepat and Sirsa Cadmium: Gurgaon, Jhajjar, Jind, Rohtak

Source: Central Ground Water Board

4.3. Perception on Physical Water Risk

Faridabad and Ballabgarh regions of Haryana are major industrial towns and hence significant consumer of water and primary sources of pollution in the area. CKinetics estimates that the textile wet processing units in the Faridabad-Ballabgarh cluster alone consumes 200 MLD[46] of water and the major physical water risks associated with the region are both water scarcity and quality.

Decline in groundwater level and its pollution have become the main concern for the region. Depleting groundwater level was unanimously stated as one of the greatest challenges for the textile industry. It also degrades the quality of the groundwater, which then increases the challenge for the water intensive industry. The declining groundwater table also increases abstraction and processing cost for the industry.

The indiscriminate disposal of waste in the last decade by the industry has brought about the deterioration of water. Pollution of the shallow groundwater is the reason for high concentration of fluoride, chloride, sulphate, nitrate in most parts of the region. Concentration of heavy metals in this area is attributed to the discharge of industrial effluents and needs immediate attention.[47] The three primary reasons that has brought about deterioration of water quality are:

a) The under capacity of the installed Effluent Treatment Plants (ETP)
b) The lower operation of ETP than as prescribed.
c) Unavailability of skilled labour.

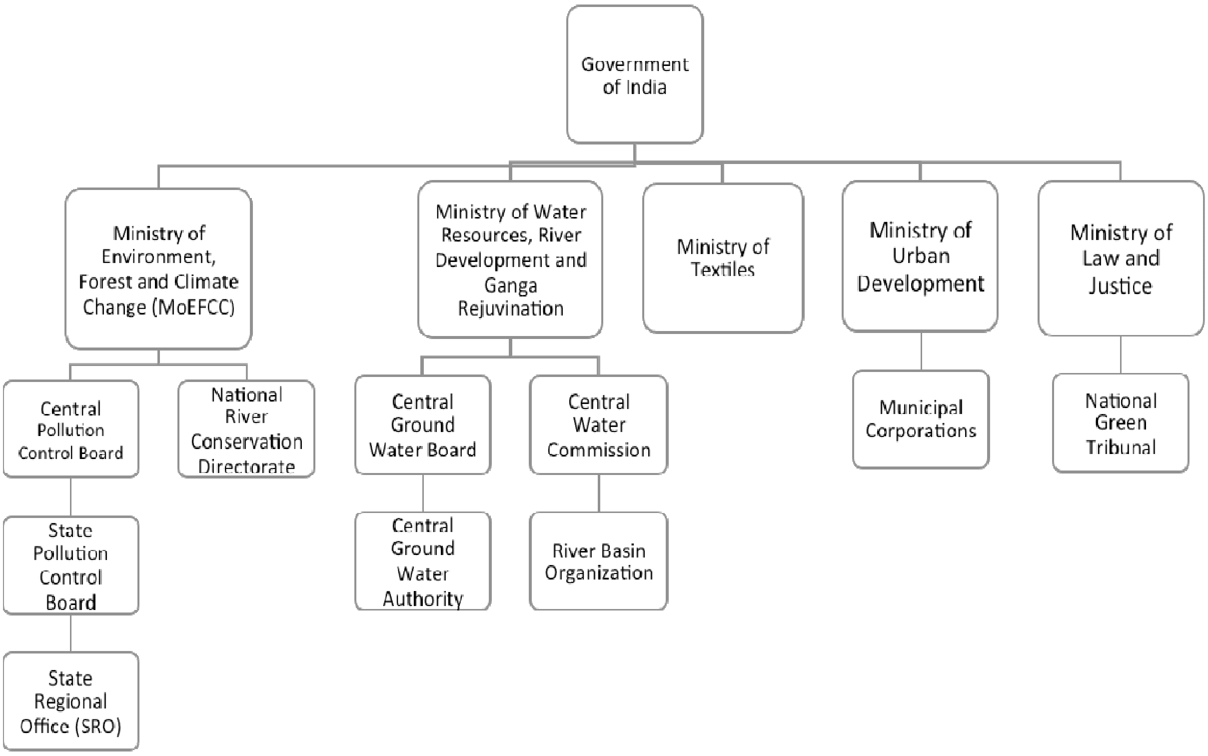
The Faridabad-Ballabgarh region in Haryana suffers from the problem of very high Total Dissolved Solids (TDS) value. The high TDS levels of the region drives the industries to depend greatly on tankers for water availability. The TDS in the region is in the range of 2500-3000 mg/l, while the water supplied by the tankers has TDS value of about 1000 mg/l. The maximum TDS allowed for the operation of the boiler is 200 mg/l, for which the industries need to depend on RO systems with an efficiency of about 50%. It implies that 50% of the water fed into the RO system is discarded and due to its high TDS value it cannot be used for other purposes. The majority of the industries in this region partly or completely depend on tankers for water supply. The water is purchased at the rate of about 8.84 USD/ 12 kl, which acts as an incentive to minimize the amount of water used.

Driven by the ZLD policy, the region is currently motivated to take up measures to ensure that toxic waste from the industries does not further degrade the streams, rivers and other water bodies.

Chapter 5 Water Governance Landscape Pertaining to Textile Industry

5.1. National Level Policy Landscape of Water Governance

The management of water resources is a matter of proper implementation of rules, processes and practices and hence requires good governance. Water governance in India is managed by different ministries and their subordinate bodies to ensure that the society's use of water resources does not compromise water security. The main government bodies involved in establishing policies in relation to water governance is mapped below.



Source: Government of India

Figure 14 Water Governance Structure at National Level

Each of those regulatory bodies play crucial roles in the value chain of water governance to ensure sustainable development of the textile industry by means of various laws, regulations and initiatives which can be delineated as below. These value chains of textile water use entail water allocation to the industry; water abstraction or water use permits and pricing by companies; water savings or water use efficiency in the production process; water pollution prevention and control, including permits and pricing, water reuse and return flow to water environment.

	Water allocation to the industry	Water abstraction or water use permits and pricing by companies	Savings or water use efficiency in the production	Water pollution prevention and control, including permits and pricing Water reuse Return flow to water environment
Key actor	Central Ground Water Board (Ministry of Water Resources, River Development and Ganges Rejuvination), Ministry of Urban Development	Central Ground Water Board (Ministry of Water Resources, River Development and Ganges Rejuvination)	Industries, Ministry of Textiles	Central Pollution Control Board (Ministry of Environment, Forest and Climate Change)
Roles	Central Ground Water Board: 1) To Issue No Objection Certificates (NOC's) for groundwater abstraction by industry or process Ministry of Urban Development: To supply water (subject to water planning by Ministry of Water Resources, River Development and Ganges Rejuvenation)	To Issue NOC's before establishment of an industry or process for withdrawal of ground water	Industries: 1) To adopt water efficient technologies Ministry of Textiles: 1) To assist textile industries to upgrade to water efficient technologies	1) To plan and execute programmes for prevention and control of water pollution. 2) To provide technical assistance to the State Boards. 3) To prepare guidelines, codes and manuals relating to treatment and disposal of effluents. 4) To set norms for water use and waste water discharge by industries.
Laws/ regulations		1) National Water Policy, 2012	1) National Textile policy, 2000	1) The Water (Prevention and Control of Pollution) Act, 1974 2) The Water (Prevention and Control of Pollution) Cess Act, 1977
Initiatives			1) Technology Upgradation Fund Scheme (TUFS, RRTUFS, ATUFS)	1) Integrated Processing Development Scheme (IPDS) 2) Zero Liquid Discharge (ZLD) 3) Scheme of Integrated Textile Parks (SITP) 4) Micro and Small Enterprises – Cluster Development Programme (MSE-CDP) 5) National Water Quality Monitoring Programme

Source: Government of India

Figure 15 Water Governance Value Chain Pertaining to Textile and Leather Industry Water Use in India

5.1.1. Key Actors and Their Roles

A. Ministry of Environment, Forest and Climate Change (MoEFCC)

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative setup of the Government of India with the key responsibilities of overseeing the proper planning and implementation of the country's environmental and forestry related policies and programmes. Under the principle of sustainable development, the Ministry works for the enhancement of social wellbeing and animal welfare. The ministry primarily aims at the conservation of natural resources of the country, such as rivers, lakes, biodiversity and prevention and control of pollution by the use of environmental audit, natural resource accounting, command and control measures, voluntary regulations, awareness drives and fiscal methods. The focus of the various programmes and schemes of the Ministry is on pollution prevention and control as well as the promotion of clean and low waste technologies, waste minimization, reuse and recycling, improvement of water quality, institutional and human resource development, etc.[48]

Central Pollution Control Board

The Central Pollution Control Board (CPCB) under the MoEFCC was constituted under the Water (Prevention and Control of Pollution) Act, 1974. Additional responsibilities was established related to air pollution control in 1981. The umbrella legislation Environment (Protection) Act, 1986 further widened the scope of action of the CPCB. The key roles of the CPCB in relation to water are as follows:

a) Advisory on matters relating to the prevention and control of pollution and restoration of the quality of water and Coordinate the activities of the boards at the state level and resolve disputes amongst them.
b) Monitoring and regulation of water pollution prevention and control, e.g. by establishing and modifying standards for wells or streams.
c) Training and capacity building, i.e. through technical guidance and all types of assistance for the state boards; prepare guidelines and manuals on treatment of effluents; plan and organize nationwide programmes; conduct mass awareness campaign; and collate and publish technical and statistical data on water pollution.[49]

National River Conservation Directorate

The National River Conservation Directorate (NRCD) under the MoEFCC has the responsibility of improving river water quality by implementation of River Action Plans in the polluted stretches of the river. NRCD is also responsible for the implementation of the centrally sponsored scheme of National River Conservation Plan (NRCP) and National Plan for Conservation of Aquatic Eco-systems (NPCA).[50]

The NRCP was launched in 1985 as the Ganges Action Plan (GAP) Phase I with the primary aim to prevent the pollution and improve the quality of the Ganges. GAP Phase II approved Yamuna and Gomati Action Plan in 1993. Other major river conservation programmes were approved in 1995. In 1996, GAP II and NRCP were finally merged.[51]

The NPCA programme of NRCD aims at improving and conserving aquatic systems such as lakes and wetlands by means of uniform policy, guidelines and conservation strategies.[52]

B. Ministry of Water Resources, River Development and Ganges Rejuvination

The Ministry of Water Resources, River Development and Ganges Rejuvination (MoWR), is primarily responsible for the development, management and conservation of India's water resources. The ministry performs its functions through its 2 attached offices, namely Central Soil and Material Research Station and the Central Water Commission. It also has 7 sub-ordinate offices which helps the ministry in its functioning: Central Ground water Board, Ganges Flood Control Commission, Central Water and Power Research Station, Farakka Barrage Project, Banasagar Control Board, Sardar Sarovar Construction Advisory Committee and Upper Yamuna River Board.[53] The functions allocated to the ministry are as follows:

a) Advisory: plan and coordinate policies for the water resource sector; facilitate resolution of disputes relating to inter-state rivers, and carry out negotiations with riparian countries regarding shared water resources.
b) Monitoring and regulation through groundwater management and ensuring conjunctive use of ground and surface water
c) Training and capacity building, i.e technical, infrastructural and research support for water development; central and external financial assistance for specific projects; and determine water balance of different basins and sub-basins for the consideration of inter basin transfers.[54]

Central Ground Water Board

The Central Ground Water Board (CGWB) is the scientific organization under the MoWR working towards management and development of ground water resources by the development and dissemination of technologies and implementation of national policies. The main activities of the board are:

a) Regulate ground water development by Central Ground Water Authority.
b) Groundwater monitoring by recording data at observation wells, investigating groundwater supply, and undertaking periodical assessment of groundwater resources.
c) Training and capacity building, for example through groundwater management studies; carry out ground water modelling, pollution and water balance studies; publishing maps; and conducting awareness and training programmes.[53]

CGWB has also passed a guidelines, effective from 16 November 2015, for evaluation of proposals or requests for groundwater abstraction,by water intensive industries such as the textile, tannery, and distillery. In safe, semi-critical and critical areas, No Objection Certificate (NOC) for ground water abstraction from CGWB shall be mandatory and the withdrawal limit is given in the table below.[53]

Table 13 Groundwater Withdrawal Limit for Different Categories

Category	Ground Water Withdrawal Limit
Safe	Withdrawal limited to 200% of ground water recharge.
Semi-critical	Withdrawal limited to 100% of ground water recharge.
Critical	Withdrawal limited to 50% of ground water recharge.
Over exploited	No permission for Industries under this category.

Source: Central Ground Water Board

Central Ground Water Authority

The Central Ground Water Authority was constituted to regulate, develop and manage the ground water resources of India under Section 3 (3) of the Environment (Protection) Act, 1986. The CGWA has three key regulatory functions:

a) Regulate the ground water withdrawal by industries or projects for the over exploited and critical assessment units. SPCB and MoEFCC need to refer to CGWA for permission to establish a new industry or process in critical zones.
b) Notify critical/overexploited areas, e.g. in Haryana for control and regulation of the resources.
c) Prohibit construction of new groundwater structures in notified area,s except drilling of tube-wells for drinking water supply by government agencies.[55]

Central Water Commission

The Central Water Commission (CWC) is the attached office of the Ministry of Water Resources, River Development and Ganges Rejuvination as its main technical arm. CWC initiates and coordinates in consultation with the state government, schemes for conservation and sustainable utilization of the water resources throughout the country for various purposes such as navigation, flood control, drinking water supply and water power development. The broad functions of CWC are:

a) Advise the government on water resources development and act as Central Bureau of Information relating to water resources, including production of relevant statistical data.
b) Undertake river valley development project on behalf of the national and state government .
c) Training and capacity building through investigations and surveys for development of the river valleys for various purposes including water supply, power generation, flood management, irrigation and restoration; undertake research on various aspects of river valley development schemes; and promote modern data collection techniques such as remote sensing technology.

CWC also has a Yamuna Basin Organization who is responsible for observation of relevant data and flood forecasting in relevant states including Haryana; monitoring of schemes such as the Accelerated Irrigation Benefit Program (AIBP), Common Area Development (CAD) Programme and restoration of water bodies.[56]

C. Ministry of Urban Development

The Ministry of Urban Development was constituted on May 13, 1952 as the authority to formulate policies, support, sponsor and monitor programmes related to urban development and also assist coordination between central ministries, state governments and other nodal agencies. The ministry has also been delegated an additional responsibility under India (Allocation of Business) Rules 1961 to supply water, subjected to coordination with the MoWR, sewerage, drainage and sanitation facilities to the urban areas. [57]

D. Ministry of Textiles

The Ministry of Textiles is responsible for formulating policies, planning, developing, promoting exports and regulating trade of the textile industry, which includes all types of natural and man-made cellulosic fibres used in the making of textiles, handicrafts and clothing. The Ministry's vision is to improve industrial production capacities to ensure a global standing in the manufacturing and exports of all the types of textiles. It also works towards preserving the cultural heritage associated with the industry and promote handlooms and handicrafts for economic development. The Ministry also promotes growth and technological upgrade for sustainable development of the industry.[58]

E. National Green Tribunal (NGT)

The National Green Tribunal was established under the National Green Tribunal Act, 2010 for expeditious and effective disposal of cases related to environment. The tribunal is required to dispose cases within 6 months from its filing. It is guided by the principle of natural justice and not bound by the procedure under the Code of Civil Procedure, 1908. The main functions of the NGT are:

a) Ensure expeditious and effective disposal of cases related to conservation and protection of environment and its natural resources.
b) Enforce legal right relating to environment and giving compensation and relief to persons and property for damages.
c) Handle environmental disputes.[59]

5.1.2. Laws and Regulations

India has always been very serious about the water issue and has a very well established regulatory framework when it comes to prevention of water pollution. The Water (Prevention and Control of Pollution) Act, 1974 has stringent provisions for maintenance of the nation's water resources. The Water (Prevention and Control of Pollution) Cess Act, 1977 supports the Water Act of 1974 by augmenting resources for the pollution control authorities by charging cess from the industries. The National Water Policy, 1987 is also a very crucial, in terms of protection of the river bodies of the country. These policies complement and supplement each other and help in ensuring that the water resources of India are managed and safeguarded to ensure sustainable development. These policies are discussed in detail as follows.

A. The Water (Prevention and Control of Pollution) Act, 1974 (amended in 1988)

Water Act was enacted in the year 1974 with the aim to prevent and control water pollution[4]. This act is India's comprehensive attempt to deal with the problem of environmental deterioration and its key features are:

a) Establishes CPCB (Subs. by Act 53 of 1988, s. 3) and SPCB (Subs. by Act 53 of 1988, s. 4).
b) Authorizes the CPCB to pass directions to SPCB. In case of inconsistency between the directives from CPCB and the state government, the matter is to be referred to CPCB.
c) Empowers state governments to restrict the act to certain area in consultation with SPCB.
d) Authorizes SPCB to carry out survey of any area and keep the records of the characteristics, flow or volume of a stream and collect samples of any trade effluent, sewage or stream for the purpose of analysis.
e) Prohibits the disposal of polluting matter into a stream or well.
f) Restricts the establishment of a new industry, process or treatment disposal system, which is most likely to discharge effluent or sewage without previous consent of SPCB.
g) Authorizes SPCB to refuse or withdraw consent in the absence of treatment and disposal system for an industry, operation or a process.

[4] Pollution as defined In the act is "contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms"

h) Prescribes a time frame to install a treatment plant to meet the provisions of the act and empowers the Central Board to establish and modify standards.[60]

B. The Water (Prevention and Control of Pollution) Rules, 1975

The Water (Prevention and Control of Pollution) rules, 1975 authorizes CPCB to function as a SPCB for a Union Territory under sub-section (4) of section 4. The rule empowers the Central Board to take samples of water from any stream, sewer or that of a trade effluent for the purpose of analysis passing from any plant, vessel or over or from any place into a stream or well within the boundaries of the union territory.[61]

C. The Water (Prevention and Control of Pollution) Cess Act, 1977(amended in 1992, 2003)

The Water Cess Act was passed in 1977 and further amended in 1992 and 2003 with the aim to augment the resources of the Central and State Pollution Control Boards. The Act made provisions to charge and collect cess (taxes) from specified industries mentioned in Schedule I for various operations and process specified in Schedule II. The amendment in 2003 omitted the Schedule I and defined Industry as "any operation or process, or treatment and disposal system, which consumes water or gives rise to sewage effluent or trade effluent, but does not include any hydel power unit". Schedule II includes various processes in which water is consumed, such as cooling, spraying in boiler feeds or mine pits; for domestic purpose; processing which may pollute the water. The cess charge depends on the process involved. The amendment also authorizes the Central Government to exempt cess from any industry consuming water less than mentioned in the after considering: the nature of raw material, manufacturing process, source of water abstraction, effluent receiving water body, and production data, including water consumption per unit production, in the industry and the location of the industry.[62]

D. National Water Policy, 1987 (amended in 2002, 2012)

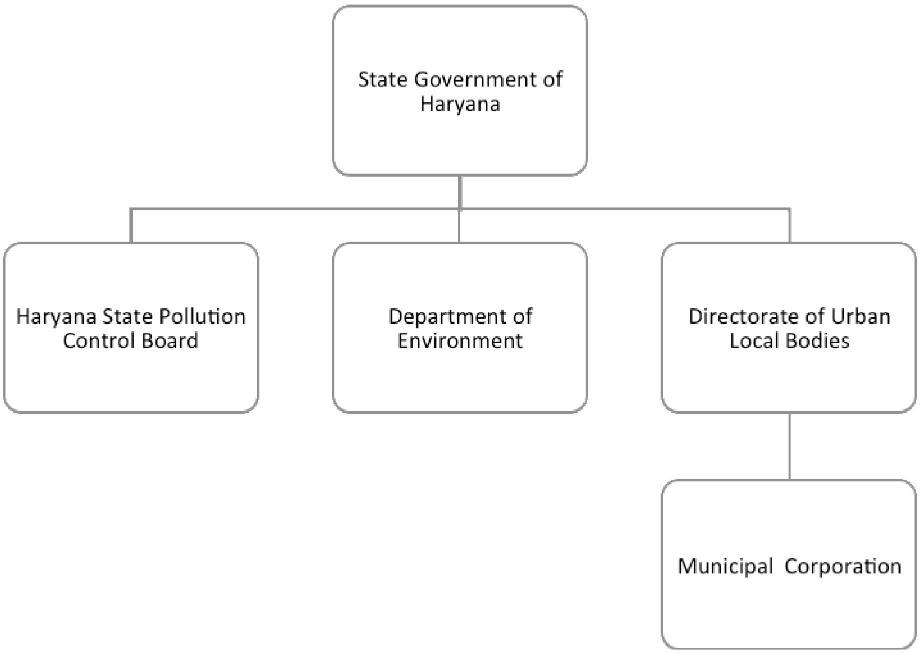
The National Water Policy (NWP) was formulated by the MoWR in 1987 and amended in 2002 and 2012 with the aim of water resource development and sustainable utilization. NWP 2012 only deals with sustainable and efficient use of water resources and not the allocation unlike the predecessors.

The act supports the formulation of National Framework Law as a guiding statement for assisting governance in each state. A number of issues are addressed within the NWP, such as the minimum amount of potable water and its adaption due to climate induced variability; water footprint in of industrial projects; water reuse and recycle; the use of new strategies like rainwater harvesting, avoiding evapotranspiration, desalination, and water pricing issue. It views that water needs to be fairly priced to ensure its efficient use and equitable access for all purposes, as decided by an independent Water Regulatory Authority established by each state after stakeholder consultation .[63]

A National Water Board was constituted in 1990 under the chairmanship of Secretary of MoWR to review the implementation and progress of NWP and report periodically to National Water Resources Council that has the Prime Minister as its chairman.[64]

5.2. State Level Landscape of Water Governance

At the state level, there are fewer actors involved in the governance of water. Their roles across water governance value chain pertaining to the textile industry is mapped in Figure 16.



Source: Ministry of Haryana

Figure 16 Governance structure for Haryana

5.2.1. Key Actors and their Roles

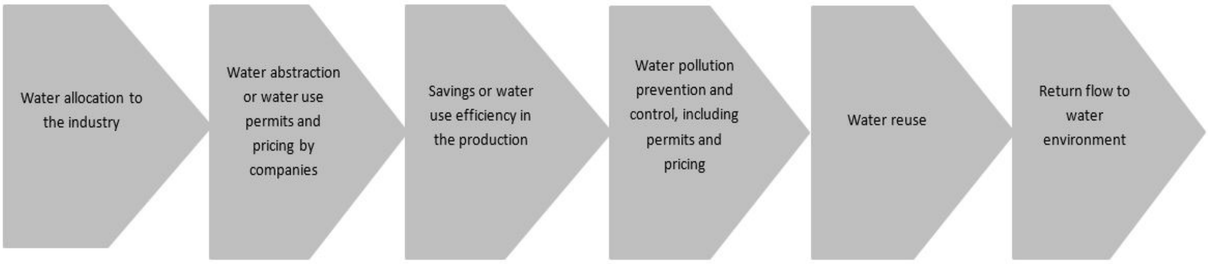
A. Haryana State Pollution Control Board

The Haryana State Pollution Control Board (HSPCB) is the statutory authority set up under the Water (Prevention and Control of Pollution) Act, 1974 to implement environmental laws and rules. HSPCB implements all judicial, legislative pronouncements regarding protection and maintenance of the environment in Haryana. The primary functions and responsibilities of the board are:

a) Advise state government on the prevention and control of pollution and the location of any industry which is likely to pollute a stream or well.
b) Monitoring and regulation of policy by inspecting industrial effluents and plants; setting standards for industrial effluent and ambient water quality; varying or revoking any orders as well as requiring construction or modification of systems for the prevention, control and abatement of water pollution.
c) Planning and implementation of reliable and economic methods of effluent treatments.
d) Training and capacity building, e.g. through comprehensive programmes, publishing information, research and investigations, training programmes and mass education, for the prevention and control of pollution. [65]

B. Department of Environment

The Department of Environment was established in 1989 to coordinate the working of the HSPCB to ensure effective implementation of all the laws and acts regarding environment and pollution control.[66]



Key actor	Public Health and Engineering Department (PHED), Municipal Corporation of Faridabad (MCF)	Public Health and Engineering Department (PHED)	Industries	Haryana State Pollution Control Board (HSPCB) Department of Environment (DoE) Public Health and Engineering Department (PHED)
Roles	PHED: 1) To supply water to urban and rural areas except panchkula and Faridabad MCF: 1) To supply water to Faridabad district.	PHED: 1) To fix the price for water supply to industries Abstraction of groundwater is overlooked by regional offices of the Central Groundwater Authority (CGWA)	Industries- 1) To adopt water efficient technologies	HSPCB: 1) To provide No Objection Certificate for establishment of a new industry 2) To monitor the quality and level of pollution in the receiving water 3) To plan and execute programmes for prevention and control of water pollution. 4) To advise state government on prevention and control of pollution DoE: 1) To assist in implementation of pollution prevention policies PHED: 1) To fix the price for wastewater discharge by industries

Figure 17 Water Governance Value Chain in Haryana

C. Public Health and Engineering Department

The Public Health and Engineering Department (PHED) under the state government of Haryana was established to provide adequate water supply and sewerage facilities, except in Faridabad and Panchkula towns where Municipal Corporation of Faridabad and HUDA are responsible respectively. The main functions of the department are:

1) Provide piped drinking water supply to the villages and towns.
2) Provide sewerage facilities and storm water disposal facilities in towns.
3) Construction of sewage treatment plants.
4) Installation of sanitary amenities in government buildings.[67]

D. Municipal Corporation of Faridabad

The Municipal Corporation of Faridabad has the primary responsibility to maintain, develop and upgrade the services provided to the citizens of Faridabad, including water supply and sewerage facilities through the following tasks:

1) Upkeep and maintenance of 800 km of surface drains.
2) Upkeep and maintenance of 638 km of sewer lines.
3) Upkeep and maintenance of 910 km of water supply lines.[68]

5.2.2. Initiatives

In spite of the existence of various laws and regulations, the water resources have had a decline in quality as well as quantity. Degrading quality of water resources pertaining to industrial wastewater has called for effective initiatives to monitor and prohibit further pollution. The Government of India has launched some major initiatives for regulating industrial water pollution, such as monitoring of water quality, assistance to upgrade to water efficient technologies, development of Common Effluent Treatment Plants, in order to ensure the protection and management of water bodies. The following section discusses these initiatives.

A. National Project on Aquifer Management (NAQUIM)

Due to depleting ground water resource, NAQUIM was started with the objective of understanding the current status of the aquifer so as to assist Central Ground Water Board in managing of the groundwater resources during the XII & XIII Plan period. NAQUIM does not merely map the ground water but also involves community for the management of groundwater in order to infuse a sense of ownership among the stakeholders. Hence, it also supports groundwater management, upgrading irrigation facility, drinking water security and sustainable development of water resource in rural and urban area.[69]

B. National Water Quality Monitoring Programme

To ensure maintenance of the quality of water body as required by The Water Act, 1974, the CPCB has established a number of monitoring stations across India, which includes a network of 2500 stations, including 807 groundwater stations spread across 28 states and 6 Union Territories in the country monitoring 445 rivers (1275 stations), 154 lakes (190 stations), 12 tanks (12 stations), 78 ponds (79 stations), 41 creeks/seawater (41 stations), 255 canal (41 stations), 45 drains (45 stations), 10 water treatment plants (10 stations) and 807 wells. The main objectives behind monitoring of the water quality are as follows:

1) Plan and prioritize pollution control strategies.
2) Gauge the extent and nature of pollution control measures required.
3) Evaluate and assess the effectiveness of existing measures for pollution control.
4) Assess the trend of the water quality.
5) Evaluate the assimilative capacity of the water body to reduce pollution control costs.
6) Understand the fate of pollutant in the water body.
7) Evaluate the suitability of water body for different uses.[70]

C. Micro and Small Enterprises – Cluster Development Programme (MSE-CDP)

The Ministry of Micro, Small and Medium Enterprises (MSME) has implemented the cluster development programme as a key strategy for improving the productivity and capacity building of the micro and small enterprises (MSEs) in the country. A cluster is a group of enterprises within an identified, contiguous area producing similar products and services. The important characteristics of enterprises in a cluster are: a) similar and complimentary methods in production, pollution control, consumption of energy; b) similar technology and marketing practices; c) similar communication channels in the cluster; and d) conjoint challenges and prospects.

In 2007 the scheme for cluster development Small Industries Cluster Development Programme (SICDP) was renamed as Micro and Small Enterprises – Cluster Development Programme (MSE-CDP). The Integrated Infrastructural Development (IID) Scheme was also merged with MSE-CDP to upgrade existing infrastructure and develop sites for new enterprises. The objective of MSE-CDP was to address common issues, such as technology upgrade, improving skills and quality, enhancing market access, developing self-help groups for capacity building, infrastructure upgrade, and setting up common facility centres, such as raw material storehouse, testing centre and effluent treatment.[71]

D. Scheme of Integrated Textile Parks (SITP)

The (SITP) was launched by Ministry of Textiles in 2005 to support the compliance Scheme of Integrated Textile Park of textile units to international social and environmental standards.[72] The primary objective of the SITP is to provide the industry with world-class state-of-the-art infrastructure facilities. This scheme engages a group of professional agencies for project identification and implementation in order to create potential growth centres of international standard.

The total cost for the project was to be jointly funded by a mix of equity or grants from the Ministry of Textiles, state government, State Industrial Development Corporation, industry, project management consultant and finally loans from banks and financial institutions. The support of the central government is limited to 40% of the total project cost and a maximum of Rs. 40 crore[v] (US$ 6 million) by means of grant or equity for the textile park.

E. Centrally Sponsored Scheme for Integrated Processing Development Scheme (IPDS)

The Integrated Processing Development Scheme (IPDS) was launched by the Ministry of Textile based on the learnings from the SITP in order to deal with the problem of highly polluting effluents from textile dyeing units. The primary objective of IPDS was to increase the competitiveness of textile industry in the global market through environmental-friendly production technology and standards. The scheme created new processing parks and upgraded existing clusters, in terms of cleaner technology and water and waste management. The scheme includes:

[v] 1 crore equals to 10 million.

1) Group A: Water treatment and effluent treatment plant and technology (including marine, Riverine and ZLD), which is supported by mandatory grant from central government.
2) Group B: Common infrastructure, such as captive power generation plants on technology preferably renewable/green technology.
3) Group C: Common facilities such as Testing Laboratories and R&D centres.

The cost of land is not part of the total project cost and the Indian Government shall not give grants for the procurement of land which under the scheme is to be arranged by the Special Purpose Vehicle (SPV). The total project cost shall be borne in the ratio 50:25:15:10 by the centre, state, beneficiary, bank loan.[73]

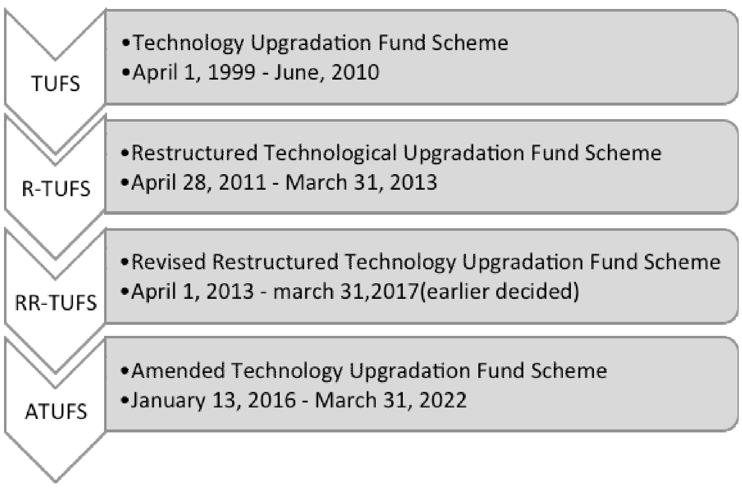
F. Zero Liquid Discharge (ZLD) by Polluting Industries

The Madras High Court had passed the direction to textile industries in Tirupur region to achieve Zero Liquid Discharge (ZLD) in order to achieve approval from Tamil Nadu Pollution Control Board. CPCB also passed notification to nine SPCB along the Ganges River Basin for industrial sectors, including textile (wet processing), which discharge effluent into the river with a BOD load of 500kg/day or having hazardous chemical in it.

ZLD refers to the process of absolute recycling of the industrial effluent and conversion of solute, i.e. dissolved organic and inorganic compounds or salt into solid residue by means of concentration and thermal evaporation. It is certified on the basis of two criteria: water consumption with respect to wastewater reused/recycled and the corresponding amount of solid recovered. The purpose of ZLD is to prevent further degradation of water resources due to disposal of highly degrading effluent into the water environment thus rendering it improper for any kind of use.[74]

G. Technology Upgradation Fund Scheme (TUFS)

The Technology Upgradation Fund Scheme (TUFS) aims to catalyze investment in the textile sector by providing subsidies and assistance to upgrade existing technologies. The scheme covers technologies, such as wet type venture scrubbers and dry type bag filter, which may be used in pollution control and prevention.[75] The subsidies motivates textile industries to switch technology to improve water efficiency in the textile mills. An assessment by M/S CRISIL revealed that TUFS was helpful in improving the quality of the entire value chain and reducing cost and waste.[76]



Source: Ministry of Textile.

Figure 18 TUF Scheme Timeline

5.3. Regulatory Water Risk

Policy is currently driving action in the Faridabad-Ballabgarh textile cluster. The Zero Liquid Discharge policy calls for adoption of practices to ensure complete recycling of industrial effluent and concentration of the solute into a solid mass by means of evaporation by December 2016. This is a major step which has been undertaken to ensure that the heavily polluting, water intensive industry, such as textile units, does not further degrade the quality of the ground and surface water resources. The region already has immense water scarcity and quality issue and in such a scenario it is a ray of hope for the region.

However, this is also a big hurdle for the industries, which face the risk of increased production cost and loss of market competitiveness, compared to those who do not face the same regulation. Moreover, there are many challenges in the implementation of this policy. For this very reason various stakeholders from industries, service providers, government representatives and educational institutions were interviewed to trace out the implications, challenges and perceptions to risks with regard to this recent ZLD policy.

5.3.1. Perceptions on Risks and Opportunities Associated with ZLD policy

For the textile wet processing units in the Faridabad-Ballabgarh cluster, the ZLD policy, if implemented properly, would lead to the shutting down of many small enterprises since upfront capital expenditure as well as on-going operating expenditure associated with installing ZLD is extremely high. It is likely that the industry goes through a phase of consolidation in which the medium and large scale textile industries would not witness much loss in business, provided that the ZLD policy is extended to the entire country instead of being restricted to the nine Ganges states.

"In the short run, textile industries may think that ZLD is not feasible but they need to learn from Tirupur and see this as an opportunity of recycling water and hence saving on money"

-Technology service provider

"The small scale industries are employment generators and hence the government needs to be flexible in their approach and should assist and support them"

- Professor (Department of Regional Water Studies), TERI University

The industries also stated that in a scenario wherein the policy is not properly implemented, the medium and large scale industry may adversely get affected as the units that will implement ZLD will face an increase in end-product cost and hence lose their competitiveness, in comparison to units that do not need to comply with the policy.

However, most of the textile wet processing units in the focused clusters in Haryana view the ZLD policy as an opportunity in the long run. These units believe that they will have enhanced opportunities as the larger brands would prefer environmentally sustainable production and they will not face undue competition from smaller units, which currently use non-compliant, low-cost materials and processes, that do not properly treat their effluent.

"It was also stated that the increase in production cost would be most likely absorbed by the exporters. India would not lose its competitive advantage in the global market due to low end product cost impact of the textile industry. The ZLD initiative is also likely to reduce the gap between buyers and sellers and hence an opportunity for the factory."

- Creative Dyeing and Printing Mills

Moreover, since the impact on end product cost is not very high and ZLD would reduce the overall chemicals and water requirement, the industries would benefit from the change in process efficiencies. Hence, the ZLD policy may create shocks initially but would eventually consolidate the industry and help it become more competitive both in domestic and international markets.

5.3.2. Implementation Challenges

Although the policy has been passed and ZLD is to be achieved by end of 2016, there are a number of practical difficulties, which have been pointed out by different industries during the interviews. Most of the units view ZLD policy as a necessary step to protect the environment and are also ready to implement it. However, they are still unsure about how this would be executed. Although a CETP seems to be a solution for this, the majority of the units do not intend to take part in it due to the perceived practical difficulties. The stakeholders believe that it is imperative to analyze the situation at a local level and understand the gaps and barriers so as to ensure proper implementation.

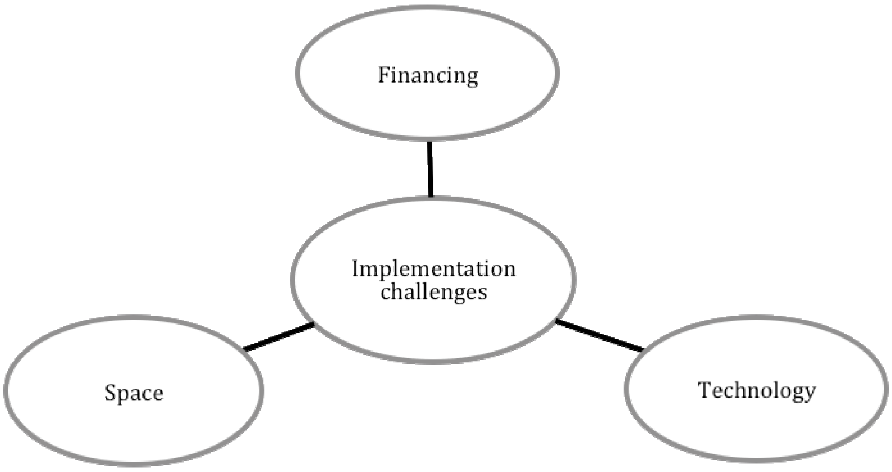


Figure 19 Understanding Major Implementation Challenges for ZLD in Faridabad-Ballabgarh Cluster

Financing

ZLD is likely to increase the cost of dyeing and coloring segment of the textile value chain by as much as 6% to 10%. The capital cost and operational cost associated with the technology to achieve zero liquid discharge is very high, which is a major risk for the industry. The capital expenditure for ZLD is as high as Rs. 6 Crores for a typical 1000KLD plant, while the operating expenditure is three times the amount for running the plant for just 6 years according to Business-as-Usual.[77]

The difficulty in the disbursement of loans and funds under some of the existing scheme (eg: TUFS) is one of the key implementation barriers for the industries. The industry believes that there should be incentives, such as low cost interest loans and fast tracking of loan processes, that ensure that the industries do not bear undue losses in the process of implementing the policy.

> "There is no subsidy for setting up ZLD units by individual industries and it is also difficult to avail subsidies under the TUF scheme."
>
> \- Shivam Devansh Fab Pvt. Ltd.

It was also pointed out by different stakeholders that incentivizing the implementation of the policy by proper financial instruments, especially for the small scale enterprises, is extremely important.

> **"There should be a roadmap which if followed by us would help us in getting funds from the financial institution. Moreover, banks should be asked to fast track cases concerning loan for ZLD implementation"**
>
> **- Richa Industries**

Technology

There are a plethora of technology options available in the market to achieve ZLD. However, all the companies stated that too many options had created confusion for them and made them unsure which technology would best fit them economically and otherwise. Lack of confidence and technical knowledge about the Zero Liquid Discharge is a large implementation hurdle for them.

> **"Technology is a major barrier. No one seems to know exactly about the practical difficulties. Technologies like Membrane Bio Reactor are being offered, which is not appropriate for textile wastewater"**
>
> **-Richa Industries**

The technology provider interviewed suggested that because the OPEX was much higher, the industries should have a synoptic vision when they selected the ZLD technology as lower cost technology might in the longer run incur higher operating cost and lead to plant shutdown.

> **"Technology is not a barrier, the industries should learn from Tirupur and the government should facilitate the process, so the best can be made out from the Tirupur experience"**
>
> **-Technology service provider**

The companies also pointed out that lack of skillsets and difficulty in changing the mindset of the skillsets was a major barrier.

> **"Changing the mindset of the operator is difficult and yet very important for optimizing water use and hence capacity building is required"**
>
> **-Creative Dyeing and Printing Mills**

Space

Setting up a ZLD plant requires a lot of space. Industry representatives pointed that most of the wet processing units in the Faridabad-Ballabgarh region do not have enough space to install ZLD plant within their factory premises.

Because industrial units in the region are dispersed and the collected wastewater may be heterogeneous in nature, a Common Effluent Treatment Plant might not be a feasible solution, unlike Tirupur, where the textile parks were already established.

> **"Nano-filtration alone requires about 25 sq. km. area, hence setting up a ZLD unit is difficult due to lack of space, especially for the small scale industries"**
>
> **- Creative Dyeing and Printing**

Furthermore, the stakeholders view that having two way pipelines to send the wastewater for treatment and bring back treated water to the industrial unit would not practically and economically be feasible. The civil work required alone would take a minimum of 1.5 years and hence the construction would not be completed within the given time frame. Concerns were also raised regarding the functioning of the CETP since quite a few of industrial units were set up on rented property where the land was not owned by the unit. Most of the medium and large textile wet processing units are likely to construct individual treatment plants to meet the ZLD policy.

"A CETP will be atleast 10-12 km far from the factory and getting clearances for it from different government bodies will be nerve wrecking"

- Creative Dyeing and Printing

5.3.3. The Need for Increased Transparency and Enhanced Coordination

The stakeholders believe there is lack of coordination between various government agencies, which act as a hurdle for implementation of policies. It was stated by the majority of industrial units that all actions require permissions from different government agencies, which leads to loss of time and money and hence demotivates the units to take appropriate actions. Most of the stakeholders pointed out that laying of pipelines from the industry to the Common Effluent Treatment Plant (CETP) is not feasible in a short time frame bevause it requires approvals from various government agencies, including the National Highway Authority of India and the City Municipal Corporation.

Tirupur has already implemented Zero Liquid Discharge and can be taken as an example for implementation of the policy in the Faridabad-Ballabgarh region. Nevertheless, communication gap between the authorities render provide a challenge to learn from the experiences of Tirupur. Hence, most of the stakeholders were of the opinion that there was a lack of coordination and communication that needed to be addressed to enhance learnings from past experiences.

It was stated by majority of the stakeholders that there is corruption, lack of transparency and disclosures at both ends – industry as well as government agencies. There is lack of transparent disclosure from the industry on parameters such as amount of groundwater extracted, installed ETP capacity, effluent quantity and quality, etc.

"Transparency is low with very little disclosure from both industries and government and low participation as no feedback is taken from the mill, however we are hopeful about increase in accountability with time.

- Creative Dyeing and Printing

On the other hand, the government agencies released the policy without prior consultation with the industry. Though concerns raised by the industries after the policy was passed were forwarded to Ministry of Environment, Forests and Climate Change (MoEFCC), the industry is still unsure to what extent they would be addressed.

"There were a lot of complaints and queries raised after putting up of the notification in October which have been forwarded to MoEFCC and shall be catered to"

-Representative from CPCB

Chapter 6 Capacity Building Workshop

6.1. Workshop Organisation

Stockholm International Water Institute (SIWI) in collaboration with Sustainability Outlook under the Sweden Textile Water Initiative Project organized a multi-stakeholder capacity building workshop with a focus on driving innovations toward sustainable textile industry in India through ZLD Policy. The workshop focused on the risks, opportunities and challenges faced by the industry in the implementation of ZLD as an industrial water governance policy. This workshop also provided a forum for the stakeholders to discuss potential incentive instruments and solutions to catalyse technological, business and governance innovations toward sustainability as a competitive advantage of the industry.

The capacity building workshop took place at the 6th Annual Summit of the Sustainable Business Leadership Forum on 24th November 2016 at Hotel Taj Palace, New Delhi.

6.2. Inputs from the Workshop

Session 1: Water Risks and ZLD Implementation: Current Status, Opportunities and Implementation Challenges

The first session saw participation from representatives from Central Pollution Control Board and key textile industry representing both large and medium scale units. The opening remarks for the session were provided by Ms. Josa Kärre, Head of Economic and Trade Section, Embassy of Sweden.

A snapshot of the Industrial Water Governance Report prepared by Stockholm International Water Institute (SIWI) in collaboration with Sustainability Outlook was presented during the session. The presentation elaborated on the evolution of policy in India with respect to industrial water governance.

It was identified, that though there is high upfront and operational cost, the impact of ZLD on a shirt would be less than 1% impact on the end product pricing. Hence, it does make sense to go for ZLD in the industry. However, all the participants agreed that some major challenges which are decelerating the uptake are lack of space, high implementation cost, by-product disposal, escalated carbon footprint, lack of understanding of appropriate technology and lack of financing sources

<u>Key Highlights of the New Policy:</u>

1) Same norms made applicable to all integrated textile units, units of cotton/ woollen/ carpets/ polyester, units having printing/ dyeing/ bleaching process or manufacturing and garment units.
2) Parameter for Total Dissolved Solids (TDS) introduced
3) The TDS value with respect to treated effluent was notified to be 2100 mg/l; however, in cases where TDS in intake water is above 1100 mg/l, a maximum contribution up to 1000 mg/l was permitted, provided the maximum value of 3100 mg/l was not exceeded in the treated effluent.
4) The standalone Micro, Small and Medium Enterprises (MSMEs) as per the MSME Development Act, 2006 were mandated to meet the new notified standards.

5) The standalone large scale units were notified to meet the new standards; the large scale units in environmentally sensitive /critical areas could be mandated to achieve Zero Liquid Discharge by CPCB or SPCBs /PCCs with prior approval of CPCB.

Session 2: Bridging implementation gap and capturing opportunities

The workshop also provided a forum for the stakeholders to discuss potential incentive instruments and solutions to catalyse technological, business and governance innovations toward sustainability as a competitive advantage of the industry. The participants for the group discussions included representatives from textile wet processing industry, water treatment solution providers and catalyst agencies.

The focussed group discussion discussed three key problem statements:

1) What are the innovative ways for ZLD implementation through following interventions:
    - Good Governance
    - Incentivizing through Policy Instruments
2) How do we create standardization in operating performance and applicability of technologies to enable different stakeholders (industry, policy makers, etc.) for smoother roll-out and reliable implementation.
3) Given the pros and cons of individual vs. Central ZLD Systems, what would emerge as a preferred and reliable way forward, why and what steps need to be taken to enable it.

<u>Key Takeaways:</u>

1) Financially incentivize uptake of wastewater as make-up water
2) Need to create standards for water consumption
3) Test technologies on pilot basis and create a standard user manual to ensure usage of clean and efficient technologies
4) Individual ZLD facilities are more preferable than common facilities

It was also highlighted that there is a need to financially incentivize uptake of more sustainable techniques like waiving away of the cess for units using partially or untreated wastewater for the amount of make-up water being consumed in excess of the benchmark. Moreover, a stick and carrot approach needs to be introduced as per the benchmarks to ensure better compliance.

Comparison between common treatment facilities and individual ZLD facilities was made based on the criteria of accountability, effluent characteristics, financial aspects and longevity. It was concluded that due to greater accountability and much more stable and better monitored effluent characteristics in case of individual facilities, the concept of individual ZLD makes more sense as this also increases the longevity of the system. In terms of the expenditure involved, though the burden on the units is reduced in case of a common treatment facility but it is achievable in both the scenarios. Moreover, setting up the two-way pipelines to send the effluent to the common facility and taking back the recycled water in itself is a huge hassle and hence individual ZLD is a preferred option.

The workshop hence took stock on ZLD implementation and addressed the major challenges and risks associated thus building capacity as a step towards a more water efficient textile industry.

Chapter 7 Conclusions and Recommendations

7.1. Conclusion

As outlined in the first chapter, this report aims to look at the physical and regulatory water risks as well as the water governance landscape pertaining to the textile industry in India, with a special focus on the Faridabad-Ballabgarh cluster in the state Haryana. Based on the desk research as well as interviews to the stakeholders, the report finds that:

1) To a large extent, the key physical water risks related to the textile industry at the national level are similar to those at the state level and even at the industrial cluster level. The main physical water risks are:

   a. Increasing gap between the supply and demand of freshwater that are required to underpin the growth and ambition of the textile industry.
   b. Declining groundwater table due to overexploitation of the resources.
   c. Degrading water quality both for surface water and groundwater.
   d. Suboptimal performance of existing individual ETPs or CETPs.

   There is a vicious circle between declining groundwater table, degrading water quality due to increased salinity or pollution, higher costs of water use in the textile production due to either declining water table or degrading water quality, and sub-optimal effluent treatment by the industry. It is clear that appropriate intervention is needed to address each of the key water risks and break the vicious circle.

2) The government, both at the national and state level, has had in place a water governance landscape with a broad coverage regarding the types of key actors and their responsibilities, existing laws and regulations, as well as progressive initiatives at the national and state level.

   The institutions involved in the governance of water for textile industry entail beyond the typical line ministries in charge of water resources, but also the Ministry of Textile and the Ministry of Law and Justice. The initiatives target not only the monitoring of the situations of the water resources (both quantity and quality) and stringent effluent standards, but also on upgrading technologies for cleaner production, including efficient water use and effluent treatment at textile unit as well as at industrial parks.

3) Lack of good water governance contribute to regulatory water risks in the form of:

   a. The gap between industry readiness in practice and the expected performance of the industry as required by the regulations, especially but not limited to the small scale industry.

   b. Some regulations have not been able to keep up with the fast pace of degrading quantity and quality of water resources, which require timely adjustment of the regulations so as to provide incentives for improved water management by the industry. For example, water price for water abstraction by the industry that does not substantially change over time despite increasing water scarcity; and CETP that allows effluent with high TDS, which ultimately contribute to the suboptimal performance of CETP.

   c. Lack of good governance capacities, especially with regard to coordination across government agencies and lack of transparency and accountability in the implementation of the regulations and initiatives. This will add not only higher costs to the industry and also demotivate the industry in adopting cleaner technologies for better water management in their production processes.

4) The ZLD policy as the most ambitious initiative that the Government of India has launched in terms of sustainable water management has been seen both as opportunities and risks by the stakeholders, especially the affected industry, under the implementation challenges regarding financing, technology and space availability.

7.2. Recommendations

Based on the findings of the report and the inputs from the capacity building workshop, the report suggests the following priority areas for capacity building in view of improving industry's readiness toward the ZLD policy:

10) Assessment of appropriate financial instruments and mechanisms to catalyse faster adoption of cleaner technology for the industry, especially for the small scale industry considering its importance in generating employment.
11) Development of guidelines for selecting cost-efficient and appropriate technology for the industry with regard to the scale, characteristics, and production line of the textile units. The guidelines can facilitate a rapid development of customised or mixed solutions for textile units. The assessment shall employ Cost Benefit Analysis of potential solutions, including the construction of new ETPs or CETPs or improvement of existing ETPs/CETPs that are suitable to local conditions and current water risk challenges, especially in the view of limited space availability.
12) Improving the skills in operating cleaner production processes and effluent treatment plants, through capacity building activities across the industry. STWI Projects has undertaken such workshops but this needs to be replicated on a wider scale across the industry.
13) Improving communication and harmonisation of regulations across government agencies in order to expedite: a) learning of best practices from other states (e.g. Tirupur) or countries; b) enhance the efficacy of regulations.
14) Enhancing good water governance through better transparency and accountability of decision making processes as well as the implementation of various initiatives related to the ZLD policy.
15) Financially incentivize uptake of wastewater as make-up water.
16) Need to create standards for water consumption.
17) Test technologies on pilot basis and create a standard user manual to ensure usage of clean and efficient technologies.
18) Individual ZLD facilities are more preferable than common facilities.

Annex A: Workshop Notes

Key Participants in the Workshop

Ms. Josa Kärre	Embassy of Sweden
Ms. Reena Satavan	Central Pollution Control Board
Mr. Abhishek Bansal	Arvind Ltd
Mr. Sumeet Nath	Raj Group Panipat
Mr. Promod Mehra	Global
Ms. Sonam Chaurasia	Global
Mr. Shafqat Kazmi	Global
Mr. Arif khan	Global
Mr. Sukhwinder Singh	Jawandsons
Mr. Akash Kumar	Jawandsons
Mr. Harwin Singh	Jawandsons
Ms. Shalika	Maharani of India
Ms. Ruby	Maharani of India
Mr. S. Ghose	Kanika Worldwide
Mr. Susheel Kumar	Kanika Worldwide
Ms. Swati Pant	Novozymes
Mr. Debashish Maity	Shahi (Sarla)
Mr. Mohd. Aslam Shaikh	Shahi (Sarla)
Mr. Rohit Kumar	Shahi Exports
Ms. Preksha	H & M
Ms. Mamta	H & M
Mr. Kapeesh	Vardhman
Mr. Jaspreet Singh	Vardhman
Mr. Rakesh Pandey	RMP Fab
Mr. Shiv Narain	RMP Fab
Mr. Rajiv	Indiska
Mr. Sethia	Kanika Worldwide
Mr. Upul Nallaperuma	Ocean India
Mr. Ananda Nikapotha	Ocean India
Mr. Deepak Rajput	Gupta Overseas
Mr. Rajesh Sharma	Gupta Overseas
Mr. Rahul Yadav	Gupta Overseas
Mr. Katariya Dhiraj	Ashima Group
Mr. N. Venkatachalapathy	GMR- Hyderabad
Mr. Aanis Anwar	BLINT
Mr. Naresh Grewal	BLINT
Mr. Ashok Sharma	Riviera Home
Mr. Jai Singh Tyagi	Sunny International

Testimonials

"Some of the concerns raised by the industry were, that blanket ZLD is not feasible for Textile sector as it is very costly. Capital cost of one MLD plant would be around Rs. 15-18 crores excluding the cost of land and captive power plant. Moreover, a 1MLD plant would generate 6-7 Tonne of mixed salts, out of which 4-5 Tonne of salt can be recovered for use but disposal of the remaining 1.5-2 Tonne of mixed salt would be a problem."
-Ms. Reena Satavan, Scientist C, CPCB

"ZLD has impact on overall production cost of a textile mill, however, the impact on overall cost is low as compared to the price of end product. Moreover, cost effective technologies are available and in operation now; ZLD system with OPEX of 100 Rs./m^3 is feasible, however, initial investment and lack of technical skills a major challenge for implementation."
-Mr. Abhishek Bansal, Chief Sustainability Manager, Arvind

"The govt. should develop policies to encourage adoption of cleaner technologies. It should provide financial assistance or subsidies to industries to adopt the newer technologies."
-Mr. Sumeet Nath, Managing Partner, Raj Group Panipat

Pictures


SOLVING FOR WATER
SWEDEN
TEXTILE
WATER
INITIATIVE
Program Proponents (STWI - India)
KappAhl
SIWI

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