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Market opportunities for Swiss companies

Market size and overall demand

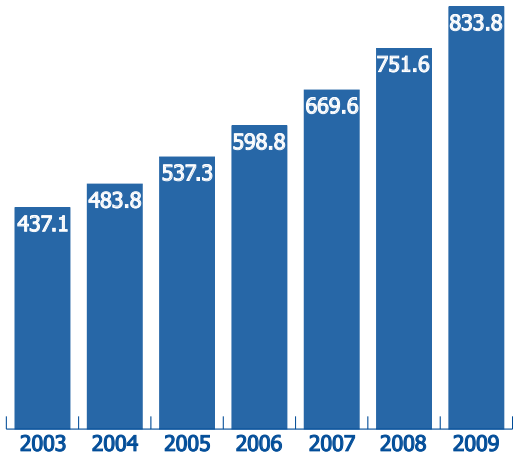
According to the Center for International Trade Development, India's total water market is estimated to be worth more than USD 4 billion, and growing by 10 - 12 per cent. Water companies from all over the world have established presence in India . If the latest count is correct, these companies are pursuing around 70 projects spread across 20 Indian cities.

Projects launched by governmental bodies contribute over 50 per cent of revenues in this market. The private sector contributes the other half of the market.

As far as the treatment of used or wasted water is concerned, the infrastructure is inadequate. Only about 26 per cent of domestic and 60 per cent of industrial wastewater is treated. In 423 class I cities (ie cities with a population of more than 100,000), only 29 per cent of wastewater is treated. Even worse, class II towns (ie towns with a population between 50,000 and 100,000) are able to treat just 4 per cent of wastewater. Even India's national capital, New Delhi, treats less than half of the 3,267 million litres of wastewater it generates every day.

Considering India's much cited economic growth, rise in disposable income and growth of wealth, it comes as no surprise that the market for water treatment products is estimated to be worth almost 834 million euros, growing at about 18 per cent each year.

Demand for water treatment products in India (million euros)

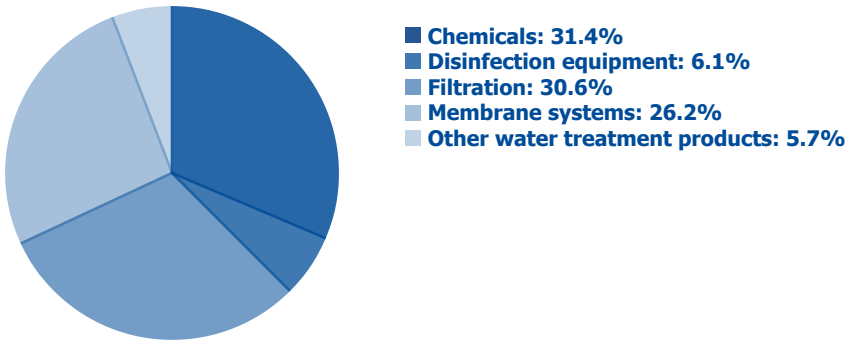


Drivers of demand

Because the government of India as well as the governments of federal states and municipalities are making efforts to improve their performance, demand is predominantly driven by them. This, however, indirectly includes private households as the main beneficiaries of any municipal water utility.

India's population is growing, and there are more and more private households in an increasingly urbanised setting. As a result, the demand for drinking water is growing rapidly. It is doubtful whether municipal water utilities are capable of supplying sufficient volumes of usable water, and that free of interruption.

Demand for water treatment products in India in 2009
Share by product type



Development in demand for water treatment products in India by type (million euros)

	2003	2004	2005	2006	2007	2008	2009*
Chemicals	123.4	140.3	159.5	181.4	206.2	234.5	262.2
Disinfection equipment	10.6	13.8	18.1	23.5	30.7	40.0	50.5
Filtration	196.1	205.0	214.4	224.2	234.4	245.1	254.8
Membrane systems	79.2	94.2	111.9	133.0	158.1	187.9	218.5
Other water treatment products	27.8	30.5	33.4	36.7	40.2	44.1	47.8

*Estimated

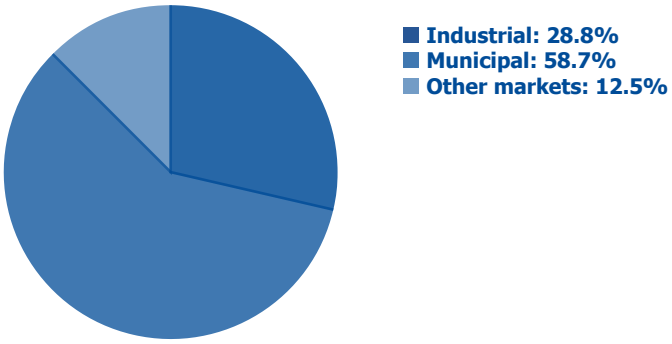
Source: Global Research & Data Services, 2010

Industries are under equal pressure. Many industrial companies have been forced to adopt water-recycling systems due to the scarcity of water. Growing public concern, media pressure and renewed legislation has left industries with no option but to install water treatment equipment.

Many existing treatment plants need to be replaced or upgraded to meet the more stringent standards. There is a compulsory requirement of environmental clearances from pollution control boards at the federal and the state government levels.

Of the many market segments, the following are likely to drive demand at a particularly large scale:

Demand for water treatment products in India in 2009
Share by markets



Development in demand for water treatment products in India by markets (million euros)

	2003	2004	2005	2006	2007	2008	2009*
Industrial	126	139.9	155.1	172.6	192.9	216.5	240.2
Municipal	249.2	278.3	311.3	349.0	391.9	441.2	489.8
Other markets	61.3	65.7	70.9	77.2	84.8	94.0	103.8

*Estimated

Source: Global Research & Data Services, 2010

- Real estate: there is a national norm in India that stipulates no establishment with more than 50 people can be without a wastewater treatment plant. Suppliers of solutions and equipment should will find a market for themselves wherever hotels, hospitals, software parks, shopping malls and the likes are planned.

- Food & beverages: the Indian processed food output is expected to grow by 44 per cent to reach a size of around USD 90 billion. This industry produces a lot of wastewater.

- Pharmaceutical: This industry has shown an average annual growth rate of 9.9 per cent until 2010. This growth is likely to diminish only slightly to 9.5 per cent until 2015.

- Textile: The Indian textile industry's size was estimated to be around USD 52 billion in 2008. It is expected to reach the size of USD 115 billion by 2012.

- Auto components: The size of the auto components industry was estimated at a size of USD 19 billion in 2008 - 09, growing at a compound annual growth rate (CAGR) of about 23 per cent over the previous five years. The industry is expected to grow to USD 40 billion by 2016.

Another factor with a direct impact on demand is the role which multilateral and bilateral agencies play. Such organisation provide major funding for infrastructure projects in India. The World Bank currently operates four projects in the supply of water as well as two projects in sanitation and the improvement of sewage. These projects are worth USD 700 million. The World Bank's total commitment to India's water sector amounts to more than USD 1.3 billion.

Opportunities for Swiss companies

The main source of imports of water treatment equipment to India are the USA, claiming an estimated market share of 40 per cent. However, Swiss companies of various sizes and areas of expertise will find interesting market opportunities in India. In particular if these Swiss companies offer services and products for the

- Collection
- Conveyance
- Treatment
- Monitoring
- Analysis

of water and wastewater for multiple purposes and end users. Swiss companies that specialise in any of the following technologies, services and infrastructure solutions will be well placed to serve the Indian market:

Integrated solutions such as performing feasibility studies, designing, technical consulting and providing operation and online maintenance services; it must be kept in mind that in order to successfully offer such solutions Swiss companies should consider entering a joint venture (or another type of partnership with strategic depth) with a carefully selected Indian business partner.
Systems and equipment for water supply, sewerage treatment as well as efficient use and reuse of water; such offerings should be addressed primarily to industrial organisations with a high degree of pollution (e.g. cement, pulp, paper).
Technical designs and equipment for wastewater systems (collection, conveyance, monitoring, analysis).
Equipment for wastewater treatment, including treatment technologies, bio gas regeneration through anaerobic treatment of municipal and industrial wastewater.
Technical designs and equipment for rainwater harvesting systems.
Equipment for water saving and water recycling.
Systems for the rehabilitation of sewage (including septic system rehabilitation).
Packaged and transportable sewerage and wastewater treatment systems.
Waterless composting toilets.
Technical designs, equipment and maintenance of equipment for disinfecting water by electrolysis.
Solutions for the efficient use of water (including systems for irrigation such as sprinkler or drip irrigation and low-flow faucets and other water use systems).
Instruments to analyse water (including water-saving devices for private households).
Water purification systems for municipal, community and household use.

Market challenges

In spite of the many opportunities one is well advised not to be too impressed by size and numbers. India has a set of its own problems which may or may not pose hurdles for foreign companies.

It is commonly known that widespread poverty, poor rate of literacy and a malfunctioning infrastructure have an impact on the country's social and economic development that must not be ignored. But there are further limiting factors which foreign companies have to face. For example, public tenders are often intransparent and leave foreign bidders with small chances to win a contract.

Also, Indian businesses are quite price sensitive and add pressure on the foreign vendor's profit margin. And, in the case of transfer or technology, prevailing case law in India tends to favour the Indian party over the foreign one. It should be noted here that transfer of technology (or TOT as it is commonly referred to in India) is not just a buzz word. From an Indian perspective it is perhaps the most favoured model of co-operation with foreign companies and research & development institutes. For obvious reasons: Technology that is transferred to India becomes a commercially exploitable indigenous resource. As such, it can contribute much more value to the national economy than imported goods or services availed from companies without a set up in India.

It is therefore important for Swiss water and wastewater technologies, services and infrastructure firms that are considering doing business in India to:

- Research the opportunities and their potential competition in the Indian marketplace
- Consider connecting and/or partnering with Indian firms as part of their market strategy, and
- Identify niche market opportunities for their water and/or wastewater technologies and services.

Local competition

The water and wastewater treatment market is highly fragmented and unorganised. Most companies are small, not registered and run by an entrepreneur with a small size of staff.

These companies operate in their own niches and are quite cost-competitive. It is estimated that equipment made locally in India is about 30 per cent cheaper than imported goods. This is partly due to lower manufacturing costs, and partly because of high import duty on certain goods. However, most such companies lack the capability (financing, know-how, technology, market outreach) in order to compete with suppliers of more sophisticated systems.

Money floods into wastewater treatment

Industrialisation, technology, urban need make commercial water supply a growing opportunity. The 47.3 hectare Commonwealth Games Village coming up in Delhi on the bank of the Yamuna river will house thousands of athletes in October 2010 in 1,100 flats. Thousands of litres of water will be used every day (...). The village will have the most advanced water treatment plant using membrane technology.

At Panipat, Indian Oil Corporation's new naphtha cracker project is using the latest technology to recycle 150 million litres of water per day (...). Down south in Chennai, water-starved Chennai Petroleum Corporation Ltd. has commissioned a 26.367 million litres per day reverse osmosis-based desalination plant to become self-sufficient in its daily water requirements.

"Siemens India is also planning to enter the water treatment business in a big way in India. (...) In the coming years, water treatment will contribute a major share of revenue to our business as many projects from the government and municipal sector are coming up in India," said Armin Bruck, managing director of Siemens India.

Water and wastewater treatment, especially in the industrial and municipal sectors, is becoming big business. The country's commercial water market is growing consistently at 10 - 12 per cent in the past four to five years. The point-of-consumption market, which involves localised treatment of water by setting up distribution channels, is growing at over 20 per cent per year.

(...) What has helped is water treatment and supply projects was making these eligible to bank finance and a 10 year tax holiday. That the government has allowed 100 per cent foreign direct investment in the infrastructure sector, including water treatment systems, is another incentive for global players to test Indian waters.

Source: Business Standard, November 27, 2009

Part 2: **Water in India**

Water in India

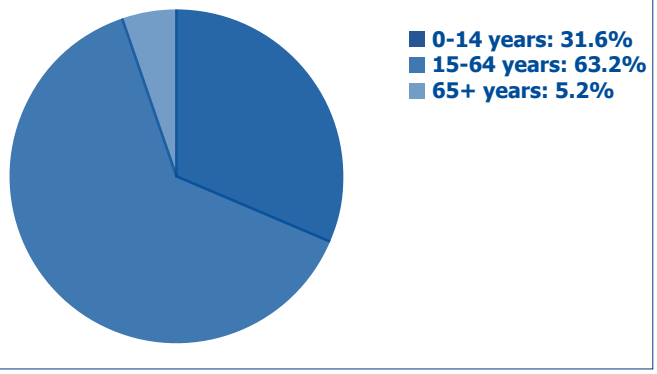
In recent times, both documentation and activism on water have increased in India. But awareness at the primary consumer level (ie the citizen) remains very low. Only a thin minority knows about the benefits of the conservation of water and water resources.

One reason is that water has been coming virtually free of cost. Farmers tap water from nature itself, industries pay a pittance as water cess (a tax specific to the consumption of water), while most households pay nothing at all. In fact, many Indians see groundwater in particular as a "democratic resource". The government, generating very little revenues from water, is unable to operate and maintain the existing infrastructure or even create fresh capacity. Most water utilities perform poorly at operations and maintenance.

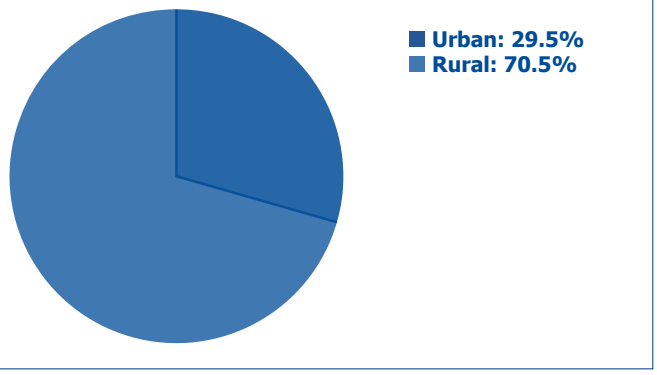
But there are improvements that should be introduced urgently: metering, applying appropriate user charges, reducing water losses, increasing water availability, coverage and access in partnership with customers, stakeholders and donors.

Although India is endowed with sufficient water, there are significant variations in its spatial and temporal availability. There are areas where water is available in excess only to become a shortage within days or weeks. There are significant variations in water availability even within a river basin. Overall, the annual per capita availability of renewable freshwater in the country has fallen from around 5,277 cubic metres in 1955 to 2,464 cubic metres in 1990. Given the projected growth of population by the year 2025, the per capita availability is likely to drop to below 1,000 cubic metres. If the availability drops below this level, water will have become a scarcity across the country.

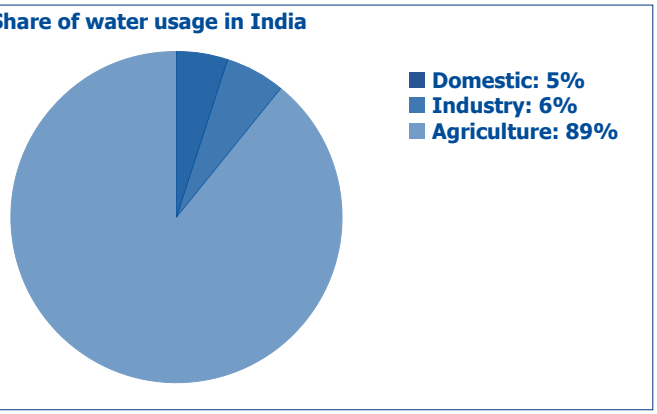
Population of India by age groups, 2009 (share)



Population of India, urban/rural share, 2009



Share of water usage in India



Of all cities in India, only 50 per cent are supplied with piped water. None of the municipal authorities of the 35 cities with a population of between one and five million distribute water for more than a few hours per day. When water becomes available, people struggle to get water because of insufficient pipe pressure.

Capacities to treat sewage is insufficient, too. Domestic sewage from cities and towns is the biggest source of pollution of water bodies in India. According to the census of 2001, all large Indian cities together generated an estimated 29,129 million litres per day sewage (as per population in 2001 census). But the installed sewage treatment capacity was only 6,190 million litres per day. The gap of 22,939 million litres per day was closed since 2001 only marginally. At present, a capacity addition of around 1,700 million litres per day is under planning or construction.

It is likely that by 2025, 50 per cent of the Indian population will live in urban areas. There is sufficient empiric and statistical evidence that water usage per capita is higher in urban areas, if coupled with increasing disposable household incomes. If water quality further declines because of groundwater contamination and surface water pollution, water treatment should be in huge demand.

Real and estimated water usage in India

Year	Population (million)	Irrigation*	Domestic and livestock*	Industry*	Thermal power*	Total*
1990	800	4,600	250	150	300	5,300
2000	1,000	6,300	340	360	500	7,500
2025	1,400	7,700	500	1,200	1,600	11,000
2050	1,700	7,000	600	2,000	1,600	11,200

*Billion cubic metres

Source: EA Water Pvt. Ltd., 2009

Historically, the water sector has been owned and operated by the government. In the light of its own inability to solve all problems single-handedly, the government is now encouraging the private sector to participate and introducing regulatory reforms.

Schemes such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) are expected to stimulate public and private spending of about USD 10 billion on water and sewerage in 63 cities by 2014. However, to reach the World Bank's millennium development goals, India will have to invest around USD 650 billion by 2012 in the water sector alone.

The usage of water is driven mainly by the following factors:

- Population: India's population is expected to increase from 1.13 billion in 2005 to 1.7 billion by 2050
- Urbanization: The urban population is expected to grow from 29.2 per cent of the total population in 2007 to 55.2 per cent by 2050
- Per capita income: The per capita income is expected to increase from USD 468 (gross domestic product per capita) in 2007 to USD 17,366 by 2050
- Agriculture: Production of water-intensive crops is expected to grow by 80 per cent between 2000 and 2050.

Domestic water consumption

Households in India consume around 5 per cent of total available water. This share is likely to increase to 11 per cent by 2050. With this, the per capita consumption will roughly double from 89 litres a day now to 167 litres a day by 2050.

In 2005, around 65 per cent of households in Ahmedabad, Delhi, Hyderabad, Kanpur, Kolkata, Madurai and Mumbai faced water deficiency. As a result, such cities are reaching out to distant water sources. For example, Delhi receives water from rivers up to 250 kilometres away, while some of the water in Chennai comes from rivers that are 450 kilometres away.

Drinking water sources vary both in the rural and urban regions of India. The most common urban source of drinking water are taps that get their supply from the local administrations. These government bodies source most of their supply from surface wa-

Enough is not enough

Delhi's story is typical. Demand for water there has been rising for years. The local utility cannot meet it. The city's pipes and other equipment have been so poorly maintained that 40 per cent of the supply fails to reach the customers. So the utility rations it by providing water for a limited number of hours a day and, in some places, by restricting the quantity. Householders and landlords build tanks, if they can, and fill them when the water is available. Residents, or their weary employees, set their alarm clocks to turn on the tap before the flow dribbles away to nothing. Property developers, anxious to take advantage of a booming economy and a growing middle class, drill bore holes, but these now have to go deeper and deeper to reach water.

As for the Yamuna river, long the main source of the city's drinking water, it is clinically dead. Quantities of sewage are poured into it daily, 95 per cent of which is untreated, and it is also a depository for industrial effluents, chemicals from farm runoffs and arsenic and fluoride contamination. The city's master plan proposes three new dams, but they will not be finished for several years.

Source: The Economist, 2010

ter (lakes and rivers) as well as from reservoirs. In addition to drinking water from taps, urban citizens get water from open and closed wells, bore wells (both legal and illegal), hand pumps, small water bodies like springs, ponds, lakes or rivers and, in few cases, harvested rain water.

Traditional methods of purifying water are simple, using cloth for filtering, decantation or boiling. In order to cool it, water is stored in earthen pots and urns even today in many towns and cities in India. Many middle class households have acquired electronic refrigerators.

Packaged water

Due to increasing awareness of potential health problems, packaged drinking water and water dispensers have become quite popular in India. With around 1,600 brands, the Indian packaged drinking water sector is estimated to have a size of USD 247 million. About 5 billion litres of bottled water are sold in India today, making the country the tenth largest consumer of bottled water globally. It is estimated that this market is growing at a rate of about 25 per cent annually.

Although these are big numbers, the per capita consumption of bottled water in India is only around 0.6 litre per year.

There is no single brand that dominates the Indian market by volume. Of the 1,600 certified manufacturers, three famous brands jointly hold a market share of 30 per cent: Bisleri (Parle), Aquafina (Pepsico) and Kinley (Hindustan Coca Cola). These players primarily market smaller containers of 300 and 500 millilitres or 1 and 2 litres.

Local brands made by regional players, who sometimes belong to the unorganised sector, account for the remaining 70 per cent of the market. A large proportion of these companies' business comes from bulk packs of 20 or 25 litres. These packs are usually supplied at the doorstep of consumers by local distributors.

Water filters and purifiers

The water purifier market in India is dominated by a large number of prominent players with well established distribution and marketing channels. Some of the players in this segment are Eureka Forbes, Hindustan Unilever, Ion Exchange, Kenstar, Kent, Philips, Usha Britta, Whirlpool, and Zero B.

Of the total installed base of purifiers, ultraviolet systems account for a market share of 51 per cent thanks to their affordability. Products based on reverse osmosis too have a significant share of 42 per cent. Their share is rising because public opinion has it that reverse osmosis is the best method.

Pollution

Discharge of untreated wastewater is leading to increased pollution and depletion of clean water resources.

Water in India is polluted predominantly by two sources. There is a lot of untreated domestic wastewater that is reused for agriculture, causing health hazards. Runoff from agricultural fields often contains pesticides and fertilizers that pollute surface

water. As a result, 14 per cent of India's total river length is severely polluted, another 19 per cent is moderately polluted. Further, the quality of groundwater suffers from high levels of chemicals in soil as well as in water:

- 69 districts across 14 federal states have fluoride above acceptable levels
- 6 districts in the Ganges river plains of the federal state of West Bengal have high levels of arsenic
- In 40 districts across 13 federal states, heavy metals were found in groundwater.

Rainwater harvesting

Rainwater has been harvested in India for centuries out of sheer necessity. However, in recent years methods and technologies are being sophisticated. Also, the legal framework is being changed in order to promote rainwater harvesting because groundwater tables are falling. Today, rooftop rainwater harvesting systems are now mandatory for new buildings in 18 of India's 28 states and 4 of its 7 federally administered union territories.

In January 2010, India's Minister of Rural Development revealed that about 50 per cent of the funds for India's Rural Employment Act (a governmental programme to cut down unemployment in rural areas) are being used for water harvesting systems.

Coke completes rainwater harvesting projects in India

Atlanta-based Coca-Cola's subsidiary in India and its partners have completed 16 rain water harvesting projects in the central Indian state of Madhya Pradesh, according to today's ImagesFood.com, which covers the business of the Indian food industry.

The projects are at government schools in the Madhya Pradesh cities of Bhopal, Indore, Jabalpur, and Gwalior. The public-private partnership includes UN-HABITAT and the Lake Conservation Authority (LCA) of Madhya Pradesh.

The projects have the combined capacity to harvest 3.6 million litres of rainwater annually, benefiting the schools and surrounding communities.

Source: Cleantech Group, 2010

Many Indian cities lack sufficient water supplies. Urban growth is making it difficult and expensive to build the dams, pipelines and canals used in the modern era to supply cities with water. Among other cities, Bangalore introduced a rule requiring all new buildings to have water harvesting systems. According to calculations by the municipal administration of Bangalore, rainwater would cover the city's water needs for six months every year. The rule will be extended to all cities in the federal state of Karnataka in 2011. The state government is also considering a water bill rebate for citizens who install such systems in their houses.

However, even though regulations like these are being enacted, making sure the rainwater systems are actually built is another matter. In the city of Mumbai, for example, the water authority made it mandatory in 2002 for new buildings with an area of more than 1,000 square meters to have rainwater systems installed. But the rule has been poorly implemented because of a lack of monitoring.

Desalination

Today, plants where sea water is desalinated provide only about 1 per cent of the world's drinking water. Although very small, this share is growing every year. India, with its long coastline of 7,600 kilometres, is likely to be one of those countries with the highest growth ratios in desalinating water.

Coastal areas of federal states such as Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu are short of water because river water is scarce and ground water levels are low. But demand in these states is quite high, not only because they are highly populated (which is true for almost every state in India) but because they are more industrialised than other states. Industrial users of water readily pay high prices for

reliable water supply. Large industries such as refineries, petrochemical complexes and power plants come up near the coast. In order to cover their need of huge volumes of water they consider desalination as a practicable and economical solution to their problem.
However, the Indian market for desalination is widely untapped. Only a handful of desalination plants is operational. The major ones include:

- Nirma Industries, Bhavnagar, state of Gujarat (10 million litres per day plant developed by Thermax, India)
- Reliance Industries, Jamnagar, state of Gujarat (48 million litres per day plant developed by IDE, Israel)
- Gujarat Electricity Board, Sikka, state of Gujarat (4.5 million litres per day plant developed by Ion Exchange, India)
- Chennai Petroleum Corporation, Chennai, state of Tamil Nadu (22 million litres per day plant developed by Ion Exchange, India)
- Tata Chemicals, Mithapur, state of Gujarat (5.8 million litres per day mobile desalination plant developed by GE Water, India in 2007 for four years on a build own operate (BOO) basis).

In addition, a number of small community-based desalination plants have been put up by the government at coastal areas in the states of Andhra Pradesh and Tamil Nadu.

Reverse osmosis desalination projects
Unlike conventional technology, the market for membrane based desalination plants is growing. Since the early 1990s, hundreds of membrane based brackish water desalination plants with capacities of 10 - 100 cubic metres per day were set up to providing safe drinking water to villages in the states of Andhra Pradesh, Gujarat, Rajasthan and Tamil Nadu.

Reverse osmosis desalination plants were installed also in the industry sector:

- Gujarat Electricity Board, Sikka, state of Gujarat (4.5 million litres per day sea water reverse osmosis plant developed by Ion Exchange, India)
- NIRMA, Bhavnagar, state of Gujarat (10 million litres per day sea water reverse osmosis plant developed by Thermax, India)
- Rashtriya Chemical Factory, Mumbai, state of Maharashtra (12 million litres per day waste water reverse osmosis plant developed by Aquatec, India)
- IFFCO, Phulpur, state of Uttar Pradesh (3 million litres per day wastewater reverse osmosis plant developed by Ion Exchange, India).

Recovery

Recovering already used water to reuse it follows the purpose of increasing local water supply. Given India's shortage of usable water, recovery represents one of the largest potential sources of "new water" there. Communities throughout India are in urgent need for additional water supply for a variety of uses. Policy makers, industrialists and water utilities are looking for ways to increase the volume of reused water.

Irrigation

Agriculture contributes about 18 per cent to India's gross domestic product (GDP). Yet, about 65 - 70 per cent of the Indian population depends on agriculture for its livelihood. It is a rather risky dependency because nearly 60 per cent of India's agricultural area depends on seasonal monsoon rains.

Since 1950 India's national as well as federal state governments have invested around USD 18 billion to provide irrigation infrastructure across the country. Today, India's irrigation infrastructure is growing with investments at USD 1.5 billion each year. But it should grow three times faster if the actual need is to be met.

Irrigation in India is caught in a number of problems. About 70 per cent of Indian farmers are extremely poor. They own no or only marginal pieces of land and subsist on most of what they produce. It is hardly possible for them to pay for irrigation. On the other hand, if they do not irrigate their land, they risk losing their crop.

Irrigation demand in India's major river basins by 2050

River basins	Major agricultural states in the river basins	Population density (number of people per square kilometre)	Water used for irrigation (of total consumption)
Ganges	Uttar Pradesh	449	91%
Krishna	Maharashtra, Karnataka	253	90%
Kaveri	Tamil Nadu, Karnataka	389	95%
Godavari	Andhra Pradesh, Karnataka	189	89%

Source: Grail Research, 2009

This is true even though rates for irrigation water are very low. But these prices are highly subsidised, were fixed decades ago and not revised since then. Additional subsidies on electricity have led to excessive pumping of groundwater for agriculture. And, because the government does not collect any or too little water cess (a tax specific to water), operations and maintenance are hardly done. As a result, the supply of irrigation water is unreliable and unsatisfactory.

Ground water

Across India, there are 12 million energised wells which contribute to more than 50 per cent of the total irrigated area. Hence, ground water has become a critical source for agriculture growth. However, ground water mining has resulted in hazardous contamination. In the states of Gujarat (mainly in its north) and Rajasthan fluoride is found in worrying quantity. In the state of West Bengal (mainly in its south) arsenic contamination is endangering livelihood. Various non-governmental organizations say that one quarter of India's harvest is at risk from ground water depletion. The most seriously affected states are Gujarat, Haryana, Karnataka, Punjab, Rajasthan and Tamil Nadu.

Tank irrigation systems

Tanks have historically been built and maintained by local communities. Over the past decades, however, this system has disintegrated due to paucity of funds at the local level. Although water tanks can be commonly seen in rural India, only 15 per cent of those farms that own tanks also have wells as a supplementary source of water. Their tank is the only source for irrigation. When there is insufficient rain, the majority of such farms suffer. As a result, poor farmers resort to buying water from better-off fellow farmers. The price of such water usually is higher than the one bought from local water utilities.

In its inability to counter the trend on its own, India's Planning Commission and the Ministry of Water Resources favour private sector participation in agricultural irrigation projects as well as financing.

The increasing use of water in agricultural production is being driven by demographic and economic factors. In the year 2000, India's demand for food grain was 178 million metric tons. By 2050, this number is likely to have grown to 241 million. Agricultural products with a high water footprint are becoming more popular since disposable income is growing. Processed food is selling well among the upper middle class in Indian cities where people work more hours and days in offices than only a few years ago.

Similarly, the contribution of nonfood grain (sugarcane, fruits, vegetables, etc.) and animal products in daily food intake for an individual is expected to grow from 35 per cent in 2000 to about 50 per cent in 2050.

But the growth in agricultural production is leading to greater water stress. Rice, wheat and sugarcane together constitute about 90 per cent of India's crop production and are the most water-consuming crops. Of the top rice and wheat producing countries such as China, US and Indonesia, India has the highest water footprint.

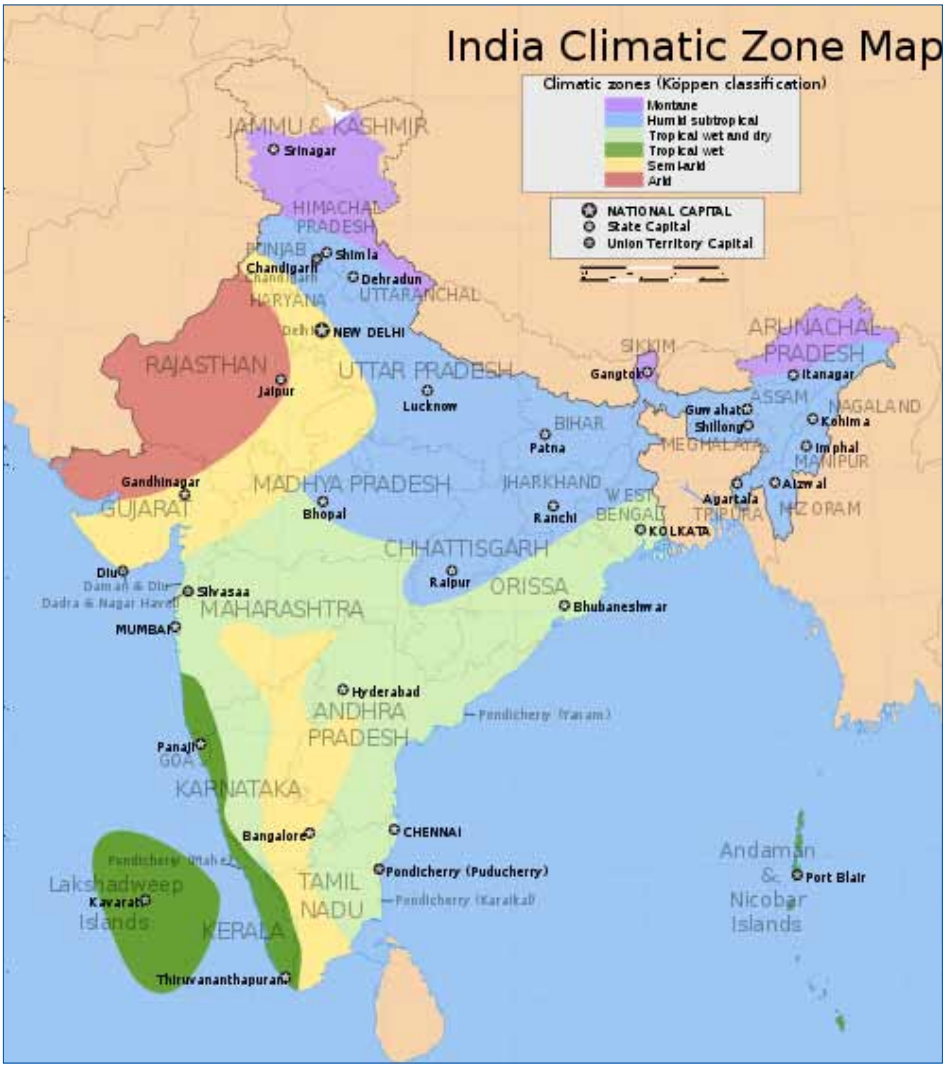
Climate, rainfall and water quality

Climate

India's climate comprises a wide range of weather conditions across a large geographic scale and varied topography. The country has four seasons:

- Winter (January and February)
- Summer (March to May)
- Monsoon season (rain, June to September)
- Post-monsoon period (October to December).

India's unique geography and geology strongly influence its climate. This is particularly true of the Himalayas in the north and the Thar Desert in the northwest. The Himalayas act as a barrier to the frigid winds flowing down from Central Asia. Thus, North India is kept warm or only mildly cold during winter. In summer, the same phenomenon makes India relatively hot. Although the Tropic of Cancer passes through the middle of India, the whole country is considered to be tropical.



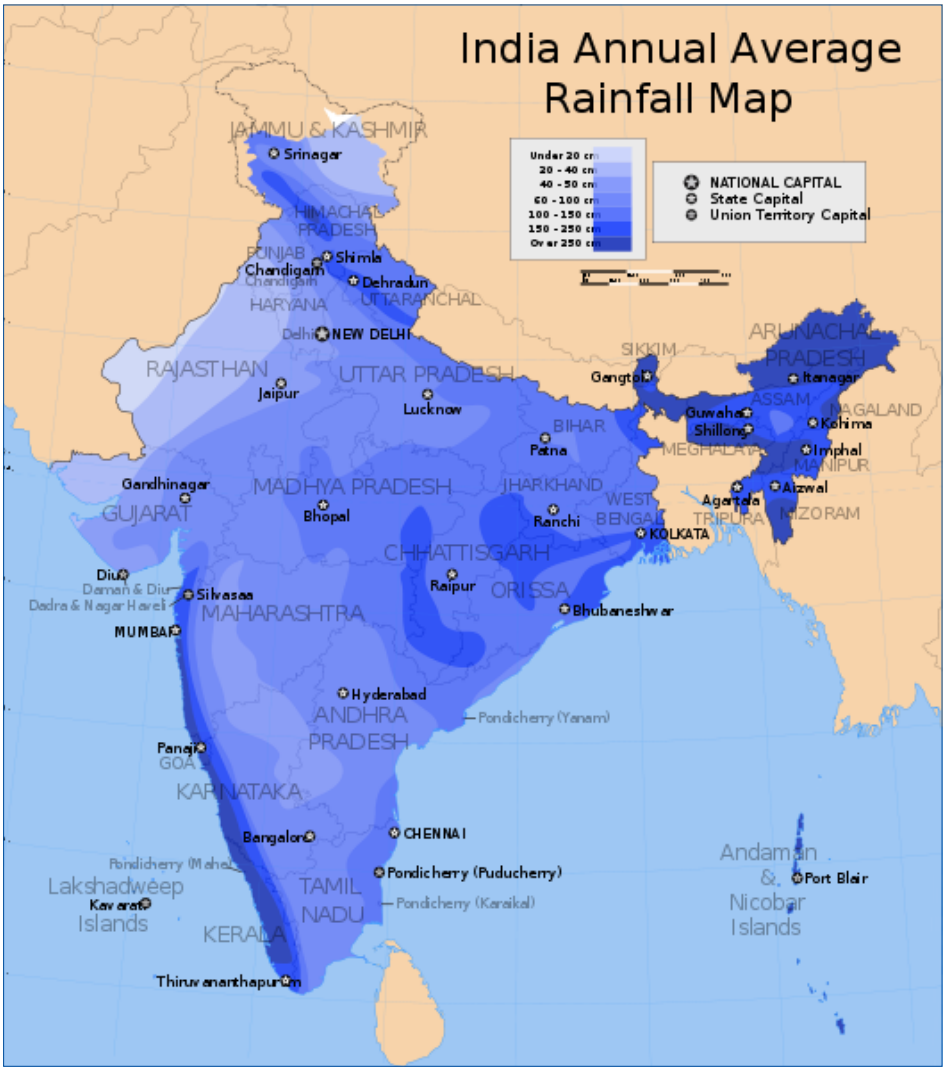
Four major climatic groupings predominate, into which fall seven climatic zones:

- Tropical wet: A tropical rainy climate covering regions experiencing persistent warm or high temperatures, which normally do not fall below 18° Celsius.
- Tropical dry: A tropical arid and semi-arid climate dominates regions where the rate of moisture loss through evapotranspiration exceeds that from precipitation. Without artificial irrigation, this region is not suitable for permanent agriculture.
- Subtropical humid: Most of Northeast India and much of North India are subject to a humid subtropical climate. Though they experience hot summers, temperatures during the coldest months may fall as low as 0° Celsius.
- Alpine: India's northernmost areas are subject to an alpine climate.

As in much of the tropics, monsoonal and other weather conditions in India are unstable: major droughts, floods, cyclones and other natural disasters are sporadic, but have killed or displaced millions. India's long-term climatic stability may be further threatened by global warming.

Rainfall

The rainfall in the country is mostly confined to four monsoon months between June and September. Almost 80 per cent of the total rainfall happens in this period. The Indian monsoon is affected by two seasonal winds, the northeast monsoon and the southwest monsoon.



The southwest summer monsoon, a four-month period when massive thunderstorms dominate India's weather, is world's most productive wet season. The monsoon is a product of southeast trade winds originating from a high-pressure mass centred over the southern Indian Ocean. Attracted by a low-pressure region over South Asia, the mass spawns surface winds that ferry humid air into India from the southwest. During the post-monsoon months of October to December, a different cycle, the northeast (or "retreating") monsoon, brings dry, cool, and dense Central Asian air masses to large parts of India.

Monsoon rains have a significant impact on India's economy. Favourable monsoons result in a booming economy as 600 million persons work in this sector, producing by and large what the entire nation eats and drinks. Weak or failed monsoons (droughts) result in widespread agricultural losses and substantially hinder overall economic growth. The rains reduce temperatures and replenish groundwater tables, rivers, and lakes.

Groundwater

India's groundwater resources are almost ten times its annual rainfall. According to the Central Groundwater Board of the Government of India, the country has an annual exploitable groundwater potential of 265 billion cubic metres. Nearly 85 percent of this currently exploited groundwater is used only for irrigation. Groundwater is now the source of four-fifths of the domestic water supply in rural areas, and around half that of urban and industrial areas.

However, according to the International Irrigation Management Institute (IIMI), the water table almost everywhere in India is falling between one to three metres every year. Furthermore, the IIMI estimates that India is using its underground water resources at least twice as fast they are being replenished.

Water quality

Realising the importance of groundwater quality and its deterioration, the Central Pollution Control Board (CPCB) of India, in collaboration with the National Institute of Hydrology in Roorkee (federal state of Uttarakhand) initiated a groundwater quality survey in metropolitan cities.

Reports on 8 cities were finalised in 2008, while reports on ground water quality of 14 further cities were compiled in 2009. Twenty five ground water samples were collected in each city during before and after monsoon seasons and analysed for various physicochemical and bacteriological parameters, heavy metals and pesticides.

Quite disturbingly, ground water in various regions in India is not only saline, but contaminated with one or more hazardous substances.

Groundwater pollution in India

Pollutant	Federal state
Salinity (inland)	Bihar Haryana Maharashtra Rajasthan Uttar Pradesh
Salinity (coastal)	Andhra Pradesh Gujarat Orissa West Bengal
Arsenic	West Bengal
Fluoride	Andhra Pradesh Gujarat Haryana Kerala Orissa Punjab Rajasthan Tamil Nadu Uttar Pradesh
Chloride	Karnataka Madhya Pradesh Maharashtra Rajasthan West Bengal
Chromium	Punjab
Iron	Assam Bihar Orissa Rajasthan Tripura Uttar Pradesh West Bengal
Manganese	Orissa Uttar Pradesh
Nitrate	Andhra Pradesh Bihar Delhi Haryana Himachal Pradesh Karnataka Madhya Pradesh Maharashtra Punjab Rajasthan Tamil Nadu West Bengal
Sulphide	Assam Bihar Orissa Rajasthan Tripura Uttar Pradesh West Bengal
Zinc	Andhra Pradesh Delhi Rajasthan

Source: EA Water Pvt. Ltd., 2009

Regulations

According to India's constitution, water (and sanitation) is a state subject. Each federal state controls, manages and administrates water policy and its implementation individually. There is a complex maze of institutions in every state with different responsibilities. Relations between urban and urban areas are complex, and so are the coordination of capital investments, operations and maintenance as well as revenue generation and sharing. The role of the central government in New Delhi is primarily to achieve harmonisation and resolve disputes. This is done primarily through its five-year plans.

India's five-year plans

The Indian government implements its economic policies through five-year plans. These are developed, executed and monitored by the Planning Commission. The first five-year plan was introduced in 1951.

Performance in meeting the planned targets has improved, largely as a result of economic reforms. While traditionally the gross domestic product's (GDP) growth rate has been the central objective, the current 11th five-year plan also sets targets for other dimensions of economic performance, including reversing the slowdown in agricultural growth and providing education and health services to all citizens.

The role of the federal states in meeting targets has been expanded. Many of the focus areas in the current plan, such as health, education, drinking water, urban infrastructure and agriculture, are the responsibility of the states, with substantial assistance from the central government.

For cities, water and sewerage policy is carried out at three levels:

- Central government
- Federal states
- City governments.

In an attempt to conserve water, India has launched numerous programmes but lacks an independent regulator to control and coordinate implementation efforts. Due to a lack of coordination between government authorities involved in water management, the government of India constituted the "Water Quality Assessment Authority (WQAA)" in 2001. The WQAA consists of 12 member authorities (various government ministries, boards and commissions with responsibilities that include a water aspect), and aims to gauge the current situation and establish priorities for action.

Still, there remain unresolved issues related to water governance:

Multiple government agencies have responsibility for water management, which hinders effective policy development and implementation

Water tariffs and policies differ across states. Water is available for free or is highly subsidized in some states. More than 40% of India's water does not generate any revenue. About 13.8 million people living in the national capital Delhi, pay for less than 50% of the water they consume.

Administrative stakeholders in India's water sector

Department	Function, role, responsibility
Ministry of Water Resources	Principal agency responsible for all water in the country. Manages the Central Water Commission and the Central Ground Water Board.
Ministry of Rural Development	Watershed development and water supply in rural areas.
Ministry of Urban Development	Drinking water supply in urban areas. Administrates Central Public Health and Environmental Engineering Organisation (standards setting), National Environmental Engineering Research Institute (training and research), and Accelerated Urban Water Supply Programme.
Ministry of Power	Development of hydropower without any mandate on water pollution from power plants
Ministry of Environment and Forests	Quality of surface and groundwater. Manages and oversees the National Rivers Conservation Directorate and Central Pollution Control Board
Ministry of Agriculture	Provides resources for irrigation of agricultural lands
Ministry of Industry	Planning and development of water resources for industry
Central Pollution Control Board	Monitoring and regulation of industrial water pollution
Central Ground Water Authority	Regulation of quantity and quality of groundwater
Water Quality Assessment Authority	Apex body set up by Ministry of Water Resources and Ministry of Environment and Forests

Annex

Number of households in India, 2003 - 2009								
	2003	2004	2005	2006	2007	2008	2009*	CAGR**
Millions of households	199.0	202.6	206.3	209.9	213.5	217.1	220.9	1.8%
*Estimated **Compound annual growth rate								

Gross domestic product of India, 2006 - 2011						
GDP*	2006	2007	2008	2009**	2010***	2011***
Billion euros	677.9	840.0	891.4	906.3	1,100.1	1,261.4
Growth	9.4%	9.6%	5.1%	6.8%	7.8%	8.0%
*Gross domestic product **Estimated ***Forecast						

Projected wastewater generation in urban Indian			
Year	Urban population (million)	Consumption (lpcd*)	Gross wastewater generation (mld**)
2021	488	121	59,048
2031	638	121	77,198
2041	835	121	101,035
2051	1,093	121	132,253
*Litres per capita per day **Million litres per day Source: EA Water Pvt. Ltd., 2009			

State wise data on population, households, electrification and access to tap water (only available data displayed)							
State	Population		Households		Permanent	Electrified	Water on tap
	Million	Female (%)	Million	Urban (%)			
Andhra Pradesh	75.72	49	20.01	24.88	54.7	67.2	48.1
Assam	26.64	48	4.94	14.49	19.7	24.9	9.2
Bihar	82.99	48	13.99	9.46	19.7	24.9	3.7
Delhi	15.56	45	2.55	93.33	n.a.	92.9	75.33
Goa	1.34	49	0.28	49.46	69.9	93.6	69
Gujarat	50.59	48	9.64	3.76	65.3	80.4	62.31
Haryana	21.08	46	3.53	36.18	65.8	94.8	84.13
Himachal Pradesh	6.08	49	1.2	1.81	64.5	82.9	46.14
Karnataka	52.7	49	10.2	33.91	54.9	78.5	58.9
Kerala	31.8	51	6.59	28.47	68.1	70.2	20.4
Madhya Pradesh	60.38	48	6.59	27.18	41.5	70.0	25.31
Maharashtra	96.75	48	19.06	44.59	57.8	77.5	64.02
Meghalaya	2.3	49	0.42	23.59	22.2	42.7	34.53
Orissa	36.71	49	7.87	13.46	27.6	26.9	8.73
Punjab	24.29	47	4.26	31.91	86.1	91.9	33.61
Rajasthan	56.47	48	9.34	23.79	64.9	54.7	35.27
Tamil Nadu	62.11	50	14.17	38.74	58.5	78.2	62.53
Uttar Pradesh	16.6	47	25.76	20.18	53.4	31.9	23.7
West Bengal	8.22	48	15.17	29.64	40.4	37.5	21.4
Uttaranchal	8.47	49	1.58	1.83	86.3	60.3	65.89
Jharkhand	26.94	48	4.86	23.48	31.4	24.3	12.56
Chattisgarh	20.79	50	4.14	19.82	25.4	53.1	15.49
Source: EA Water Pvt. Ltd., 2009							

Financial status of water utilities in selected cities			
City	**Annual water use (m^3)**	**Annual water billing (INR**)**	**Annual O&M* costs (INR**)**
Ahmedabad	237,250,000	330,000,000	318,086,000
Amritsar	62,416,685	248,270,000	233,666,000
Bangalore	336,928,010	3,800,407,300	3,413,551,100
Bhopal	94,170,000	56,120,900	282,299,000
Chandigarh	139,167,200	428,942,660	547,526,000
Chennai	227,700,000	2,053,389,600	1,387,623,200
Coimbatore	83,366,000	179,200,000	111,000,000
Indore	66,760,000	186,038,400	880,616,080
Jabalpur	63,917,000	82,277,000	104,014,350
Jamshedpur	135,090,000	531,669,000	328,300,000
Kolkata	354,619,400	260,000,000	1,228,500,000
Mathura	13,932,780	8,662,000	28,123,000
Mumbai	1,168,000,000	4,640,300,000	4,284,060,400
Nagpur	222,000,000	704,300,000	424,413,000
Nasik	113,150,000	197,748,920	214,585,000
Rajkot	52,500,000	203,833,390	148,500,000
Surat	220,314,650	365,414,000	368,228,000
Varanasi	98,550,000	218,700,000	182,856,000
Vijaywada	48,119,000	79,784,020	104,076,190
Vishakhapatnam	83,384,670	609,700,000	411,600,000

*Operation & maintenance
** Indian Rupees

Source: EA Water Pvt. Ltd., 2009

Standards for drinking water according to Bureau of Indian Standards (BIS)				
Characteristic	**IS* requirement limit**	**IS* permissible limit**	**WHO** guidelines**	**US EPA*** limit**
Essential characteristics				
Colour (in Hazen units)	5	25	15	15
Turbidity (in NTU)	5	10	5	-
PH	6.5 - 8.5	6.5 - 8.5	-	6.5 - 8.5
Total hardness (as CaCO3)	300	600	-	-
Iron	0.3	1.0	0.3	0.3
Chlorides	250	1,000	250	250
Residual Free Chlorine	0.2	-	-	-
Desirable characteristics				
Dissolved Solids	500	2,000	1,000	500
Calcium	75	200	-	-
Copper	0.05	1.5	2	1.3
Manganese	0.1	0.3	0.5	0.05
Sulphate	200	400	250	250
Nitrate	45	100	50	10
Fluoride	1.0	1.5	1.5	4
Phenolic compounds	0.001	0.002	-	-
Mercury	0.001	0.001	0.001	0.002
Cadmium	0.01	0.01	0.003	0.005
Selenium	0.01	0.01	0.01	0.05
Arsenic	0.05	0.05	0.01	-
Cyanide	0.05	0.05	0.07	0.2
Lead	0.05	0.05	0.01	0
Zinc	5	15	3	5
Anionic detergents	0.2	1.0	-	-
Chromium	0.05	0.05	0.05	0.1
Polynuclear aromatic hydrocarbons	-	-	-	-
Mineral oil	0.01	0.03	-	-
Pesticides	absent	0.001	-	-
Alkalinity	200	600	-	-
Aluminium	0.03	0.2	0.2	0.05 - 0.2
*Indian standard **World Health Organisation ***U.S. Environmental Protection Agency Source: EA Water Pvt. Ltd., 2009				

In India				
Name	**Place**	**Dates**	**Year**	**WWW**
8th EverythingAboutWater International Exhibition and Conference on Water and Wastewater Management 2011	Mumbai	January 06 - 08	2011	www.eawater.com/expo
Water Expo 2011	Chennai	March 16 - 18	2011	www.waterexpo.biz

Useful addresses in Switzerland					
Organisation	**Postal address(es)**	**Phone umbers(s)**	**Fax number(s)**	**E-mail**	**WWW**
Osec	Stampfenbachstrasse 85 Postfach 2407 CH-8021 Zurich Avenue d'Ouchy 47 Case postale 315 CH-1001 Lausanne Corso Elvezia 16 Casella postale 5399 CH-6901 Lugano	+41 44 3655151 +41 21 6133570 +41 91 9115135	+41 44 3655221 +41 21 6133502 +41 91 9115139	contact@osec.ch info.lausanne@osec.ch info.lugano@osec.ch	www.osec.ch
MARWAS AG Swiss-Indian Business Bridges	Dufourstrasse 24 CH-8008 Zurich	+41 44 3802932	+41 44 3802931	waseem.hussain@marwas.ch	www.marwas.ch
Swiss-Indian Chamber of Commerce	c/o DPS Communications Gessnerallee 28 CH-8001 Zurich	+41 44 2269061	+41 44 2210085	dorit.sallis@sicc.ch	www.sicc.ch

Useful addresses in India (in alphabetic order)					
Organisation	**Postal address(es)**	**Phone number(s)**	**Fax number(s)**	**E-mail**	**WWW**
Indian Water Works Association (IWWA)	Mr Prakash Padhye Administrative Manager MCGM Compound, Pipeline Road Vakola, Santacruz (East) IN-Mumbai 400 055	+91 22 26672665 +91 22 26672666	+91 22 26686113	iwwa@rediffmail.com info@iwwa.org	www.iwwa.info

Center for International Trade Development, USA, 2008

Central Pollution Control Board (CPCB), Ministry of Environment and Forests, Government of India, Delhi, 2009

Cleantech Group, USA, 2010

Confederation of Indian Industry (CII), 2008

DNA (Daily News & Analysis), India, 2009

Federal Planning Commission, India, 2009

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Global Research & Data Services, Finland, 2010

Grail Research, USA, 2009

India Brand Equity Foundation (IBEF), India, 2009

International Irrigation Management Institute, Sri Lanka, 2010

MARWAS AG, primary research, Switzerland and India, 2010

Press Information Bureau of India (PIB), India, 2010

Press Trust of India (PTI), India, 2010

The Economist, United Kingdom, 2010

The Telegraph, India, 2009

United Nations Development Programme, 2009

World Bank Group, "India's Water Economy", 2009