# Module One: Drinking Water

## The Water Situation in Asia

Asia's cities are ballooning, and the accompanying upsurge in the consumption of water and production of waste in urban areas is placing new pressures on the environment.

Home to 53 % of the world's urban population, Asia has the highest concentration of megacities, including Shanghai, Tokyo, Karachi, Beijing. Not only are Asia's cities big and numerous, they are among the most polluted. The urban explosion has made providing safe water and sanitation a massive challenge for the region.

Historically, the availability of local water resources has determined not only where major cities have been established but how well they have fared. But in Asia, rapid – and often unplanned – urban growth in recent decades has overwhelmed water systems.

Asia's per capita water availability is already the lowest of any continent. Fast economic growth, coupled with breakneck urbanization and changing lifestyles, has made a difficult situation worse. In 2012, slightly over half of the world's population lived in urban areas. By 2050, that ratio is projected to jump to more than two-thirds, with much of that growth taking placing in Asia.

The region's urbanization is fuelling demand for water not just for municipal use but also for manufacturing and agriculture. And changing diets, especially an increased preference for meat – the production of which is notoriously water-intensive – are compounding water challenges. Asia needs to make substantial water savings in agriculture to quench the thirst of its expanding cities. Some of the largest urban centers -- from Beijing and Manila to Jakarta and Dhaka -- are already at risk of running out of water.

The challenge of providing safe drinking water is compounded by the growing incidence of floods and droughts in Asia. According to the Asian Development Bank, people living in the Asia-Pacific region are "four times more likely to be affected by natural disasters than those living in Africa, and 25 times more likely than those living in Europe or North America." Most Asian megacities are in coastal areas, making them vulnerable to global warming-induced rises in ocean levels.

As cities across the region struggle to access adequate water supplies, many of their residents are beginning to rely on bottled water. This practice, however, has fuelled a serious waste-management problem. Due to very low recycling rates, billions of plastic bottles end up as garbage every year, taking up increasing space in landfills or even littering the landscape. Some cities are running out of places to put those bottles.

The environmental problems do not end there: The retreat of mega deltas due to China's upstream damming of rivers originating on the Tibetan Plateau has become a serious issue. According to several scientific studies, heavy upstream damming, which can obstruct the flow of silt to plains and estuaries, is contributing to the retreat and subsidence of Asia's big deltas, which are home to such megacities as Tianjin, Shanghai, Guangzhou, Bangkok, Kolkata and Dhaka. This development, in turn, is causing seawater to flow into coastal freshwater aquifers, affecting municipal supplies.

UNCOVENTIONAL SOLUTIONS Yet despite this deepening crisis, a water-stressed Asia continues to live beyond its means environmentally, overexploiting water resources while hoping to postpone the day of reckoning. Some countries have responded to these challenges by implementing grand but environmentally questionable projects, from China's South-North Water Transfer Project (the world's biggest hydraulic initiative) to India's now-stalled proposal to link up its most important rivers.[1]

**The Ganges River Basin**

The Ganges River Basin spans China, Nepal, India and Bangladesh. About 1200 billion cubic metres of precipitation falls into the basin each year. Over 500 billion cubic metres flow into the Ganges river. The rest recharges the Ground Water or evaporates. With a catchment area of nearly 1.1 million sq. km, the Ganges basin supports more than 500 million people in agriculture-based civilizations in South Asia who value the Ganges not only for irrigation, drinking water and energy production but also have a spiritual and emotional connection to the river as the Ganges is considered sacred in Hindu scriptures.

The annual Surface Water availability in the Ganges basin is high, but there is tremendous variability in the spatial and temporal distribution of water supplies. Ground Water plays a critical role in supporting the lives and

livelihoods of both rural and urban populations in the Ganges Basin. The concept of the Ganges water machine, accelerating surface–subsurface Water interactions to increase water availability, although not a panacea to basin problems, is probably more relevant now than in the past. Water use and variability is accelerating as the climate changes so the concept needs to be explored in detail as a solution for certain parts of the Basin. Pollution in the river and Ground Water contamination, arsenic in particular, has grown into a huge issue with time, but effective systems to deal with these challenges have not been put in place.[2]

**Water Management in India**

Water management has only incrementally improved in the recent centuries while India's water use has grown exponentially. The availability of quality of water is essential for growth, and with India's economic boom the demand for it has skyrocketed. Regrettably, the country's management practices remain decades behind.

India now uses more Ground Water each year than China and the United States combined. Due to this serious overuse, Ground Water levels are falling nationally by an average of 0.3 metres a year. And in some areas the levels are falling by as much as 4 metres a year.

Indian utilities exacerbate the problem by routinely losing an estimated 40 to 60 per cent of water produced — in contrast to cities like Tokyo which loses 3.7 per cent, Singapore at 4.9 per cent and Phnom Penh's 6.5 per cent.

The management of water quality is equally poor. Estimates by the Third World Centre for Water Management indicate that 90 per cent of Waste Water is not properly discharged into the environment. Unsurprisingly all the water bodies within and near urban centres are now heavily contaminated by organic and chemical pollutants that pose serious risks to human health and the environment.

India's water management is inevitably complex as all major rivers run across state borders and the Indian constitution mandates that states are responsible for managing their own water. It has become an extremely convoluted process to decide the amount, purpose and time period of each state's water distribution.

Facing constantly increasing demand from agricultural, industrial and domestic sectors, the preferred policy has been to increase supply. But even with steadily increasing supply, poor water management has meant that Indian demand cannot be met from available water sources during drought periods.

Managing demand and increasing efficiencies have at best received lip service. Politicians believe that there is enough water for all uses and the government's main objective is to provide free or subsidised water for all uses. Politicians of all parties seeking rural and urban votes have been reluctant to institute proper and equitable water pricing and have refrained from making hard decisions to manage demand.

In spite of widespread belief, India is not facing a water crisis because the resource is scarce. The crisis stems from the poor management practices, insufficient demand-side policies and a lack of interstate coordination.[3]

**Kolkata Demographics and Urban Sprawl**

Kolkata Metropolitan Area (KMA), is the urban agglomeration of the city of Kolkata in the Indian state of West Bengal. It is the third most populous metropolitan area in India after Delhi and Mumbai. It had a population of 14.11 million (Census 2011).

Kolkata Metropolitan Development Area (KMDA) reports that the total area is 1886.67 km², making the population density 7,480 per km². Kolkata therefore has India's highest population density amongst metropolitan areas. Almost twice that of Mumbai.

Complete details of KMC and KMA areas are at Annexure One.

**Geography**

The area falls between 22.5726° North and 88.3639° East.

Spread roughly north–south along the east bank of the Hugli River, Kolkata sits within the lower Ganges Delta of eastern India; the City's elevation is 1.5–9 m (5–30 feet).[4]

The Kolkata Municipal Corporation area is flat with some depressions. It is located at 5.3 m above Mean Sea Level (MSL). The slope is not uniform, but is primarily away from the river, to the East and South East.

**Geology and Soil**

The Kolkata Metropolitan Area's Geology and Ground Water Geology is at Annexure Two.

**Rainfall**

The average annual rainfall is about 1919 mm with the four monsoon months (June to September). Rainfall peaks in July. Average number of rainy days is about 146 days per annum. During monsoon months, it is not uncommon to receive 75 mm to 100 mm of rainfall in a 24 hour period. Such heavy rainfall may occur from four to ten times in a year.[5]

**Green Cover**

The city has lost over a quarter of its green cover between 1980 and 2010, more than any metro in the country. During this period, its urban sprawl has increased 4.3 times — from 72.66 sq. km to 314.3 sq. km, expanding eight sq. km every year.[6]

Rampant construction and poor compensatory plantation are taking a toll on Kolkata's environment. The City's green cover now stands at less than 5 %, which is way below the requirement of 15 % for metros. Compared to Kolkata, the green cover in Delhi (some 19.09 %) and Mumbai (some 18 %) is much higher whereas the national average stands at some 19 %.[7]

**Surface Water and Ground Water**

There are four types of situation: i) Entire water supply from Surface Water ii) Entire water supply from Ground Water iii) Mixed supply, a combination of both, and iv) Rain Water Harvesting.

Kolkata City water supply is dependent on both Surface Water sourced from the river Hugli and Ground Water sources.

**Surface Water Sources**

Hugli River is the main source of potable Surface Water.

**Water Distribution System**

The East–West dimension of the city is comparatively narrow, stretching from the Hugli River in the West to roughly the Eastern Metropolitan Bypass in the East, a span of 9–10 km (5.6–6.2 mile). The north–south distance is greater, and its axis is used to section the city into North, Central, and South Kolkata. The slope of the City to the South East and East.

As per CPHEEO guidelines, potable water demand of Kolkata is expected to reach close to 1,400 MLD requiring a generation capacity of around 1,660 million litres per day (MLD). By When? CPHEEO stands for Central Public Health and Environmental Engineering Organisation (India). One gallon is equal to 4.55 litres.

Kolkata Municipal Corporation's (KMC) present supply of treated Surface Water is _____ MLD.

The Ground Water supplied by deep Tube Wells is estimated at 110 MLD.

Capacity augmentation of _____ MLD to meet estimated demand of _____ MLD by the year _____ is underway.[8]

Complete details of water supply infrastructure are at Annexure Three.

In Kolkata, two agencies jointly run the water management system: the Kolkata Municipal Water and Sanitation Agency (KMW&SA) and the Kolkata Municipal Corporation or KMC. The KMC is in charge of the Kolkata Municipal area, while the KMW&SA covers the rest of the Metropolitan Area.

Information sheet for how to get water supply connection in buildings at Annexure Four.

Water Supply: Frequently Asked Questions are at Annexure Five

Schedule Of Fees And Charges For The Year Of 2016-2017 are at Annexure Six.

**Per Capita Water Consumption**

According to official statistics, the city today has a supply of 202 litres of drinking water per person and day. That is more than twice the per capita

amount available in Mumbai. Yet Kolkata is growing, and Ground Water is exploited to the extent it gets contaminated with saline water in many areas.[9]

**Water Supply Statistics at a Glance**

i) Water demand in 2016 > 293 MGD

ii) Water demand in 2026 > 402 MGD

iii) Total daily potable water supply (in million litres) > 1350 MLD i.e. 300 MGD

iv) Per capita availability of water per day (in litres) > 202 litres / per day including 30 % UFW (Unaccounted for Water)

v) Unaccounted water > 35 %

vi) Treated Surface Water supply > 271 MGD

vii) Ground Water supply: 25 MGD

viii) No. of Tube Wells Big Diameter > 439 (power driven) ix) Small Diameter > 10,050 (hand driven)

x) Average supply hours: 8 hours

xi) No. of connections Domestic: 2,45,019

xii) Coverage of household connections: **92.70 %**

xiii) % of households covered by Surface Water > 82.70 %

xiv)% of house hold connection by Ground Water > 10 %

xv) Industrial and Commercial Connections > 25,000 Water consumption in MGD and % of total supply.

xvi)Public Access Standard Posts (in nos.) > 17,019

xvii) Unfiltered water through street hydrants (in nos.) > 2000

xviii) No. of reservoirs at present > 7

ix) Reservoirs under construction > 14

xx) No. of Booster Pumping stations > 17+1 (Tallah)

xxi) No of Booster Pumping stations (under construction) > 5

xxii) Length of distribution networks > 5800 km

xxiii) Combined capacity (in million gallon): 96 [8]

Cost of supply vis-à-vis revenues collected.

**Ground Water Sources**

KMC owns 264 nos. large dia (203 mm) Tube Wells fitted with 20 HP (horse power) submersible pump and 10,000 nos. small dia (40 mm) Tube Wells fitted with Hand Pump, which are operating in KMC area. In Kolkata Metropolis?

As on December, 2006, withdrawal from large dia Tube Wells is about 112.5 MLD and Hand Pump fitted small dia tube well is 21.4 MLD.

Withdrawal of Ground Water in KMC area:

Name of the Source: No. of the source: Withdrawal (MLD*)

Large Dia Tube well (KMC): 264 nos. > 112.5 MLD

Shallow Tube Well: Hand Pump fitted (KMC): 10,000 nos. > 21.4 MLD

Small Dia Private Tube Well: 5831 nos. > 735 MLD

*MLD: million litre per day (Source: CGWB, Kolkata)

Withdrawal from large dia tube well is about 112.5 MLD and Hand Pump fitted small dia tube well is 21.4 MLD. Besides KMC owned Tube Wells, there are 5831 nos. of private owned small dia (101 mm) Tube Wells fitted with 1 to 2 HP pump in KMC area. Withdrawal from these Tube Wells works out to be 735* MLD. Thus, a total of 868.9 MLD of Ground Water is being withdrawn in KMC area.[8]

**Demand in 2025**

In order to meet the potable water generation capacity of around 1,900 MLD in 2025, a Water Treatment Plant of 135 MLD is coming up at Dhapa and augmentation of generation capacity by 68 MLD at Garden Reach Water Works has started. In addition, a 225 MLD Water Treatment Plant has been planned

at Garden Reach Water Works. There shall be adequate provision to add another 225 MLD Water Treatment Plant in future.[10]

**Piped Water Quality**

The water supplied by the Kolkata City's Municipal Corporation is not only safe to drink but also healthier than most of the packaged variety. A study conducted by Jadavpur University's School of Water Resources Engineering has even recommended that residents should opt for the piped water that the Kolkata Municipal Corporation (KMC) supplies for drinking purposes if it is sourced directly from the tap as this is more beneficial than mineral water.

The study was conducted last year and its findings published in the journal 'Desalination and Water Treatment' in early 2016. It found that KMC tap water contains more minerals required by the body for healthy living and is less acidic than many varieties of Packaged Drinking Water (PDW) sold in the city. University researchers comprising Arunabha Majumdar, Professor Emeritus, Pankaj Kumar Roy, Associate Professor and Susanta Ray, a student, conducted the study. Majumdar is also a former director of All India Institute of Hygiene and Public Health.

They tested the quality of water of 27 mineral water brands selected randomly from different parts of the city along with 18 samples of KMC tap water collected from various parts of Kolkata.

"Under this situation of low-mineralised PDW, municipal supply water can be a good alternative for drinking. In India, bottled water is consumed primarily by people in the higher economic class group and drunk in places like social gatherings, offices, restaurants and hotels. In such circumstances, authorities should encourage people to use water supplied by the KMC," the study said.

The study says drinking of tap water should be encouraged in restaurants and parties.

While the study expresses satisfaction with the quality of water when collected directly from corporation taps, it may require filtration at home if the water is stored in reservoirs where the contamination occurs.

The study said most packaged water were found with very low "total hardness (TH)" with the maximum value of 76 mg/l, "which is much below the standard

limit". It also revealed that "maximum proportion of packaged drinking water was acidic in nature.

Further, it was found that all PDW under the study contained very low concentration of TDS (Total Dissolved Solids), TH, Calcium, Magnesium, Chloride and other minerals. Regular consumption of very low-mineralised water may not be considered safe as it has a potential health risk for human beings. On the other hand, the quality of KMC water has been found to be good and contained all minerals with sufficient concentrations".

Professor Majumdar said the quality of water sourced from Hugli river, after purification, is perfect for drinking, whereas the reverse osmosis system adopted by PDW manufacturers often tends to degrade the quality of water.[11]

**Arsenic contamination**

In a study published in September 2016, it has been found that of the 144 wards under Kolkata Municipal Corporation (KMC), 100 have significantly higher arsenic contamination in water than the limits deemed safe by the World Health Organisation (WHO).

The arsenic contamination threat in Kolkata has changed alarmingly since 2009, according to the study published in the Environmental Monitoring and Assessment Journal.

"It is clear that the Ground Water arsenic contamination of Kolkata has changed drastically since 2009. The wards under arsenic contamination threat have increased in number, and the situation in most parts of Kolkata has become seriously alarming," the study said, adding that this increase in contamination isn't just related to the increase in population, but also dependent on the "lack of Ground Water replenishment in certain regions".

The study — conducted by Arindam Malakar, Samirul Islam, Mohammed Ashif Ali and Sugata Ray of Kolkata's Indian Association for the Cultivation of Science — has studied water samples collected from Hand Tube Wells (general depth varying between 45 m to 60 m) installed by the KMC in 144 wards.

According to the study, the Centre's decision to keep the arsenic level in water at 50 µg/L was "rather relaxed", as the same for WHO is 10 µg/L.

“100 wards out of 144 have alarming level of arsenic contamination in their unconfined shallow water table… Of the 100 infected wards, 51 (35.4 per cent) have arsenic level above 50 µg/L, while the level in the rest is between 11 to 50 µg/L… Only 30 per cent of wards (44) across the city have arsenic levels below 10 µg/L…” the report said.

It added that while in 2009, arsenic contamination was limited to Central, South East, and Western regions of the city, the study found that while the “major area in North and Central Kolkata has entered the red zone (critical)”, “parts of South and far West Kolkata have recovered” with arsenic contamination less than 10 µg/L.

“The most dramatic change was observed in North Kolkata, where the far-North has jumped to the red zone (critical) from the green zone (safe) over a period of seven years,” the study said.

While the study noted that the rapid decline in the quality of water in north Kolkata is “somewhat puzzling”, it pointed out the possibility of rapid urbanisation at Rajarhat being a possible reason.

“There had been quite rapid urbanisation in some parts of this region too, and if one considers the growth of the new township at the North Eastern part of the city (Rajarhat-New Town), the observation may not be entirely surprising,” it added.

According to the study, Central South and East Kolkata have traditionally had arsenic contamination in water. The reason: Water here flows continuously through the year to the “central trough”, increasing arsenic contamination.

Moreover, while Eastern, Central South and South Kolkata get reasonable rainwater replenishment, central Kolkata has nearly no replenishment other than the Ground Water that flows from surrounding areas, explaining the massive decline over the last seven years.

The study concludes that “artificial recharge and rainwater replenishment” have become a necessity to deal with the situation.

“But before that, extending treated water supply service to the whole of Kolkata needs to be taken up urgently” to stop human consumption of contaminated Ground Water.

When contacted, researcher Sugata Ray said: “There are lots of problems. When you use water from the ground, it also needs to be replenished. For instance, if rainwater falls on your roof and then flows through a pipe into the drain, it doesn’t get into the ground.

“The more you cover the ground with concrete, the less you replenish the Ground Water. You have rainfall, but everything is concretised. So as a result, the Ground Water level decreases, and proportionately, contamination increases,” he added.

“So, when you have large parts of the city like Rajarhat and stretches along Eastern Metropolitan Bypass seeing construction — which requires large amounts of water — a lot of Ground Water is replenished,” he added.

“There is a correlation between population density and increase in construction and arsenic in water. The presence of arsenic in Bengal and Bangladesh is a part of the soil’s chemistry. But in this case, you will see that there are no new constructions in Park Street. But in these areas or even North of Kolkata, where old homes are being replaced with new flats, arsenic is increasing because of Ground Water depletion,” said Ray.[12]

**Rain Water Harvesting**

Except for a handful of pilot initiatives by the Central and State Bodies, there is no other information of Rain Water Harvesting in the Kolkata Metropolitan Area.[13]

**Conclusion**

There is a dire need to look into the matters of depleting green cover, indiscriminate pumping of ground water[14], token charges for water supply, water distribution losses, unaccounted for water losses and Rain Water Harvesting.

**References of Module One: Drinking Water**


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