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Water Sector in Delhi: An overview

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Abstract

Water is a basic necessity for all life forms including human beings. Hence all require minimum sustainable level of water. Catering for the consumption of some groups of individuals at the cost of other's subsistence needs and only for the present consumption without taking care of future consumption is not sustainable. Policies, not incorporating the sustainability, are bound to break the entire system.

Over the last couple of decades, there was a huge demand of water worldwide. According to latest report of India's Water Reforms, if the current pattern of water demand continues, about half of the demand for water will be unmet by 2030. The water level, which is one of the most important source, in most part of the country has fallen considerably and is getting contaminated.

Availability of water is declining with increasing development. New and varied uses of water are emerging. The pattern of household consumption is also becoming more water intensive with increased urbanisation. Understanding factors affecting demand and supply of water is a complex issue. Any policy decision by the authorities will have a very long and lasting impact on the economic and social wellbeing of people. Hence comprehensive studies should be undertaken before any policy decision is taken.

To help policy makers understand the issues involved and take corrective measures, a sample study has been undertaken by the author. This paper revolves around important issues relating to household water sector in Delhi. It also aims to study the sources of water supply in different parts of the city.To avoid being theoretical and to incorporate the actual ground realities the paper is based on primary data collected froma sample of 277 households living in Delhi.

The availability of per capita water in India is falling and hence immediate and steadfast actions by the government is required. The paper examines the water requirements, institutional and legal framework, availability of water resource andsources of water specifically in Delhi. It shows that within different regions of Delhi, there is huge variation in sources of water. It concludes that the demand and supply is not even and equitable and there is a large gap in supply vis-à-vis demand. A lot has to be done by the policy makers to improve and preserve the sources of water and make it sufficiently available to all.

Introduction

India was traditionally endowed with large freshwater reserves. But growth of the Indian economy is driving increased water usage across sectors. Increasing population and overexploitation of surface and groundwater over the past few decades has resulted in water scarcity.According to ministry of water resources, groundwater in 320 of 640 districts in the country is contaminated by fluoride, arsenic and other chemicals, and heavy metals like lead and chromium, which affects 6 lakh habitations directly and many more indirectly. The Central Ground Water Board (CGWB) has revealed a shocking assessment, according to which 276 districts have high levels of fluoride in their groundwater. At least 387 districts in 21 states, of the 676 districts in the country, have nitrate above permissible levels and eighty-seven areas have a high amount of arsenic, which is a slow poison.

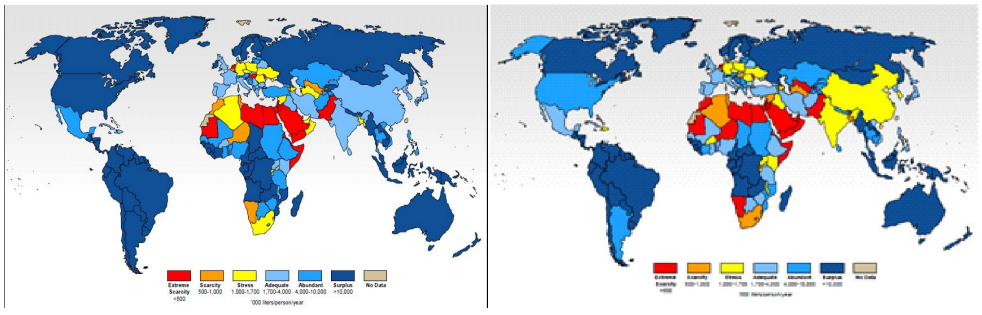
Wastewater is increasing significantly and in the absence of proper measures for treatment and management, the existing freshwater reserves are getting depleted. Due to increased urbanization, per capita water consumption in towns and cities is also rising. It is also driving a change in

the consumption patterns and leading to increased demand for water-intensive agricultural crops and industrial production (Grail, 2009)[1].

Around the world, human activity and natural forces are reducing available water resources. On an average, India receives annual precipitation (including snowfall) of about 4000 km^3. However, there exist considerable spatial and temporal variations in the distribution of rainfall and hence in availability of water in time and space across the country. It is estimated that out of the 4000 km^3 water, only 1869 km^3 is the average annual potential flow in rivers, isavailable as water resource. Out of this total available water resource, only 1123 km^3 is utilizable (690 km^3 from surface water resources and 433 $km^3$from ground water resources). The water demand in the year 2000 was 634 km^3 and it is likely to be 1093 km^3 by the year 2025.

The following figure compares the per capita water availability around the world, in 1975 with the per capita water available in 2000.

FIG 1: Per capita water availability in 1975 (left) and 2000 (right)



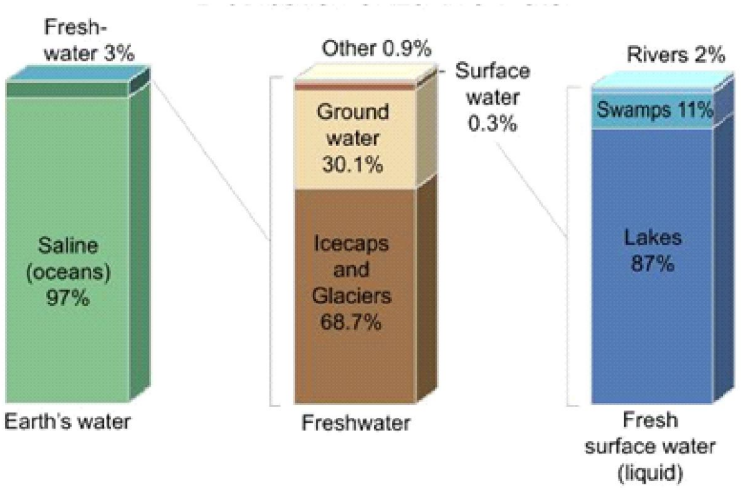
Source: 'Global Water Initiative' (2005, June)[2]

Forms of water availability

The water distribution on earth shows that most water in the Earth's atmosphere and crust comes from the world ocean's saline seawater, while freshwater accounts for only 2.5per cent of the total. The oceanscover roughly 71per cent of the area of the Earth and reflects blue light, therefore the Earth appears blue from space, and is often referred to as the blue planet. An estimated 1.5 to 11 times the amount of water in the oceans may be found hundreds of miles deep within the Earth's interior, although not in

liquid form.

FIG 2: Distribution of Earth's Water



The vast bulk of the water on Earth is saline or salt water, with an average salinity of 35‰ (or 3.5per cent, roughly equivalent to 34 grams of salts in 1 kg of seawater). In all, water from oceans and marginal seas, saline groundwater and water from saline closed lakes amount to over 97per cent of the water on Earth. Though, saline groundwater is seldom considered except when evaluating water quality in arid regions.

The remainder of the Earth's water constitutes the planet's fresh water resource. Typically, fresh water is defined as water with a salinity of less than 1per cent that of the oceans - i.e. below around 0.35‰. Water with a salinity between this level and 1per cent is typically referred to as marginal water because it is marginal for many uses by humans & animals. The ratio of salt water to fresh water on Earth is around 40 to 1.

The planet's fresh water is also very unevenly distributed. Although in warm periods such as the Mesozoic and Paleogene when there were no glaciers anywhere on the planet all fresh water was found in rivers and streams. Today most fresh water exists in the form of ice, snow, groundwater and soil moisture, with only 0.3per cent in liquid form on the surface. Of the liquid surface fresh water, 87per cent is contained in lakes, 11per cent

in swamps, and only 2per cent in rivers. Small quantities of water also exist in the atmosphere and in living beings. Of these sources, only river water is generally valuable. Most lakes are in very inhospitable regions.

Although the total volume of groundwater is known to be much greater than that of river runoff, a large proportion of this groundwater is saline and should therefore be classified with the saline water above. There is also a lot of fossil groundwater in arid regions that has never been renewed for thousands of years; this must not be seen as renewable water.

However, fresh groundwater is of great value, especially in arid countries such as India. Its distribution is broadly similar to that of surface river water, but it is easier to store in hot and dry climates because groundwater storages are much more shielded from evaporation than are dams. In countries such as Yemen, groundwater from erratic rainfall during the rainy season is the major source of irrigation water.

Water Availability in India

Over the years, the supply of water, its reach and penetration all over India is definitely improving. As per the Plan Documents and the Census Data; coverage of water supply in rural India has constantly increased. It was only 3per cent of the total villages in 1971 and has increased to 73.2per cent of total households in 2001. In the urban India the situation has improved over the years. The coverage of water supply was 82per cent of the total population in 1971, and it had increased to 90per cent of total household by 2001.

Table-1: Availability of Water-Facts at a Glance

Area of the India as per cent of World Area	2.4per cent
Population as per cent of World Population	17.1per cent
Water as per cent of World Water	4per cent
Rank in per capita availability	132
Rank in water quality	122
Average annual rainfall	1160 mm (world average 1110 mm)
Range of distribution	150-11690 mm
Range Rainy days	5-150 days, Mostly during 15 days in 100 hrs
Range PET	1500-3500 mm
Per capita water availability (2010)	1588 m^3

Table-2: India's Water Resources

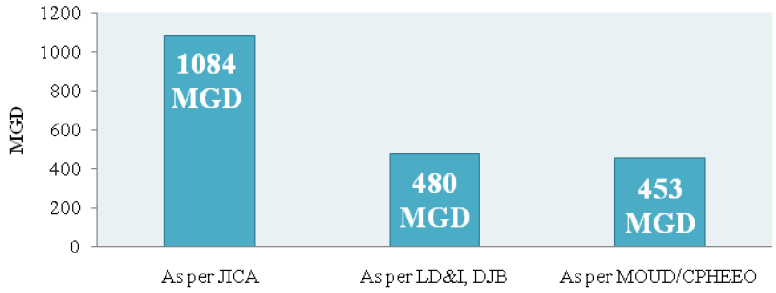
S.No.	Water Resource at a Glance	Quantity (km^3)	Percentage
1	**Annual precipitation (Including snowfall)**	4000	100
2	**Precipitation during monsoon**	3000	75
3	**Evaporation + Soil water**	2131	53.3
4	**Average annual potential flow in rivers**	1869	46.7
5	**Estimated utilizable water resources**	1123	28.1
	Surface water	690	17.3
	Replenishable groundwater	433	10.8
	Storage created of utilizable water	253.381	22.52
	Storage (under construction) of utilizable water	50.737	4.5
6	**Estimated water need in 2050**	1450	129
7	**Estimated deficit**	327	29
	Interlinking can give us	200	17.8

(*Source: Water Resources at a Glance 2011 Report, CWC, New Delhi)*

Water requirement of Delhi

Water requirement of Delhi as suggested by different institutions based on different per capita water requirements for 2011 are presented here. The institutions referred to are Japan International Cooperation Agency (JICA), Leak detection and investigation LD&I (department of DJB) and Ministry of Urban Development(MOUD) / Central Public Health and Environmental Engineering Organisation (CPHEEO).

FIG 3: Total Water Requirement of Delhi, 2011



Source: Jaladhikar:Center for social justice and democracy (2012)

The water requirement of Delhi in the year 2011 as per JICA was estimated to be 1084 million gallons per day (mgd) (274.4 liters per capita per day (lpcd) x 18 million population), as per LD&I it is 480 mgd

(126.81lpcd x 18 million population) and as per MOUD/CPHEEO it is 453mgd (119.6lpcd x 18 million population). The total water demand for Delhi is projected to be 1380 mgd by the year 2021, calculated at 60gpcd (274.4lpcd as per UK) for a population of approximately 230 lacks.[3]

Institutional and legal framework of water sector in Delhi

The urban water supply and sanitation in the National Capital Territory (NCT) of Delhi is the sole responsibility of the Delhi Jal Board (DJB). DJB was established by the Delhi Water Board Act, 1998, passed by the parliament. The earlier fragmented division of Delhi Water Supply and Sewage Disposal Undertaking were merged together to form DJB. The Board acts as the parastatal authority for all the capital works, operations and maintenance (O&M) and revenue functions related to water supply within the NCT of Delhi.

As per the Act, DJB has the responsibility of performing all the functions of urban water supply in the NCT of Delhi, but it supplies only bulk water to area under New Delhi Municipal Corporation (NDMC) and Delhi Cantonment Board. Further as per section 55 of the DJB Act, the board has the power of levying fees, charges, including development charges, rental, etc. and recovering them for the services rendered by it. The Board member of DJB comprises of selected representatives of government and therefore the state government has a major say in final decision related to tariff fixing and tariff revision. Table3 summarises the various functions of DJB as per the different geographical area of the NCT.

TABLE 3: Responsibilities of DJB with provision of water services in Delhi

Geographical Area	Water Supply Functions		
	Capital works	O&M	Revenue functions
MCD	Yes	Yes	Yes
NDMC	Yes	Bulk Supply only	Bulk payment from NDMC
Delhi Cantonment Board	Yes	Bulk Supply only	Bulk payment from Cantonment

Source: DJB

Though DJB carries out all the functions of urban water supply and sanitation of NC of Delhi, any hike in tariff has to be approved by the State Government. Thus to summarize the institutional arrangement; DJB is the sole body responsible for carrying out urban water supply functions

including capital works, O&M and revenue functions like billing etc. Further, while DJB is an autonomous body, most of its members are selected representative from government itself and hence the state government is indirectly involved in the Board's functioning.

Water resources of DJB

The DJB being the sole controller of water distribution to households of Delhi has the following water resources at its command.DJB's water resources come mainly from three rivers i.e., Yamuna, Bhakra and Ganga.

TABLE 4: Water resources of DJB in the year 2012

Source of water	Water in MGD
Ganga River	240
Yamuna River	310
Bhakhra Beas Management Board	140
Ranney Wells and Tube Wells of DJB	115
TOTAL	**805**

Source: DJB and Economic survey of Delhi 2012

The table shows that the total water resources of DJB was 805 MGD in 2012, which comes from various sources like Ganga and Yamuna rivers, Bhakhra Beas management board and Ranney wells[4] and tube wells. The major source of water to DJB is Yamuna River which supply 310 MGD and the second major source is Ganga River supplying 240 MGD. It is believed that after construction of Renuka Dam, another 275 MGD shall be available for Delhi. This dam may take more than 10 years for completion and is yet to get forest clearances to go ahead.

To assess the availability of water in Delhi and its feasibility, it is also important to analyze the water situation in the states with which it shares waterfrom the common pool. The states are Haryana, Punjab and U.P. These neighbouring states of Delhi have a heavy agriculture base and are the food granaries of India. The report by Central Ground Water Board(CGWB), on the groundwater situation in these states reflects a grim reality. In Punjab and Haryana, more than 50per cent of water blocks have been declared overexploited. It means these states are highly stressed for water and chances of them releasing more water for Delhi are almost impossible. Rather, it is

suspected that even the existing supply may be reduced if the issue heats up in these states. Water war between states can start any day and put Delhi in a precarious position. A studyestimates the carrying capacity of Delhi to be not more than 8 million population (Soni, 2002)[5]. It can be implied that the requirement of Delhi as suggested by JICA cannot be matched with the current availability of water resources of Delhi.

DJB has to treat the water before it is supplied to the households to bring it above the minimum acceptable level of quality. For this purpose, DJB has established various water treatment plants in different areas of Delhi. The following table shows the various plants with their installed capacity to treat water.

TABLE 5: Water treatment capacities in DJB in 2012

Sources of water	Water treatment plant	Capacity (MGD)
Yamuna	Chandrawal I &II	90
Yamuna	Wazirabad I,II &III	120
Bhakra Storage/ Yamuna	Haiderpur I&II	200
Bhakra Storage	Nangloi	40
Yamuna	Bawana	20
Upper Ganga Canal	North Shahdra (Bhagirathi)	100
Upper Ganga Canal	Sonia Vihar	140
Under Ground water	RanneyWells/ Tube wells	100
Recycling of Water	Bhagirathi, Haiderpur&Wazirabad	37
Commonwealth Games Village		1
TOTAL		**848**

Source: DJB and Economic survey of Delhi 2012

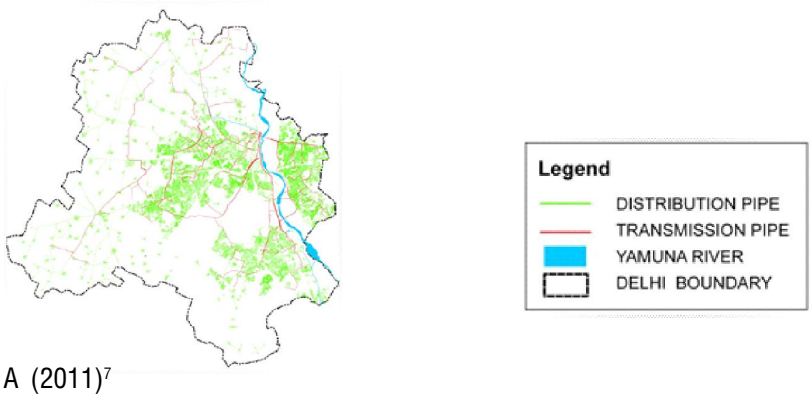
The total water treatment capacity with DJB in 2012 in 848 MGD. The largest capacity water treatment plant is Haiderpur I&II water treatment plant with a capacity of 200 MGD. This plant draws water from Bhakra storage/ Yamuna River. The second largest plant in terms of capacity is at Sonia Vihar with a capacity of 140 MGD, which draws water from Upper Ganga Canal.

Transmission and distribution of water

Treated water is first pumped from water treatment plant (WTP) through transmission pipes to around 100 underground reservoirs (UGRs) in Delhi.

Direct tapping from transmission pipes is decreasing. Length of existing transmission pipelines is approximately 700 km. About 85 percent of transmission pipes are of pre stressed concretepipes. They are being replaced because of large number of leakages. Water is boosted at UGR to large number of small UGRs/booster pumping station(BPSs) with few exception of gravitational flow in small ridge areas. Water is finally distributed from small UGR/BPS to consumers (JICA, 2011)[6]. Figure 4 shows that the distribution pipeline are highly concentrated in some places and very scare in other parts of Delhi. This shows the uneven distribution of pipes. The following figure shows the spread of transmission and distribution pipeline in Delhi.

FIG 4: Spread of transmission and distribution pipelines in Delhi



Source: JICA (2011)[7]

Effectiveness in Supplying water

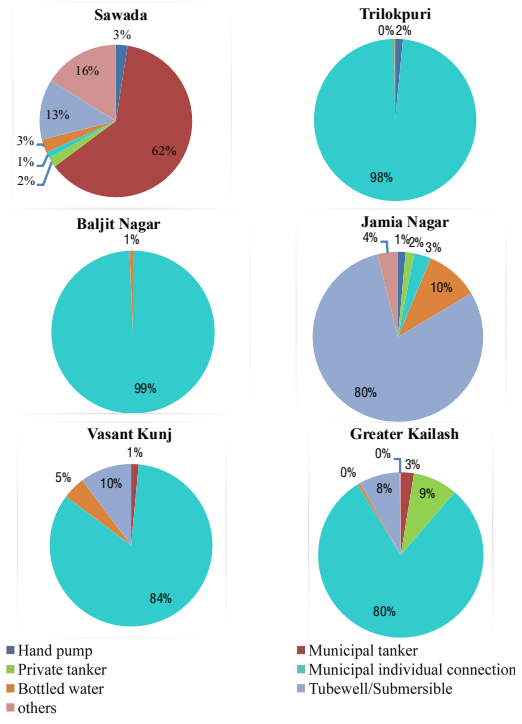
Effectiveness in supplying water is a crucial welfare activity to be accomplished by the state. We have to consider stateseffectiveness in respect of reach/penetration of municipal water in Delhi. Municipal water supply in the city is supplied by DJB, in various modes like individual connections, common tap, municipal tanker etc.

To know how effectively the end user i.e. the households of Delhi are able to benefit from the supply, share of municipal water in total water consumption by households and access to municipal water within the premises are studied through the responses of the 277 sample households belonging to different income groups from six different areas of Delhi like Sawada, Trilokpuri, Baljit Nagar, Jamia Nagar, Vasant Kunj and Greater Kailash.

Supply of water to the households in Delhi

Ahousehold can have its supply of water through many sources depending on different specific factors pertaining to a given area. Each type of source has its specific quality and characteristics like price, available quantity, quality of water etc. Hence studying the sources of water gives a fair idea about the characteristics of water consumed by the respondents. The sources considered in the paper are hand pump, municipal tanker, private tanker, tube well/submersible/boring, municipal individual connection, common tap, bottled water and others. Others include well, spring, river, canal, tank, pond, lake etc. The paper explores the difference in sources of water amongst different areas. Respondents are enquired about their source and the percentage of total household water consumption they procure from each source. Then the average percentage of water used from each source is calculated from each area.

FIG 5: Household water supply



Source: Primary data from field survey

Sawada is a resettlement colony with lowest average household monthly income. The pattern of water usage in such low income colonies can be indicated by studying the pattern in this area. There is no municipal individual connection in Sawada.Only 1 per cent of consumption here is fulfilled by municipal individual connection. Therefore, water is used from more than seven different sources. Municipal tanker is the major source of household water in this area. 62per cent of consumption is from this source. Boring water is another major source which fulfils 13per cent requirements of the area. Hand pump, private tankerand bottled water together constitute 8per cent of water used in the area. A major portion of water i.e. 16per cent is obtained from other sources.

In Trilokpuri and Baljit Nagar, 98per cent and 99per centof the household water requirements respectively are fulfilled from the municipal individual connection. Hand pump gives the rest of 2per cent water in Trilokpuri. In Baljit Nagar 1per cent is bottled water. Municipal individual connection is the crucial source in these two areas.

In Jamia Nagar municipal water either through individual connection or tanker is sparsely supplied. Only 3per cent of household water consumed is fulfilled from municipal individual connection. Hence varied sources of water are exploited in the area. 10per cent of water is sourced through bottled water. Hand pump, private tanker and other sources together contribute 7per cent of water used. Tubewell/submersible water is the major source as it contributes 80per cent of the total water consumed in the area. Tubewell/submersible water directly affects the ground water levels. This has serious implications from the policy perspective.

Major source of household water in Vasant Kunj i.e. 84per centwas taken from municipal individual connection. And 10per cent, 5per cent and 1per cent water is sourced from tube well/submersible, bottled water sources and municipal tanker respectively.

In Greater Kailash's 80per cent of household water requirements are fulfilled by municipal individual connection, 9per cent by private tanker, 8per cent by tube well/ submersible and the rest 3per cent is fulfilled from municipal tanker.

The study of source of water supply found that there is no municipal supply of water in Jamia Nagar and so boring water is the major source used in this area. It contributes 76 percent of the total water consumed here. The unchecked use of boring water in Jamia, directly affects the ground water levels. In Sawada, municipal individual connection is not available. Water used here is from more than seven different sources. The major source of water in this area is municipal tanker. The major source of water in other four areas i.e. Trilokpuri, Baljit Nagar, Vasant Kunj and Greater Kailash is municipal individual connection.

Delhi has inadequate raw watercausing insufficient water supply. The study also found that the distribution of the available water is not even. There are large disparities within the areas when we compare the frequency and duration of municipal water supply. In Sawada, the municipal tanker comes once in two or three days, which is also not fixed.Residents drink stored water, which sometimes is contaminated with mosquitoes, germs etc.Some respondents buy boring water from neighbouring households and therefore are dependent on them. This points towards the seriousness of ineffective penetration of municipal water in Delhi. This also has opportunity cost and adverse health effects for the people.

Baljit Nagar gets supply seven days a week for only an hour in a day.During hot season, sometimes the supply reduces to 15 to 20 minutes only. Short duration and low pressure leads to acute water shortage in summers. This is more severe when there is no electricity at the time of water supply as motor cannot be used to pull water.Jamia Nagar has no municipal supply at all.There is no supply in Jamia Nagar and no daily supply in Sawada hence the problem of these two areas need to be addressed immediately.

Conclusion

Availability of water per capita in India is falling and hence immediate and steadfast action by the government is required.In the year 1975, India was within the range of adequate water availability, now it came under the stressed level of per capita water availability.

The water requirement of Delhi in the year 2011 as per JICA was

estimated to be 1084 mgd and the projected total water demand is1380 million gallons per day(MGD) by the year 2021.Delhi shares its water from the states of Haryana, Punjab and U.P. These neighbouring states of Delhi are also highly stressed; water war between states can start any day and put Delhi in a precarious position.

The falling availability of water and continuous increasing demand has a huge impact on Delhi's water supply. It can be implied that the availability of water cannot be matched with the requirements of Delhi. With the stressed water availability, household income determines the purchasing power of the family and this has direct effect on the consumption pattern of the households. The consumption pattern helps in analysing effectiveness of municipal supply in reaching to different income groups.

In the year 2011, 75.2 per cent of households got drinking water from taps with treated source and 6.1per cent got from taps with untreated water source, rest of the households use drinking water from other sources. Through the years, reach of safe drinking water has improved but still it is not up to the mark. Municipal individual connection is the major source of drinking water in areas where this source is available. In areaswhere municipal water is not connected in houses, there people go for varied sources like municipal tanker, boring water, bottled water etc.Sawada that is thearea with least income households, drinks water from municipal tanker. Jamia Nagar buys water cans from private vendors.

Whenever there is shortage of any resource it leads to inequitable distribution of the resource. The lower income groups are the worst affected. If the resource is a luxury good or not a necessity then it does not have serious repercussions but in the case of necessary goods, inequitable distribution leads to serious repercussion. Thus, if lower income group is not able to get bare minimum water required to live in good health and hygiene then there is a doubt that our state is living up to its welfare motive.

All the above findings of researcher, points that the reach of water supply in Delhi is not equitable. Problems are unique to each area. And some of these problems are severe. Hence, in this sense the reach and penetration of water supply in Delhi is not effective in providing the basic

requirements of water to all.

End Notes

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2. Global Water Initiative' (June 2005), GEF International Waters Conference, the Coca-Cola Company
3. 1 gpcd = 4.55 lpcd (UK), 1 gpcd = 3.785 lpcd (US). Here calculation is according to UK. Differences in figures at places in the study are due to this difference in conversion rates used by various studies.
4. Ranney installed the first horizontal collector well in the 1920s. These high-capacity wells offer an alternative to fields with many vertical wells. Ranney wells comprise a central concrete caisson—typically 16 feet in diameter—excavated to a target depth at which well screens project laterally outward in a radial pattern. In a practice referred to as riverbank filtration, the wells are designed to induce infiltration from a nearby surface water source, combining the desirable features of groundwater and surface water supplies. For detail refer to http://en.wikipedia.org/wiki/Ranney_collector
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