

A Study of Ground Water Resource Condition: Quality and Quantity in Southern Area of Delhi Region

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Abstract: *This research paper deals with the groundwater resource conditions in terms of quality and quantitative potential of south Delhi area. This paper highlights the different aspects of water resource management of south Delhi.*

Keywords: Groundwater, south Delhi, quantity and quality

1. Introduction

Water is an essential and vital component for our life support system. In tropical regions ground water plays an important role as there is a fluctuation and increase in contamination of surface water resources. Ground water has unique features which render it, particularly, suitable for public water supply. It has excellent natural quality, usually free from pathogens, colour and turbidity and can be consumed directly without treatment.

1.1 Study Area

Situated on the banks of river Yamuna the city is mainly supplied by surface water from Yamuna, Ravi and Byas water (Bhakhra storage) and Ganga water.

Delhi, the Capital of India covers an area of about 1485 sq km. and lies between latitudes $20^{\circ} 14' 15''$ and $20^{\circ} 53' 00''$ (North), and longitudes $76^{\circ} 45' 30''$ and $77^{\circ} 21' 30''$ (East). The territory is situated at 216 m above mean sea level. Delhi is facing multifaceted problems regarding water availability quantity and quality, and in Delhi, South Delhi is facing immense population growth and rapid urbanization and this has led major problem such as water supply.

South Delhi district is one of the nine districts of National Capital Territory of Delhi which came into existence from Jan. 1997 when Delhi was divided into nine revenue districts. Prior to that there used to be only one district for whole of Delhi with district head quarter at Tis-Hazari. South Delhi Having its district Head quarter at M.B. Road Saket, Areawise, South District is the third largest district of Delhi spread over 249sq.km and covering 16.7% of the total area of National Capital Territory of Delhi .Total population of the district is 22, 62,375. 8.11% of the total population lives in rural area. The general topography of the district is plain. However some part of the District represents the ridge characteristics of the old Arawali hills

1.2 Meteorology of the Study Area

The rain fall in Delhi is confined to the months of July, August and September(i.e.90%) and rest of the 10% in the other nine months .According to Meterological Department the average rainfall is about 611.0mm per year with the humidity varying from 17%-89%

1.3 Geology of the Area

The study area of South Delhi, occupies thick alluvium. The Delhi System of rocks are mainly formed due to the extension of the Aravali hills .The Geochronological Order of the area can be studied as follows:

1.4 Geochronological Order of the Region

Delhi System: Mainly Quartzites along with the weathered Products of clay, sand stone and crushed stones at place. The recent Alluvium of the area is mainly due to Yamuna and its tributary rivers. However, these Alluviums are of Quaternary age.

2. Scope and Objectives

Ground water is the most important source of the domestic ,industrial and agricultural water supply in the world .There is an overwhelming need for information related to exploration ,protection ,and qualitative ,quantitative evaluation of ground water resources .In many parts of world ,especially in the developing countries ,the population growth has created an unprecedented demand for water for industrial, agricultural and drinking water purposes ,competing for the same a finite resource. The presence of geogenic contaminants in ground water for example arsenic and fluoride in toxic levels has posed major environmental health risks of the present century. Several million depend on arsenic and fluoride contaminated ground water for drinking purposes that endangers public health. Urgent solutions are required that are based on quality research and sound scientific principles. Over 99% of the world's fresh, available water is ground water, yet the vast majority of financial

resources are directed to surface water found in rivers and lakes. This serious imbalance requires urgent redress. Significant financial support is required for basic ground water research if sustainable development is to be a realistic goal. As a fresh water resource; ground water has major advantages over surface water.

3. Methodology

3.1 Ground Water Status

The Delhi water resources consist of both surface water and ground water. The surface water sources are presently the Yamuna, Bhakra and Ganga rivers. Water from the Yamuna river is abstracted both directly from the river at Delhi and indirectly via the Western Yamuna Canal, which also delivers water to Delhi. Raw water from the other two rivers is conveyed via the Upper Ganga and Bhakra 9(Narwana Branch) canals respectively. The water allocation from the three rivers for the Delhi Jal Board is, in million gallons per day (MGD):

(404MGD) from the Upper Yamuna River Board,
 (267MGD) from the Bhakra-Beas Management Board
 (269MGD) from the Ganga river

The total of (940 MGD) theoretically available, translates into an actual availability of (820 MGD) due to losses from the canal systems and capacity Limitation in the raw water transmission to one water treatment plant from the Western Yamuna canal.

Most of the surface water is treated at five plants; Chandrawal, Wazirabad, Haiderpur, Bhagirathi and Nangloi. The rated capacity of these five treatment plants is (550MGD), Groundwater is also abstracted to augment supplies. Nine wells taking water from the Yamuna river channel bed (the so-called Ranney wells) produce about (22MGD), which some 2300 tube wells spread throughout Delhi add another (41MGD) to supplies. In total, the Delhi Jal Board is presently producing about (640 MGD) OF water.

3.2 Water Supplies

According to Delhi Jal Board data for 2001-2002, (330MGD) water was distributed and charged to various categories of customer as shown in table below.

Table 1: Data from Delhi Jal Board

Category	Number of Connections	MGD	Percentage of Sales
Domestic	1,331,820	247	75%
Commercial and Institutional	52,623	34	10.5%
Industrial	10,876	13	4%
Bulk supplies to DCB and NDMC		35	10.5%

In addition, the following free, non-metered supplies, are given by Delhi Jal Board

Stands posts (11,533 no.) (49 MGD) (Consultant's estimation),
 Water tankers (493no.) (2MGD) (Consultant's estimation)

If follows that, in 2001/2002, (311), i.e.49% of water produced, was the amount of water that was not recorded as billed consumption and does not generate any revenue (non-revenue water or NRW). This is an unacceptably high level. However, the nonmetered supplies through tankers and stand posts account for an estimated 8% of water produced, about a sixth of the NRW. The situation on the ground clearly demonstrates the recent water supply situation in Delhi to be poor.

A look at the total water demand for all of Delhi indicates the extent of the shortage of potable water supplies in Delhi. The year 2004 total water demand is estimated to be about 600 MGD. With real losses at 40% of water produced the actual supply is giving a supply shortfall of some (216MGD), Meaning that DJB satisfy only 64% of the total estimated demand of Delhi. The demand –supply imbalance is exasperated by the high level of losses.

3.3 Water Quality Treatment

The quality of raw surface water is such that it requires treatment. This is mainly to deal with turbidity, which is normally low but can reach seasonally very high levels (5000 NTU). Some pollution of Yamuna River water has been noted in the past (high ammonium) but this is presently controlled to an acceptable level.

The quality of groundwater varies with location and depth some areas as Delhi has brackish water at shallower depths. A significant proportion (30%) of groundwater samples exceeds the permissible limit for fluoride. Nitrate pollution is also apparent in the south-west and north-east areas. The Ranney wells in the Yamuna riverbed show indicators of faecal pollution with some wells having high concentration of ammonia and iron.

Treatment of surface water follows a conventional process of sedimentation, coagulation/flocculation, and rapid sand filtration at each of five water treatment plants (WTPs). The water from the Ranney wells receives special treatment (aeration and bacteriological filtration) at a sixth treatment plant, Okhla.

Water is chlorinated both pre and post treatment plants. However, water from the numerous tube wells is not chlorinated.

3.4 Water Distribution System

The topography of Delhi is such that the difference between the highest and lowest elevation is about 50 metres. The water sources are mainly at the lower levels of the Yamuna River and the various canals that supply raw water. This situation means that all water has to be pumped to supply from the treatment plants. Booster stations have been provided in the system where needed and for onward delivery in the distribution systems.

The transmission system consists of approximately 568 km of mains in diameters ranging from 450mm to 1500mm. The vast majority of the mains are constructed with pre-stressed concrete (PSC) pipes. Some pipelines have been constructed in cast iron (older mains) and some in mild steel. The condition of the transmission mains is generally good.

There are no fewer than 495 pumping stations in the water supply system, excluding those at the water treatment plants. There are 81 main underground reservoirs associated with the transmission and distribution systems. Storage capacities at the various reservoir sites range from 1,400 to 86,370 cubic metres, with a combined total storage of 731,760 cubic metres.

4. Analysis and Discussion

The total requirement of Water in Delhi, at present is about 940 Million Gallons per day (MGD). Main sources for Delhi water are both surface and ground water. Out of the total 940 MGD water only about 820 MGD reaches the reservoirs of Delhi. Situated on the banks of the river Yamuna, the city is mainly supplied by surface water from the Yamuna, Ravi Beas water (Bhakra storage) and the Ganga water.

The water availability from surface water sources, viz. Yamuna Ganga and Bhakra system is approximately 1150 MCM per year (million cubic meters) and of this 60% is available Yamuna River.

Most of the surface water is treated at five plants. The surface water after treatment in the five treatment plant comes out to be 550 MGD. Ground water in Delhi is also extracted from nine Ranney wells which produce about 22MGD each and 2300 tubewells which produce about 81 MGD of water. The South Delhi area requires about 250 MGD water out of which 98 MGD surface water and 58 MGD groundwater is available currently. In all 156 MGD is available for South Delhi. However, in due course of time the shortage may be fulfilled through 140 MGD Scheme of Sonia Vihar Yojna.

The quality of underground water is also deteriorating and in several places it has been found to be unfit for human consumption. South Delhi consists of many unplanned jhuggi jhopri and slum clusters, by virtue of which, the ground water in huge quantity is further abstracted from the ground in unplanned manner. Salinity hazard is also a major threat for underground water quality.

4.1 Interpretation

- Rapid pace of urbanization, leading to reduction in recharge of aquifers.
- Increasing demand in agriculture and industrial sectors as well as domestic needs for the ever growing population.
- A change in cropping pattern in order to raise cash crops in certain areas.
- Stress laid on ground water extraction during drought periods when all other sources shrink.

- Unplanned withdrawal from shallow aquifer.

5. Conclusion & Recommendation

It is suggested that artificial recharge is the process by which the ground reservoir is augmented at a rate exceeding that under natural conditions of replenishment. Any man made scheme or facility that adds water to an aquifer may be considered to be an artificial recharge system.

In order to check the water level declining trend, especially in South Delhi area, needs dry land vegetation species, because a major portion of the groundwater has been exploited for horticulture in South Delhi area which is considered to be 2,000 litre/hectare/day for maintenance of green belt.

It is seen that the recycling of Delhi water is only 17% and rest of the waste water goes to river Yamuna. If the recycling potential increases this will not only fulfill the gap of demand and supply but also prevent the Yamuna River from further pollution. The recycled water may be gainfully utilized for horticulture purpose.

Delhi area is facing a major gap between demand and supply and it is seen that water leakage and illegal tapings of water is about 95 MGD for entire Delhi and about 37 MGD of water has been illegally tapped in South Delhi itself.

It is, therefore, recommended that the recycling measures and controlled distribution system with other surface water schemes may be undertaken and artificial recharging of ground water using Rainwater Harvesting system may further improve the ground water condition of the area in South Delhi.

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