ABSTRACT

"Improvement in Ground Water Quality Using Rainwater Harvesting System in Dwarka Subcity, in New Delhi"

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Today, the entire world is paying its attention to the water crises, specifically to increase the water resources and to meet the growing requirements of drinking water. The ground water is main source of the drinking water, which is used for the other purposes also. But the problem of the water is increasing day by day worldwide. In view of this, the research initiative has been taken to understand the water problems in Dwarka subcity of Delhi and to give proper solution. It was estimated that with the growing demand of the food production the consumption pattern will increase as the time proceeds. The studies suggest that in Delhi there is a continuous decline in the water level i.e. approx. 30 cm per year. This decline not only makes the water get scare but also brings it to saline, hampering the plant growth or vanishing the vegetation cover from the top surface of the earth. With the rapid growing demand of water due to increasing rate of industrialization and population, it is being contemplated that there will be a time when Delhi city will face the immense problems of water.

In view of the above problems, the Delhi government made it mandatory for the housing structures to have the rainwater harvesting systems as to bring down this problem. Years passed, but Delhi has rainwater harvesting systems in only approx. 8 -10 % housing structures and the problem of water seems to be as it is. Therefore the present study on ground water was conducted in the societies and housing structures where rainwater-harvesting systems are installed and where rainwater harvesting systems are not installed to get the impact of rainwater harvesting on the quality of ground water.

In this study, the ground water quality of Dwarka subcity in various societies was assessed by determining the physico-chemical and Microbiological parameters. These parameters were determined for the water in the societies before rainwater harvesting and after rainwater harvesting i.e. before monsoon during monsoon and post monsoon in the societies where rainwater harvesting systems are installed and where rainwater harvesting systems are not installed. The comparisons were made and impact of rainwater harvesting was monitored on both aspects of rainwater harvesting and non-rainwater harvesting. The impact of rainwater harvesting was monitored by obtaining the values of rainfall in most of the months of season and physicochemical properties of rainwater sample also. Also the water levels were monitored in various predetermined seasons.

For the research purpose, first of all the study was performed on the eastern part of Dwarka subcity. In this part, the water samples were collected from fifteen different stationers in May 2004, July 2004, August 2004, January 2005 & March 2005 i.e. pre post and during monsoon. These samples were analyzed by determining Physico-chemical and Microbiological parameters for all the samples to know the impact of rainwater harvesting. The parameters, which were determined, are pH, T.D.S., Alkalinity, Ca^{2+}, Mg^{2+}, Total Hardness, Dissolved Oxygen, Biological Oxygen Demand, Cl^- and SO_4^{2-} NO_3^- NO_2^- and Coliform. Two more samples of rainwater were collected during the rainy seasons and all same parameters were determined. After analysis, the parameters for most of the samples were found within the permissible limits prescribed by WHO and Bureau of Indian Standards. The remarkable aspect, which was experienced, was that after monsoon seasons some indicative parameters were found declining indicating that the salinity of ground water is going down. Also, after rainwater harvesting the microbiological parameters in the ground water in most of the samples were found within the permissible limit prescribed by WHO and Bureau of Indian Standards.

Further, the samples were collected from the west part of Dwarka subcity. In this study two types of study stations were selected. One, where rainwater harvesting systems were installed, and other where rainwater-harvesting systems were not installed. Five samples were collected where rainwater-harvesting systems were installed whereas four

samples were collected from the sites where rainwater-harvesting systems were not installed. Each nine ground water samples were collected in July 2006 when it was almost no rain. The samples from the same sites were then again collected in October 2006 after the rainy season. One more rainwater sample was collected in rainy season in the month of September 2006 for determining the physicochemical parameters. Additionally, the rainfall was monitored in the rainy season in the month of June, July, August, September and October. Arranging all these data the physico-chemical & microbiological parameters as mentioned above were performed and impact of rainwater harvesting was analyzed on these parameters. After the rainwater harvesting and during rainy season in the month of September the increase in water levels in all the study stations were observed. In the stations where rainwater harvesting systems were installed, the increase in water level after rainwater harvesting were 3 ft, 2 ft, 1.7 ft, 2.5 ft and 1.5 ft i.e. for the sites of samples no. 1, 2, 3,4 & 5 respectively. However an increase of 1.5 ft, 1 ft, 2.1 ft & 3.1 ft in the water level was observed respectively for the sites of samples no. 6, 7, 8 & 9 where no harvesting systems were installed. Therefore the rate of increase in water level was found higher in most of the samples where rainwater-harvesting systems were installed. The water levels were again checked after four months after rainy seasons. The decrease in water level due to the summer season was found from 2.4 ft. to 3.5ft. in the stations where rainwater harvesting systems were installed. This range was found from 2.5ft. to 4.2 ft. in the stations where no rainwater harvesting systems were installed. The determined physico-chemical and microbiological parameters report that the rate of decrease in salinity and indicative parameters in ground water were found higher in the stations where rainwater harvesting systems were installed than the stations where rainwater harvesting systems are not installed. In the stations where rainwater harvesting systems are installed the percentage decline in TDS were 2%, 11%, 45%, 48% & 50%, where as it was 1%, 9%, 10% & 60% in non installed rainwater harvesting systems. All percentage decline data of physico-chemical parameters show that overall rate of decrease in the indicative parameters were higher in the stations where rainwater harvesting systems are installed than the stations where rainwater harvesting systems are not installed.

Further, the study was conducted for the samples in which fifteen samples were analyzed in July 2004 & Jan 2005. In addition one study was conducted on the nine samples analyzed in July 2006 & October 2006. For these water samples the values of some important heavy metals like Fe, Cu, Ni, Co, Cd, Pb, Hg, Zn and Cr were determined. These parameters determined after rainwater harvesting were found declining showing the reasonable impact of rainwater harvesting on the quality of ground water.

In last portion of the study ten samples from different locations of Delhi and adjoining Greater Noida were selected for the comparative study on the geochemical impact of rainwater harvesting on the ground water. During study, samples, No. 1 & 2 were collected from North Dwarka subcity. On sampling station of sample no.1 rainwater-harvesting system is installed whereas on the station of sample no. 2, it's not installed. Samples, no. 3 & 4 refer two societies of Greater Noida. Sample no. 3 was collected from Silver City, sector 50 where rainwater-harvesting system is installed. Whereas sample no. 4 was taken from another society of the same sector approximately 500 meters away from silver City, and here no rainwater harvesting system is installed.. Samples No. 5 & 6 were collected form New friends Colony. Sample No. 5 was collected from New Friends Club where rainwater harvesting is installed, whereas sample No. 6 was taken from another place that is approximately 450 meters away from New Friends Club and has no rainwater harvesting system. Sample no 7 was collected from one of the stations of Nizamuddin East Colony where rainwater harvesting is done. Whereas sample no. 8, was collected from another station, approximately 400-500 meters away from the site of sample no 7. Sample no. 9 was arranged from a rainwater-harvested location of Jamia Millia Islamia near to Procter office. Another location was selected for non rainwater harvesting place approximately 300-400 meters away from the site of sample no 9. These samples were collected in July and October 2007 for determining physicochemical parameters. One additional sample of rainwater during the monsoon in the month of August 2007 was also collected and analyzed. Rainfall in the months of June, July, August, September and October of year 2007 was arranged from metrological department of Delhi. Moreover the soil strata chart of all ten study stations were examined to know the geochemical impact on rainwater harvesting.

Studies show that the ground water quality of the locations with subsurface strata having sand is quite good as compared to the locations where clay is predominantly found. It is due to the fact that sand is highly porous due to which transmissibility of the ground water through it is good and at the same time it gets sufficiently filtered when it reaches to the under ground aquifer.

In view of the present work, it has been discovered that rainwater harvesting has its remarkable importance to improve the ground water quality, to increase the ground water level and to decline the salinity and indicative parameters. It has been suggested therefore that if rainwater harvesting is done with predetermined plane and scheme, the problems of water crises may be removed.

- by Javed Hasan

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