

Assessment of Roof-top Rain Water Harvesting Potential in South Delhi, India: A Case Study

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Abstract

Rain water harvesting is receiving increased attention worldwide as an alternative source of water. The present study has been undertaken to assess the potential of roof top rain water harvesting technique in the sustainable development of water resources of South Delhi region, by analysing the facts and figures related to the per capita per day demand. The study further aims to bring an insight of roof top rain water harvesting that can effectively be employed by every individual without much technicalities. Comprehensive field surveys were carried out to collect relevant data that were analysed in context to the actual average annual water consumption of each household and the volume of rain water collected annually from an individual respective roof top. Per capita demand of each individual was evaluated which revealed that per capita demand in some of the selected households exceeded the maximum limit of 250 lts/day per person (i.e. up to 375 lts/day per person) as recommended by the Bureau of Indian Standards (BIS). The roof top rain water harvesting technique if adequately employed in the study area revealed a noteworthy potential ranging from 11.43% to 71% that could be served to an individual annual water demands. The study proposes the curtailment of 20% in the per capita demand of each individual. After curtailment of 20% in per capita demand, the percent increase in the potential of roof top rain water harvesting was significant that ranged from 5.95% to 69.28% for selected colonies. The present study finds its usefulness in developing awareness towards judicious use of water among masses and efficient ways to harvest rain water for sustainable management of water resources at an individual level.

Keywords: Roof top rain water harvesting, per capita demand, roof top potential, sustainable development of water resources, Bureau of Indian Standards.

1. Introduction

Water is an essential component in every aspect of life and must be valued and safeguarded. The National Capital Region (NCR) is a water scarce region but can have sufficient water if rainwater is harvested and managed properly. There has been a lack of emphasis of planning and development of ground water sources including recharge through rainwater harvesting (RWH) and other schemes to harness the potential of water in south Delhi necessary for sustainable development. Rainwater can be considered as a source of freshwater supply in regions where the rainfall is characterized by short heavy rainy periods with long intervals of no rainfall, as in our country.

The concept of RWH is both simple and ancient and systems can vary from small and basic, such as the attachment of a water butt to a rainwater downspout, to large and complex, such as those that collect water from many hectares and serve large numbers of people (Leggett et al, 2001). Before the latter half of the twentieth century, RWH systems were used predominantly in areas lacking alternative forms of water supply, such as coral islands (Datar, R. 2006; Devi et al 2005) and remote, arid locations lacking suitable surface or groundwater resources (Tripathi and Pandey 2005).

The present study aims to assess the potential of rooftop rain water harvesting by comparing the annual water demand to the volume of water collected by RWH from individual household roof catchments in south Delhi. The study further evaluates the percent increase in rooftop RWH potential by curtailing 20% in the per capita demand per day of an individual in lieu of increasing water wastage at domestic level and also proposes the efficient ways to harvest domestic rain water for sustainable management of water resources.

2. Study Area

The study area belongs to south Delhi region which covers Okhla (covering localities such as Jamia nagar, Shaheen bagh, Abul Fazal Enclave, Noor nagar extension, Gaffar Manzil, Johri farm), Sarita Vihar, Sarai Julena and Jasola localities. Extensive field surveys were conducted to gather information regarding selection of residential buildings within study area, total floors in each building, number of flats per floor, number of persons residing in each flat, gross capacity of water tanks of individual building, and number of times in a day water tanks are filled completely. Rainfall data of ten year duration was procured from Indian Meteorological Department (IMD), New Delhi for evaluating the total average annual rainfall to be utilised in determining the rainfall yield from the domestic household rooftop.

3. Data Collection

A descriptive field survey method using key informant interviews was used in the present study. A total of 20 residential buildings covering Okhla, Sarita Vihar, Sarai Julena and Jasola localities were selected to evaluate the potential of each individual building towards harvesting of the rainwater from the rooftop. Regular field visits were carried out for a period of one year, i.e., from May 2010 to April 2011 so as to collect the data pertaining to the number of persons living in each flat of a selected building and their corresponding over head water storage capacity. Data regarding number of times in single day overhead water tanks were completely filled was collected and was registered in the surveyor’s performa. Other necessary details collected included the capacity of each water tank per flat and measurement of the roof top area. It was observed that during peak summer season the overhead tanks were filled twice on a daily basis and once during winter season.

4. Results and Discussion

The collected data was organized logically into systematic patterns and themes from which the average annual consumption of water for each selected building was determined. The volume of rain water collected from each building was calculated using Eq. (1);

$$\text{Annual RWH Yield (m}^3\text{)} = A \times R \times C \tag{1}$$

Where, A is the area of the catchment in (m²), R is the average annual rainfall in (m) and C is the runoff coefficient. Gross annual water demand of each building and corresponding volume of roof top rain water harvested were compared and potential of roof top rain water harvesting was towards annual demand was evaluated.

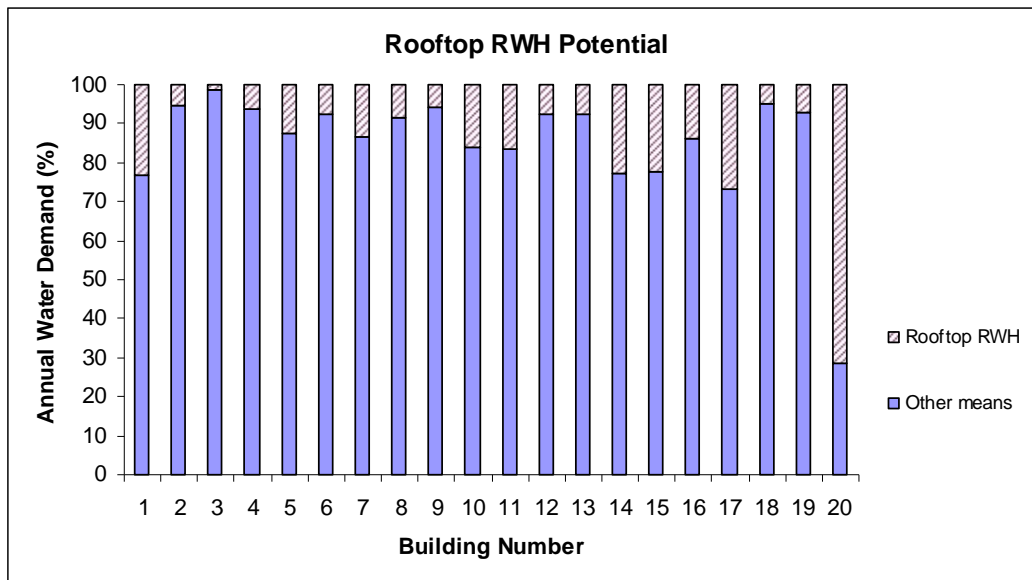


Figure 1: Potential of roof top rain water harvesting in selected buildings of south Delhi region.

Results indicated that the potential served by roof top rainwater harvesting in the selected building is significantly low in terms of the water consumption practices of each house hold. Building number 2 in Shaheen bagh, building number 4 in Johri farm (Jamia Nagar), buildings numbered 6, 8, 9, 12, 13, 18 and 19 (covering Abul Fazal Enclave, Sarita vihar, DDA MIG and HIG Jasola) revealed less than 10% potential served by harvesting roof top rain water. However, remaining buildings situated in Gaffar Manzil, Okhla Head, DDA flats Sarita Vihar showed noteworthy potential that could be served by harvesting rain water at roof top and the values ranged from 11.43% to 71% respectively. Quantitative results are shown in Figure 1.

The inferences that can be traced out from the results in Fig. 1 are majorly attributed to the fact that water in most of the localities was treated as unvalued resource. Also, there was unanimous agreement between all members interviewed in their professional capacity that the real issue with rainwater utilisation and management in south Delhi is that water is perceived to be an abundant resource that is supplied cheaply, therefore it is not valued.

To analyse the net daily consumption of an individual in every flat (household), actual per capita demand of a person per day was evaluated based on the data collected during the field surveys. It is observed that the actual per capita demand per day of an individual lies in the range from 142.9 to 375 which in most of the households is far more than the maximum prescribed range i.e. 250 (as per BIS). The high per capita demand of an individual in the selected buildings confirms to the above statement that water is being utilised more than the requirement.

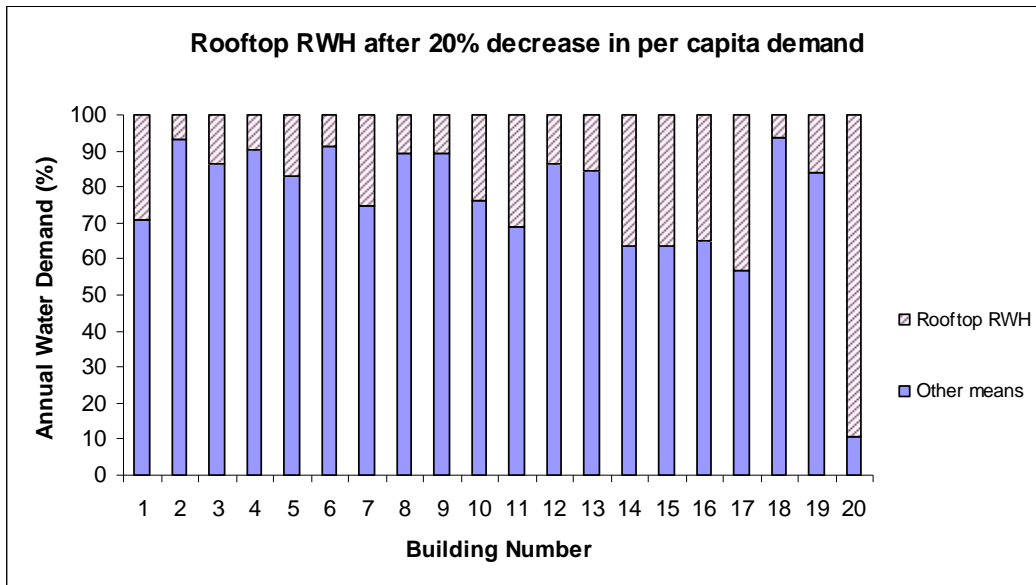


Figure 2: Potential of roof top rain water harvesting in selected buildings of south Delhi region after 20% curtailment in per capita demand of every individual.

The roof top rain water harvesting technique can prove to be enormous supplement to our existing resources if it is utilised wisely and judiciously. The potential of harvesting roof top rain water can be increased if every individual curtails at least 20% of his usage per day. Results revealed that the potential of roof top harvesting increased for each selected building and the range varied from 6.95% at the lower end to 89.3% at the higher end as illustrated in Figure 2 in the form of bar charts. It was observed that there was significant increase in the percent potential of every selected building and ranged from 5.95% (Noor Nagar, Jamia) to 69.28% (Jasola HIG, DDA Flats). It therefore implies that on a curtailment of mere 20% in our daily consumption could lead to about 70% increase in the roof top rain water harvesting potential.

5. Conclusions

The roof top rainwater harvesting technique employed in the selected buildings in south Delhi showed noteworthy potential that could be served by harvesting rain water at roof top and the values ranged from 11.43% to 71% respectively. To analyse the net daily consumption of an individual in every flat (household), actual per capita demand of a person per day was evaluated and it ranged from a minimum of 142.9 to a maximum of 375 which is far more than the maximum prescribed range i.e. 250 (as per Bureau of Indian Standards; BIS). The high per capita demand of an individual in the selected buildings confirms to the above statement that water is being utilised more than the requirement. With 20% curtailment in daily water consumption of an individual the potential of roof top harvesting increased for from 6.95% at the lower end to 89.3% at the higher end. It therefore implies that curtailment of mere 20% in our daily water consumption could boost upto 70% increase in the roof top rain water harvesting potential. The study concludes with the belief that “lack of appreciation of the need to manage waters in an integrated way according to ecosystem principles, including the fact that water is not an unlimited resource”.

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