# Domestic Rainwater Harvesting
# Some applications in Bangalore, India

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**Introduction:** Rainwater harvesting has gained tremendous interest among academics, institutions, media and laypeople especially in the past few years all over India. While rainwater harvesting has a broad generic description in the rural context as water collected mainly for agriculture purpose in dry land and tank irrigated area, rooftop rainwater harvesting has a clearer definition as water collected from rooftops chiefly for domestic consumption. In this paper rooftop rainwater harvesting refers to the process of collecting, filtering and storing water for domestic use. Storing can however mean actual storage in tanks and sumps or recharging groundwater either through open wells or deep bore wells.

**Background:** Bangalore, located at 12 58 ´ N latitude and 77 35´ E longitude and at an average altitude of 921 MSL, encompasses 1279 square kilometre of Comprehensive development area with a current population of nearly 6 million. It has received tremendous attention from international investment companies especially the software sector. This attention is attributed to various factors including a salubrious climate, skilled manpower availability, and a large number of educational institutions amongst others. The city's expansion has also contributed to tremendous strain on physical infrastructure including water. Water for the city has to be pumped from the river Cauvery that is at a distance of 90 kilometres and at 400 MSL i.e. 500 metres below the MSL of Bangalore. Huge expenditure is incurred on 50 mega watts of power required for pumping the water to the city. Additionally it is estimated that another 100 megawatts of power is required to pump the water from sumps to overhead tanks by households At present about 698 million litres per day is being pumped to the city. Augmentation projects under implementation will result in 1500 MLD being brought to the city by the year 2005. Yet according to the Bangalore Water Supply and Sewerage Board (BWSSB), the sole institutional service provider of water, their will be a shortage in water requirements of the city to the tune of 495 mld considering an anticipated population of 6 million by 2001 and a demand anticipated at 200 lpcd.

While there is stress on centralised piped supply of water to the city, surface water bodies like lakes and tanks, which were traditional sources of supply, are on a steep decline coming down from 262 in 1972 to about 82 by 1999. The existing 82 surface water bodies are also polluted with sewage since only about 40% of the city is covered with underground sewage collection facilities.

Ground water in shallow wells is polluted in large areas and in the absence of pronounced easily rechargeable aquifers confined/deep ground water levels are reported to be falling due to heavy extraction. Several deep bore wells have also been reported to have run dry. In fact 9 of the 12 Taluks comprising the Structure Plan Area are declared grey or black by the Central Ground Water Board thus raising concerns about the sustainability of groundwater use.

**Rooftop Rainwater Harvesting**: A broad picture of Bangalore's water supply requirements indicates that 1500 MLD of water will be pumped in to the city by 2005 at a cost of over Rs 30000 million or more through centralised schemes whereas in an average

year nearly 3000 MLD of water is incident on the city as rain water and virtually nothing is spent on harvesting this rainwater. The current centralized water supply paradigm seems unsustainable and energy guzzling. If an alternative paradigm on more decentralized water systems harvesting rainwater, storing in households and tanks/lakes and recharging groundwater, which too is to be used conjunctively, is to be put in place then the first step could be domestic rooftop rainwater harvesting. How then can rainwater incident on the city be harvested? The issue of ownership emerges as a key concern.. Water both surface and underground is the property of the landowner. The city of 1279 square kilometres has several owners. Rainwater incident on sites is the property of a citizen owner. That on the roads has to be taken care of by at least 10 different local bodies including City Corporation, Development Authority, City Municipal Councils and a Town Municipal Council. Once it reaches a low-lying tank or lake it becomes the property of the Forest Department of the Government of Karnataka. Underground aquifers are linked to the right to land and there is no legal jurisdiction of the State to control its appropriation. For rainwater harvesting obviously a 'cascade capture' strategy would be ideal. Capture rain at the highest points that it lands and use it. At a house level the highest point is the rooftop. Since common property resource issues and the tragedy of the commons syndrome has to be faced in larger level water harvesting, domestic rainwater harvesting with its private control on water offers a short-term implementable solution. On sensitisation of its potential, rainwater harvesting can perhaps be scaled up to neighbourhood and micro-watershed levels.

**Data and Records:** Fortunately Bangalore has uninterrupted rainfall records from 14 th July 1868. The rainfall pattern in Bangalore is bi-modal with peaks in May and October. Rainfall is also well distributed with the average rain of 970 mm- average for the last 10 years and also the average for 30 years from 1951 to 1980- occurring over nearly 60 rainy days. 85% rainfall occurs between 4.30 p.m. to 4.30 a.m. In an average year of rainfall a 100 square metre roof area would theoretically generate 97,000 litres of water of which about 77600 litres could be harvested assuming 80% capture efficiency. With a consumption of 100 lpcd and a family size of 4 rainwater should theoretically suffice for 194 days in a year. How then should the process happen?

**About the Rainwater Club:** A small group of architects and engineers met and started the rainwater club in 1995 to examine the possibility of domestic rooftop rainwater harvesting in Bangalore. A practical implementation was taken up in a residence at Vidyaranyapura, a suburb of Bangalore. Initial results were encouraging both in terms of quality and quantity of rainwater harvested probably facilitated by the fact that 1995 was a good year for rainfall.

The next step for the group was to collect information on rainwater harvesting. The Indian Metrological Department provided daily rainfall data at a cost. A small computer model was made based on the daily rainfall data for 5 years and the attempt was to estimate an optimum storage system for the Bangalore context. It emerged that 6000 litres for a 100 square metre roof area was an optimum size for a family of 5 consuming about 100 lpcd.

A look at construction revealed the fact that typically housing was coming up in the suburbs of Bangalore. These were also typically single storied or two storied. Water lines from the city supply not having reached these areas, residents were typically dependent on bore wells for water supply. Sometimes water was purchased from private tankers. A tanker load of 6000 litres costing about Rs 200/-. To store water during construction, sumps were built and these would also be 6000 litres so as to fill up a tanker load completely. Coincidentally this happened to be the exact optimal storage requirement for rainwater harvesting. This made it easier for implementation using the sump as storage.

Subsequently we estimate that more than 600 houses, institutions and industries in Bangalore now harvest rainwater. With the assistance of Rotary Northwest Bangalore a booklet in English and Kannada has been brought out suggesting in simple language, with graphics and cartoons, as to how rooftop rainwater can be harvested. A web site has been created in 1997 www.rainwaterclub.org again in Kannada and English to facilitate greater outreach.

**Lessons:** Some of the lessons learnt by the group during implementation of Rooftop rainwater harvesting include:

- There is widespread lack of awareness about both quantity and quality of rainwater and rooftop rainwater harvesting systems. Professional architects and engineers are also unaware of this possibility. Even such matters as the number and size of down-pipes from roofs, the intensity of rainfall for which down pipes have to be designed and where to place them is unclear to many.
- An impression is prevalent that rainwater harvesting means only recharge of groundwater through percolation pits and trenches. Otherwise if rainwater is to be stored, huge storage sumps or tanks are called for. This impression seems to be based on press advertisements by the Central Ground Water Board and information from the newspapers particularly from Chennai city.
- The necessity to integrate design of rainwater water harvesting with conventional building practise i.e. to interfere minimally is of great importance in reducing cost. The ideal system in Bangalore is one where rainwater is stored in sumps and the surplus used for recharging borewells.
- The best idea is not to start with rainwater harvesting for the full roof, if down pipes are spread all round the roof, but to begin with lowest cost options covering part of the roof and allow people the feel of the system including rainwater availability. Once a portion of the roof is covered for harvesting, consumers notice other rooftop rainwater going ‘waste’ from areas not covered and are themselves motivated to invest in capturing all rooftop water.
- The awareness that industries and institutions benefit hugely because of high tariff on the one hand and the usually large roof area available on the other. Water tariff for industries at Rs 60/- a kilolitre is the highest in India therefore payback periods for rooftop rainwater harvesting systems are shorter.
- That rainwater harvesting does not make economic sense for households with access to reliable city supplies especially when water is supplied at subsidised rates of Rs 3.50/- a kilo-litre whereas production cost is Rs 15 /- a kilo-litre. To compound the problem a minimum tariff of Rs 65/- is charged from

domestic consumers irrespective of consumption. Only those environmentally minded and so concerned would go for rooftop rainwater harvesting.

- That it is new house builders in the suburbs and the periphery who do not have access to city lines and where ground water is absent or with high Total Dissolved Solids (TDS) who show the maximum interest in rainwater harvesting.
- The necessity to create a team of trained plumbers who can estimate cost and implement projects on site. Typical reaction of people being, I like the idea of rainwater harvesting but can somebody build the system for me?
- Involving the media especially the press in spreading information is critical and important. Credibility with other than Government institutions is high as are expectations in service delivery.
- Getting children involved on issues of water conservation and water harvesting. The enthusiasm and ideas from school children is extraordinary. The Rainwater Club was able to reach out to 40 schools in one month in 2000.
- The interest shown by various government institutions and officials. The Bangalore Metropolitan Regional Development Authority (BMRDA) has made rainwater harvesting mandatory before plans are approved in their area and jurisdiction. The Bangalore Water Supply and Sewerage Board also express keen interest in the issue.
- The necessity to monitor and learn from implemented projects. Especially the quality of pipes, filters and storage drums and their resistance to UV rays from the sun seems a critical determinant of the long life of components. Therefore the necessity to perhaps put in place an annual maintenance contract system if possible would be important.

**The way forward:** Several issues remain to be addressed with rooftop rainwater harvesting. Foremost among them is the issue of quality. Worries about acid rain and rooftop contamination remain. How to put in place a foolproof, cost effective treatment system at domestic level? How to test quality of rain water and ensure adequacy? Should rooftop rainwater be purely for non-potable purpose or should the choice be with the user to determine its use? Should legislation be put in place and rainwater harvesting made mandatory as seems to be the Hyderabad and Chennai model or should the strategy be one of information dissemination and people making informed choices? How to work on community based approaches of harvesting rooftop water at neighbourhood levels? How to network and share information with other groups involved in rainwater harvesting? How to minimise the upfront investment required in rooftop rainwater harvesting systems and how to convince people to look at long term benefits (Loans for rainwater harvesting systems?)? How to work on closing the water loop at household level. Is it possible say to integrate low quantity water consuming devices, grey water recycling and black water treatment with rainwater harvesting being the major source of freshwater supply and make houses independent of the city infrastructure? Would this not reduce centralised pollution loads? Most water consumption quantity apparently is for high volume sewage systems can better on-site sanitation practises not be more meaningful?

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