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POLICY BRIEF - 23

# Policy Interventions for Sustainable Water Management in Cities

## A case of Rainwater Harvesting in Bengaluru

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## Background

Urban centers are growing at an alarming rate especially in the developing world with the growth of city populations averaging 5 million people every month. Between 2009 and 2050, the world urban populations are projected to increase by 2.9 billion, from 3.4 billion in 2009 to 6.3 billion by 2050[3]. In the last fifty years, the population of India has grown by two -and-a-half times, while that of Urban India by almost five times. It is estimated that by 2030, 590 million people will live in Indian cities. It is interesting to note that Census 2011 figures point to an increase in the urban population from 28.6 per cent in 2001 to 31.2 per cent in 2011 (Census of India, 2011) even as 43 per cent of the population, currently, lives in 53 million plus cities.

Increasing urban population growth has created several challenges among which, the provision of water and sanitation infrastructure has been the most pressing, one in view of the tremendous pressures being exerted on the existing water resources. Severe water shortage, dipping ground water tables and urban flooding are some of the spill over effects of a rapidly expanding urbanisation process. Like any other cities of urbanizing countries, Indian cities too are faced with an acute water scarcity as one of the major urban concerns.

Given the magnitude of the problem, Rain Water Harvesting (RWH) serves as one of the effective solutions, to overcoming the problem of water and scarcity particularly in cities. Practices of RWH are to be found throughout history of Indian civilization. In simple terms, rainwater harvesting relates to a process of harvesting rainwater through other water sources, either naturally or artificially, directly or indirectly to be stored for regular use.

There are two main techniques involved in RWH: (1) Storage of rainwater on surface – This is a traditional technique involving structures -underground tanks, ponds, check dams, weirs – for storing water. In urban areas, a catchment is surface or paved area which receives direct rainfall viz. footpaths, roads and rooftops, parks and open spaces; (2) Ground water recharge - The percolation of excess rain water through an infiltration system to the subsurface is called 'Artificial Ground water Recharge',which is adopted for bore wells and open wells.

Plate 1: Rooftop RWH, Theme Park

Plate 2: Pavers, Theme Park

Against this backdrop, this brief aims to provide insights into the emerging trends in RWH, institutional initiatives, implementation, people's perceptions, key issues and policy options.

## Methodology

We have used both the primary and secondary data for the study. Secondary data were collected from institutions or departments concerned – Bangalore Water Supply and Sewerage Board (BWSSB); Bruhat Bengaluru Mahanagara Palike (BBMP); Bangalore Development Authority (BDA); and Karnataka State Council for Science and Technology (KSCST). Primary data was collected through a household survey carried out, using structured questionnaires. We identified two areas, namely, Girinagar and Katriguppe in South Zone for a primary survey, keeping in view the fact that a majority of the households had adopted RWH, based on discussions with the BWSSB officials.

Primary data was collected from one hundred and twenty households as part of surveying RWH structures with the site dimension of these households being 40*60 and above. Two types of questionnaire were prepared for the survey - households 'with and without' RWH structures. The questionnaire designed for households 'with rainwater harvesting structures' focused on understanding the performance of RWH structures, adherence to design, awareness and perceptions regarding RWH. The questionnaire designed for households 'without rainwater harvesting structures' focused on understanding the reasons for non-installation.

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[3] World Water Development Report 2012; Joint Monitoring Programme on Water Supply and Sanitation 2013 Update.

## RWH Context

Bengaluru is India's fifth most populous urban agglomeration. The city has seen an unprecedented increase in its geographical area and population in the last few decades. The population of the city has increased from 5.70 million in 2001 to 8.5 million, as per 2011 census. Bengaluru's urbanization process has been alarmingly unprecedented making it a challenge for the State government to meet the demands of basic services.

Of the many challenges that urban Bengaluru faces, water scarcity is one of the critical issues. A study carried out in 2014 by Bank of America Merrill Lynch indicates Bangalore as one among the five cities viz. Delhi, Kolkata, Chennai and Hyderabad to face a severe water shortage in the next few decades (Manas Sen Gupta, 2015). As opined by Mr. V. Subramanian, the President of CPP, if the necessary tasks such as Rejuvenation of lakes, re-use of treated sewage water, adoption of RWH to main valleys are not carried out properly, Bengaluru has to face a severe water famine by 2020 (Prajavani, 04.12.2011). Realising a rapid decline in the number of lakes, the state government constituted the N Lakshmana Rao committee to study the revival of lakes in Bengaluru. Several studies have highlighted the gravity of the situation and the fact that the city has lost more than half of its water bodies and two thirds of its green space in the past four decades (Sridhar, K and Kumar, S, 2012). A study carried out by Indian Institute of Science, 2015, indicates that many lakes have been encroached upon for construction of illegal multi-storeyed buildings in the lake beds, affecting the natural catchment flow with a sharp decline in the catchment yield and a deteriorating quality of water bodies. The ground water level has declined by about 10mts between 1978 and 2003 (A R Shivakumar, 2010). Many defunct wells and failed (dry) bore wells are also to be seen throughout Bengaluru.

Bengaluru has an advantage of having nearly 70 rainy days spread over the year. However, Bengaluru drainage system can handle only 30mm of rainfall in one hour. So, whenever there is a heavy downpour, the city gets flooded. Also roads have been asphalted and cemented, affecting groundwater recharge.

Bengaluru gets water from river Cauvery, about 100 km away, drawn from a height of 500mts against gravity using 71mw of electricity, involving a huge expenditure of Rs.25 crore towards monthly power charges. Bengaluru still faces an acute shortage of water supply against the total estimated demand, of 1200 MLD, while the present supply is restricted to 870 MLD, with a supply-demand gap of 330 MLD.

In order to meet the supply demand gap, BWSSB has taken the initiative of drilling bore wells for supplying water; besides, the citizens also drill private bore wells in order to overcome the water shortage problem. This has resulted not only in a rapid increase of bore wells throughout Bengaluru, but also overexploitation of ground water.

Further, the carrying capacity of storm water drains designed about 20 years ago remains the same, even though the city has expanded enormously (Times of India, 26th April, 2011). Further, storm water getting mixed up with sewage is another issue that needs a serious attention. Besides, the sewage system of Bengaluru is 80 years old and lacks the capacity of huge inflows, resulting in flooding. However, BWSSB has plans to make zero sewage storm water drains so that they are free of wastes that block rainwater flow.

Thus, BWSSB has been adopting various initiatives to improve water management, of which conservation is an important area. Bengaluru aims at addressing two issues - water crisis and urban flooding. (Deccan Herald, 4th October, 2010).

Given this backdrop, RWH has been made mandatory for households in Bengaluru city with a site dimension of 40/60 and above from 2009. Post BWSSB amendment act, there has been a gradual increase in the number of RWH installations. Bengaluru has the second highest number of rainwater harvesting structures, after Chennai with more than one lakh building having RWH structures. It is mandatory for the Gated communities to have RWH structures. Most of the renowned companies have installed RWH structures as part of reusing it for gardening and secondary purposes. Bengaluru has developed a master plan for rainwater harvesting as part of its entire Comprehensive Development Plan area of 1279 sq km. The report indicates that up to 25 per cent of the city's water requirements could be met through rainwater harvesting. South West and North East monsoons bring in rains to Bengaluru on an average of 60 days between April and November. In Bengaluru, up to 77,600 liters of water can be harvested from a surface of 100sq mts. It suffices a 4-month water needs ranging from 8,000 to 10,000 liters.

## Role of Institutions in promoting RWH

Bengaluru has been proactive in promoting RWH. Bangalore Water Supply and Sewerage Board (BWSSB), Karnataka State Council for Science and Technology (KSCST); Bruhat Bengaluru Mahanagara Palike (BBMP); and Bangalore Development Authority (BDA), Karnataka Lake Conservation and Development Authority(KLCDA), Karnataka Forest Department (KFD) have been striving to promote RWH in Bengaluru city and their roles are discussed in detail here.

**Bangalore Water Supply and Sewerage Board**

- Formulation of RWH Regulations, 2009; mandatory to install RWH structures by every owner of a building on a site area of 2400 sq ft and above and whoever constructs a building on a site area of 1200 sq ft and above.
- Approval of new building construction plan only with RWH
- Creating awareness through publishing materials, training programmes for plumbers, awareness programmes for the public.
- Installing of RWH structures in its own buildings
- Monitoring a proper installation of RWH structures
- Established RWH Theme Park in collaboration with KSCST, a resource centre for disseminating information regarding RWH. Theme Park visually displays 27 models of RWH, designs, costs, with supportive information
- Coordinates with Banks to provide loans for installing RWH structures

**Karnataka State Council for Science and Technology**

- RWH promotion, practically demonstrating its promotion through implementation
- RWH in 20 landmark buildings and four exhibition plots for demonstration of cost and groundwater recharge technologies at RWH and Tumkur.
- Training programmes for Engineers, Architects, Contractors, Plumbers, Masons etc.

**Bruhat Bengaluru Mahanagara Palike**

- Rainwater harvesting on the surface of earth to be stored for present usage by way of containing it in all the water bodies - lakes, ponds, rivers, dams etc
- Ground water recharge for improving ground water by constructing recharge pits, thereby adding life to wells/bore wells

- Aims to reduce the pressures on major valleys
- Use rain water to improve flora and fauna growth
- Identified sites with defined guidelines for adoption of RWH in apartments/ other properties, properties with large open areas (1 acre), parks and playgrounds, houses above 30x40 sizes, roads by redesigning shoulder drains and adopting catch-pits for storing overflowing water.
- Awareness creation through Campaigns by political representatives, pamphlets and brochures, newspapers and other media and personal appeals by officials.
- Establishment of Rain Water Club in 1995 - group of architects and engineers involved in advocating, promoting, teaching, and demonstrating the efficacy of good water and sanitation management solutions, awareness through lectures, demonstrations, articles.
- Implementation of RWH at Government Buildings and Public places
- 'Bridge an Edge', a vital programme - RWH is adopted using percolation of rainwater through trees. There are about 25 lakh trees under BBMP purview and the rainwater collected is estimated at around 874.30 crore litres.
- Proposal to introduce a 2 percent property tax rebate for 5 years for households with RWH.
- Reviving of Lakes -183 live lakes have been identified. BBMP has taken up - surveying, fencing and development of 132 lakes.
- Removal of encroached structures on lake beds and storm water drains.

**Bangalore Development Authority**

- Rejuvenation of dying lakes
- Protection of lakes from contamination
- Improve the environment of the surrounding areas involving local community

**Karnataka Lake Conservation and Development Authority**

- Protect, reclaim and rejuvenate lakes
- Create habitat for flora and fauna in lakes
- Conduct environment impact assessment for all lakes
- Utilise the lakes for the purpose of drinking water, irrigation, education and tourism

**Karnataka Forest Department**

- Rejuvenation of lakes
- Restoration through desilting , deepening tank beds, sewage water diversion etc

All the initiatives discussed so far paint a positive scenario of RWH in Bengaluru city.

## Key Findings

- 79 percent of the respondents have installed RWH structures due to the policy that makes RWH installation mandatory with the BWSSB officials issuing notices repeatedly. Respondents have strongly felt that RWH should be made mandatory during the time of construction to avoid additional work later.
- 86.6 percent of the households have adopted groundwater recharging method, while 19.16 percent roof top harvesting method with 20 percent of the households directing the roof top rain water either directly in to bore wells or open wells.
- A Majority of the households have adopted ground water recharge, but are not keen on adopting roof top RWH for four reasons – (1) comparatively expensive; (2) Not keen on maintenance of filters, because of an additional burden on finance; (3) not keen on following technical specifications with respect to reusing stored rain water; (4) space constraints.
- Households have mainly adopted recharge method as open wells have either dried up completely or are not in use. However, deviations in design are commonly found. Scientists have come up with guidelines for specific designs where an infiltration gallery is used for recharging bore wells, as mere filtering of rainwater before letting into bore wells directly might damage bore wells. Another deviation observed relates to the construction of recharge pits in close proximity to bore wells, resulting in the pollution of ground water. People are unaware of these technical guidelines.
- Only 9 families have reported the quality of harvested rainwater being good while the rest of the respondents are not sure of the quality of harvested rain water because, water received from municipal supply and of their own bore wells is all collected in a common overhead tank.
- 94 percent of the respondents came to know of RWH through awareness programmes organized by BWSSB; 58 percent through other media - local news papers; television; 42 percent through pamphlets distributed and messages from line men or meter readers.
- Since expenditure incurred depends on features like - size of the roof top area, type of harvesting method etc, there is no variation observed in the expenditure incurred on RWH installations. Providing guidance and authentication of details regarding cost options would have been useful.
- 98 percent of households did not encounter any problem during the installation of RWH structures.
- Reasons for not installing RWH structures include - Adequate water supply (99 percent of hhs), additional work for elderly, financial burden, Poor awareness, inadequate rain water quantity to fulfill water needs, lack of interest, waste of money.

## Key Constraints

We have observed some of the households lacking in sufficient space for installing RWH structures and hence no RWH adoption. Also, information about cost variations and investing in RWH for houses constructed sometime ago have made residents apprehensive of installing RWH structures. The total cost of installing a RWH system may work out from a minimum of Rs.15,000 to a maximum of Rs.1,00,000, based on the area of house and space available.

Besides, since water is supplied at subsidized price people do not feel the need for installing RWH to save water. In a few areas, there is no problem of water scarcity. So, access to water is not an issue, hence, people are reluctant to install RWH structures, as water supply is regular and sufficient. People store water in tanks and sumps. Additionally, some households have bore wells, an alternate ground water source.

In our study area, there are complaints against lack of adherence to design resulting in technical problems. Instances of installing RWH through recharge-pits in an unscientific manner by plumbers at a low price are common. In one of the parks (Sir M. Visweswaraiah, Basaveswaranagar) RWH had been designed by a senior expert without following the scientific guidelines and as a result, it has become ineffective making it ineffective (Shiva Shankar, Prajavani 2011).

Technically, geologists opine that RWH is not suitable for low-lying areas – in low lying areas of Bengaluru, generally groundwater can be accessed at lesser depths. In such situations, with RWH implementation, sewage water contaminates RWH pits and bore wells. The residents are, observed installing pumps to drain out excess water. Geologists opine that ground water mapping is a must before RWH is implemented.

## Policy options

To summarize, RWH is an essential and a welcome initiative. However, the implementation process should be strengthened for an effective RWH practice on the ground.

## Awareness Creation Initiatives

Making people aware will help them understand the need for RWH

Awareness creation regarding RWH may be popularized effectively with media design interventions regarding water crisis in Bengaluru, expenditure towards providing water, benefits of RWH and so on. Hence, providing a context under which RWH becomes important would be crucial to influencing citizens towards RWH rather than using compulsion.

### *Need for more popularization through books and pamphlets*

Although booklets and pamphlets about RWH released by BWSSB are good, they have not reached the citizens as there are lacunae in distribution. BWSSB and BBMP should take charge of distributing booklets in a more systematic manner. Volunteers can be involved in the process of promoting RWH.

### *Promotion of Awareness creation programs*

Programmes on RWH must be aired on T.V., Radio besides being published in newspapers more frequently. There is a need for increasing the number of awareness camps conducted by BWSSB. It would also be effective to involve resource persons for promoting RWH. Other popular modes of communication like street plays may be promoted. Popularizing visits to RWH Theme park through advertisements, special trips for various institutions/residents would also go a long way in creating awareness.

### *Involvement of RWH experts and scientists is necessary*

There exist method-related deviations in the construction of recharge-pits in few places. So, it is necessary for BWSSB and BBMP to ensure that RWH-pits constructed as per the guidelines for proper conservation.

### *Awareness on Technical aspects and Costs*

At large, people are not aware of the technical details and costs of RWH installation. For instance, lack of awareness among the people regarding how harvested rainwater could be connected to bore wells. Access to proper information will aid in avoidance of deviations from the design and safeguard ground water quality with a provision made for information on cost aspects. This would help citizens take informed decisions.

### Need for being sensitive to consumer preferences and providing better support services

There is scope for a further strengthening of processes to make them user-friendly. A blanket insistence on the adoption of RWH without understanding the practical constraints involved could lead to process defaults. Many senior citizens are financially weak (pensioners) and physically dependent and hence negotiating with strangers can be stressful. It is important to be sensitive to their needs by providing a package of RWH services through BWSSB or an authentic source.

- Package services could be extended to people who are willing to pay an extra charge as part of addressing the time constraints encountered by some citizens.
- BWSSB can introduce subsidized packages for the economically weaker sections.
- Incentives/subsidies should be made effective for those who install RWH structures.
- Access to experts access for clarifying misconceptions about RWH - about causing damage to building foundation, occurrence of earthquakes, animal and bird excreta contamination, rain water toxicity, lifespan of RWH structures etc

### Integration of Institutional Initiatives

RWH would be more effective when these institutions are integrated with a common vision and plan to be shared with NGO's, RWA, social- service clubs, etc, through established networks. RWH concept and associated benefits must be included in the school syllabus with a practical implementation of RWH in their buildings. Central Ground Water Board can come up with a programme for demonstrating how underground water gets recharged following RWH adoption in urban areas. Awards/Incentives could be given to the wards where RWH is implemented successfully.

### Ground water mapping to be made compulsory before the implementation

BWSSB with the coordination of Central Ground Water Board should do a ground water mapping before sending NOTICE and also before the construction of recharge-pits in low lying areas to avoid the contamination of sewage and flooding.

To sum up, RWH is progressing though at a slow pace. With the water demand increasing, RWH may become imperative. Our policy suggestions are an attempt towards strengthening the process further so as to make it convenient and feasible for implementation of a more number of RWH structures in Bengaluru.

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