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THE IMPORTANCE OF RAIN WATER HARVESTING IN BANGALORE CITY – A GEOGRAPHICAL APPROACH

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Abstract

Water is precious in each stage of human life, it is difficult to live without water. In everyday life we are depending on water in many situations. Bangalore is a populated city to provide water for its dwellers and industries becoming a headache for the Bengaluru city Corporation and BWSSB. The city consumes more than 1125 million liters of water, but BWSSB is not able to provide the required water for Bangalore city; it is able to provide only 900 million liters of water. Here the Rain Water Harvesting gets its importance, government and non-government organizations giving priority to do the same. To do this research, data have been collected from BWSSB and Water Resource Department. The major objective of this paper is to show why Rainwater Harvesting is important in a city like Bangalore and how to solve the water problems for domestic usage. Some statistical methods have been used to process the data collected from different sources. Many research papers have been referred to give justice for this research paper.

Keywords: Populated; BWSSB; Rain Water Harvesting Introduction:

Introduction

For our water requirement we entirely depend upon rivers, lakes and ground water. However, rain is the ultimate source that feeds all these sources. Water plays a significant role in our lives since it is a precious natural resource. Over the past few years, there has been an increase of water shortages in several parts of the world. It is vital that ideal measures are put in place to help to reduce the high rate of water loss. With the change in climate patterns, people need to be aware of the alarming water shortage that we face currently and the imminent danger of severe shortage in the future. Various methods can be implemented to address the water

problem in the most area. Rainwater harvesting is one of the methods that can be used for water conservation.

Rainwater harvesting (RWH) is a simple method by which rainfall is collected for future usage. The collected rainwater may be stored, utilized in different ways or directly used for recharge purposes. With depleting groundwater levels and fluctuating climate conditions, RWH can go a long way to help mitigate these effects. Capturing the rainwater can help recharge local aquifers, reduce urban flooding and most importantly ensure water availability in water-scarce zones. Though the term seems to have picked up greater visibility in the last

few years, it was, and is even today, a traditional practice followed in rural India. Some ancient rainwater harvesting methods followed in India include madakas, ahar pyne, surangas, taankas and many more. This water conservation method can be easily practiced in individual homes, apartments, parks, offices and templestoo, across the world. Farmers have recharged their dry borewells, created water banks in drought areas, greened their farms, increased sustainability of their water resources and even created a river. Technical knowhow for the rooftop RWH with direct storage can be availed for better implementation. RWH An effective method in water scarce times, it is also an easily doable practice. Practical advice is available in books written by Indukanth Ragade & Shree Padre, talks by Anupam Mishra and other easy to follow fun ways.

Rainwater harvesting, from the common definition of harvesting, is a process that involves collecting rainwater and increasing its value by eliminating impurities or directing it to places where its use is highly required.

Types of Rain Water Harvesting

Rainwater harvesting is the collection and storage of rainwater for reuse on-site, rather than allowing it to run off. These stored waters are used for various purposes such as gardening, irrigation etc. Various methods of rainwater harvesting are described in this section.

Surface runoff harvesting: In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

Rooftop rainwater harvesting: It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the groundwater level of the area.

Methods of Rooftop Rainwater Harvesting: Various methods of using roof top rainwater harvesting are illustrated in this section.

Storage of Direct Use: In this method rainwater collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability. Each drainpipe should have mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water over flow system. Excess water could be diverted to recharge system. Water from storage tank can be used for secondary purposes such as washing and gardening etc. This is the most cost effective way of rainwater harvesting. The main advantage of collecting and using the rainwater during rainy season is not only to save water from conventional sources, but also to save energy incurred on transportation

and distribution of water at the doorstep. This also conserves groundwater, if it is being extracted to meet the demand when rains are on.

Recharging groundwater aquifers: Groundwater aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are:- Recharging of bore wells, Recharging of dug wells. Recharge pits, Recharge Trenches, Soakaways or Recharge Shafts, Percolation Tanks.

Importance of Rain Water Harvesting

Rainwater harvesting is the storing of rainwater during the monsoon season for the purpose of using it during periods of water scarcity. Generally speaking, it is a process used for collecting and storing rainwater for human use. Rainwater harvesting is best described as the technique by which rain water is accumulated and stored with the intention of reusing it during the dry season or when there is a drought.

1. Rainwater harvesting or the collection of rainwater in a proper way, can be a permanent solution to the problem of water crisis in different parts of the world. This simple method can put forward a solution which will be workable in areas where there is sufficient rain but the groundwater supply is not sufficient on the one hand and on the other surface water resource is insufficient. This is particularly applicable in hilly areas where it can be utilized for human consumption, by animals and also for farming. In remote areas, where surface pollution is comparatively low, rainwater harvesting is ideal.
2. Although the earth is three-fourths water; very little of it is suitable for human consumption or agriculture. Rainfall is unpredictable and there is a constant shortage of water in countries which are agriculture dependent or generally drought prone.
3. A bad monsoon means low crop yield and shortage of food. Even animals suffer from scarcity of water. Africa and the Indian subcontinent face acute water crisis during the summer months. The farmers are the most affected because they do not get sufficient water for their fields. Rainwater harvesting therefore is an ideal solution for farmers who depend on monsoon for consistent water supply.
4. Unavailability of clean water compels the consumption of polluted water, giving rise to water-borne diseases and high rate of infant mortality. In recent studies it has been observed that in Lima (Peru) nearly 2 million people do not have access to any water supply and those who do have access get water supply which has a high possibility of being contaminated.

5. If rain water, which comes for free, can be collected and stored, instead of letting it run off, it could be an alternative to back up the main water supply especially during dry spells. Its importance will not be limited to an individual family but can be used by a community as well.
6. The importance of rainwater harvesting lies in the fact that it can be stored for future use. Just as it can be used directly so also the stored water can be utilized to revitalize the ground level water and improve its quality. This also helps to raise the level of ground water which then can be easily accessible. When fed into the ground level wells and tube well are prevented from drying up. This increases soil fertility. Harvesting rainwater checks surface run off of water and reduces soil erosion.
7. In areas having sparse and irregular rainfall, scarcity of water is a persistent problem. It cannot be completely resolved but can be mitigated through rain water harvesting. Rainwater harvesting is an ideal solution to water problems in regions which receive inconsistent rainfall throughout the year.

Study Area

Bangalore, officially known as Bengaluru, is the capital of the Indian state of Karnataka. It has a population of over 10 million, making it a Megacity and the 3rd most populous city and 5th most populous urban agglomeration in India. It is located at 12.97°N 77.56°E and covers an area of 741 km² (286 sq mi). Bangalore has a total of 198 wards spread across the 4 taluks namely, Bangalore North, Bangalore South, Bangalore East and Anekal. It is also categorised into 8 zones namely, Byatarayanapura Zone, Dasarahalli Zone, Rajarajeshwari nagar Zone, South Core Zone, West Core Zone, East Core Zone, Bommanahalli Zone and Mahadevapura Zone.

The Bruhat Bengaluru Mahanagara Palike (BBMP), is the administrative body responsible for civic amenities and some infrastructural assets of the Greater Bangalore metropolitan area. It is the fourth largest Municipal Corporation in India being responsible for a population of 8.5 million in an area of 741 km². Its boundaries have expanded more than 10 times over the last six decades.

Bangalore is one of the most ethnically diverse cities in the country, with over 51% of the city's population being migrants from other parts of India. Historically a multicultural city, Bangalore has experienced a dramatic social and cultural change with the advent of the liberalization and expansion of the information technology and business process outsourcing industries in India. IT companies in Bangalore employ over 35% of India's pool of 1 million IT professionals. Most of the business talents blossoming in Bangalore are from a small place in Bangalore named the Ramachandra-

pura.

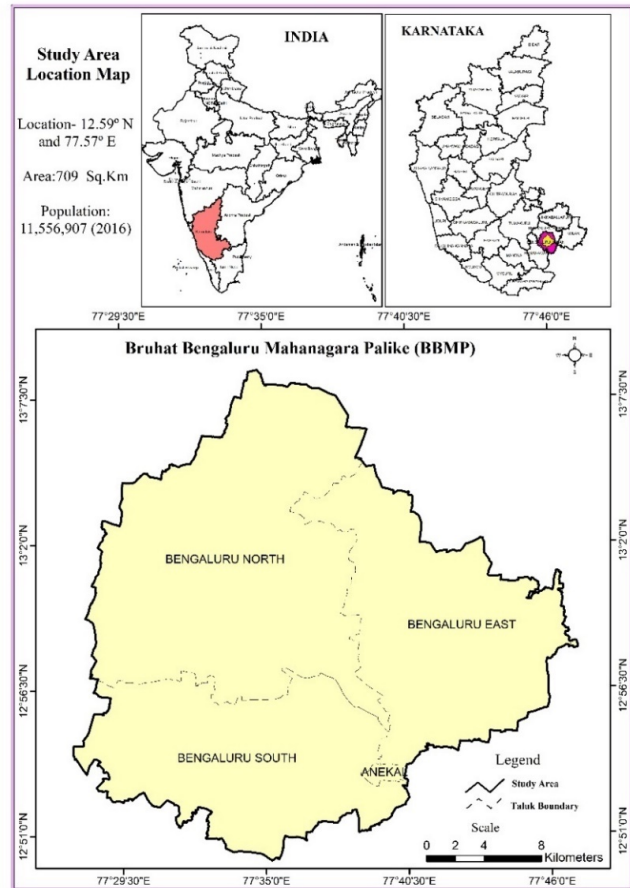


Fig. 1. Study Area Map

Objectives

As we know the importance of water in human life. Preserving water and use for the future is important because earth is covered by water but usable water is only 3%. If we get the sufficient rainfall also carrying that to non-rainy season is becoming difficult. The major objective of the paper is to show the Importance of Rain Water Harvesting in Metropolitan city like Bangalore. Installing water recharge and rain water harvesting points in suitable areas and sustainable use of water resources. Discussion on policy involving in the adaptation of rain water harvesting and other importance related to rain water harvesting.

Data Sources and Methodology

For this research paper secondary data have been used, Rain Water Harvesting data from BWSSB and BBMP wards. Installation of RWH in house and apartments. This paper is based on completely Geographical approach, statistical

methods have been used to process the data and prepare some graphs.

Result of the Research

In the last three decades, Bengaluru has experienced eight years of severe to moderate drought. Although the city receives 1,000 millimetres of rain water annually (equal to 2,30,000 litres of pure water in a plot of 2,400 sq ft), rapid urbanisation has substantially reduced the percolation of rainwater into the sub-soil, while the quantity of run-off water in storm drains, has increased tremendously. "At least 50% of the city's water requirement can be met through rainwater harvesting," "If everyone practices rainwater harvesting in Bengaluru, in the next 25 years, the city can sustain itself with its available water sources. Similarly, other places in India, should also adopt RWH. Every drop of rainwater that is harvested, will save us from a water famine,"

For example, in Bangalore (average annual rain fall 39.37 inch/1000 mm) about 2,30,000 liters of rainwater can be harvested in an area of 2,400 sq.ft. (40ft x 60ft site). The harvest yield depends on the rainfall received the catchment area and the collection efficiency. Harvested rainwater is stored in underground sumps or overhead tanks for subsequent use. Harvested rainwater can also play a vital role in ground water recharge through recharge pits, dug wells, soak pits and recharge trenches.

Rainwater Harvesting in Bangalore Context

Bangalore has the distinction of being the only city with over 300 major lakes in its agglomeration limits. Situated 920 meters above sea level. Bangalore is blessed with a healthy weather. With its beautiful parks and tree canopied roads Bangalore is also well-known as the Garden City. The naturally undulating terrain of Bangalore city, with its hills and valleys forms a unique "radial drainage patterns" which is ideal for capturing and storing rainwater. Each valley at the ridge top gives birth to small streams that cascade down to form major stream systems in the three Valleys of Hebbal, Koramangala Challanghtta and Vrishabhavati.

Over the years increase in the urban population of Bangalore has led to a spurt in the growth of residential buildings, replacing traditional bungalows with their large open spaces. With the demands for land use in developed areas going up many folds vertical growth was inevitable. This has resulted in increase in rooftop areas, pavements and roads. With massive concreting and asphaltting of ground areas, the soil exposed for rainwater infiltration has decreased, leading to a drastic fall in the groundwater table and disappearance of open wells. In the last 30 years, Bangalore has experienced five years of severe drought and three years of moderate drought. The quest for water has resulted in over exploitation of groundwater. On an average the groundwater level has

progressively declined by 10 meters between 1978 and 2003. Consequently, the quantity of run off water in the storm drains has increased tremendously. Rainwater Harvesting is all about conserving this water, thereby, supplementing the presents supply.

Bangalore City mainly depending on the Cauvery and Bore well water. If the state receives good rainfall then Bangalore city will get the water from the Cauvery otherwise we need to depend on the local lakes, tube wells and underground water. The recharge of underground water is the main challenge in cities like Bangalore. Because many part of the city is covered by the built-up areas. Recharging of rain water in these places will becoming headache for the administration.

Generally groundwater in shallow wells is polluted. Groundwater levels are falling due to heavy extraction and the absence of rechargeable aquifers. In fact, several deep bore wells have run dry. To address the issue of water shortage. Rainwater Harvesting is a perfect solution because Bangalore is ideally suited:

- Geological structure with its weathered mantle
- Physical and chemical properties of the soil
- Terrain with its undulating landscapes
- Drainage with its radial pattern
- Innumerable number of lakes and water bodies scattered all over the city.

Rainwater Harvesting is a simple, technically feasible and economically affordable option. Its benefits to the individuals institutions and the society are many.

- Easing of the shortage of water by supplementing the current supply
- Increase in groundwater levels
- Cost effective, as water pumping costs over long distances are not involved
- Creation and preservation of lakes, ponds and tanks will have a positive impact or the urban environment.
- Reduces the run-off, which chokes the storm water drains
- Flooding of roads and low-lying areas will be reduced
- Soil erosion will be reduced

Rainwater Harvesting is a community based programme and its success largely depends on the collective participation of Government bodies NGOs, builders architects, house owners and individuals.

The above table shows the rainwater potential in Bangalore city based on available rainfall in the place against to the Plot sizes of the same areas.

Advantages of rainwater harvesting: RWH is a quick solution, to increase the availability of water, in areas that have inadequate resources. It increases ground water levels and mitigates the effects of drought. It reduces rain water run-off, which may otherwise, flood storm water drains. It serves

Table 1. Rainwater Potential in Bengaluru city

Annual Rainfall		Annual Rainwater Potential (in Liters)			
		Plot sizes in Sq. feet			
in inch	in mm	600 (20' x 30')	1200 (30' x 40')	2400 (40' x 60')	4000 (50' x 80')
19.69 31.50	500 800 1000	28,000 44,800	55,500 88,800	1,11,500 1,78,400	1,86,000 2,97,600
39.37 47.24	1200 1400	56,000 67,200	1,11,000 1,33,200	2,23,000 2,67,600	3,72,000 4,46,400
55.12 157.48	4000	78,400 2,24,000	1,55,400 4,44,000	3,12,200 8,92,000	5,20,800 14,88,000

Source: BWSSB data unit.

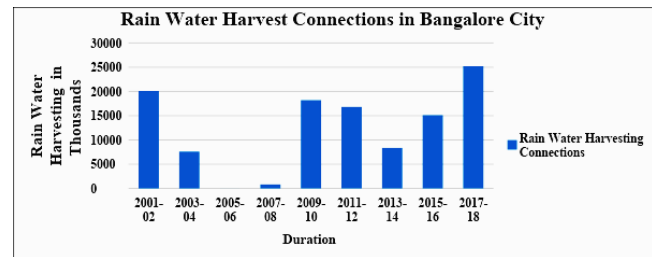
as a cost-effective method to reduce soil erosion. However, its successful implementation, depends on the collective efforts of individuals, government bodies and builders. One can store rain water in tanks and use it to flush toilets, water plants, etc. Rain water can also be harvested, to recharge groundwater through recharge pits, dug wells, bore wells, soak pits and recharge trenches.

According to survey held in the year 2018 Reasons for not installing RWH: structures Approximately 18 percent of the respondents have cited four major reasons for not installing RWH structures, such as (1) not being aware of it (2) nobody insisted on it (3) financial problems and (4) lack of space for installing it. Among the people who were not aware of RWH, around 12 percent respondents felt that it was of no use and a waste of money. More than half of the respondents (53.3 percent) cited their advanced age, poor health and the lack of capable persons in the household to carry out the task as reasons for not adopting RWH. It is ascertained that most of these households belong to retired/aged people and their children stay elsewhere. About 16 percent of the families were found reluctant to express their views regarding the non-installation of RWH structures. The below table shows the Rain water Harvesting connections in BBMP region for the last 20 years.

Year	Rain Water Harvesting Connections
2001-02	20081
2003-04	7602
2005-06	8
2007-08	832
2009-10	18207
2011-12	16846
2013-14	8374
2015-16	15134
2017-18	25229

Rainwater Harvesting is a community-based programme and its success largely depends on the collective participation of Government bodies, NGOs, builder's architects, house owners and individuals. Table-5.2. shows the number of connections in rainwater harvesting annually from 2001-02 to 2017-18 in Bangalore urban. The highest rainwater harvesting

connection took place in 2017-18 (25229 connections) followed by 2001-02 (20,081 connections), 2009-10 (18,207 connections), 2011-12 (16,846 connections) and least connections took place in 2005-06 (08 connections), 2007-08 (832 connections). Annually there is variation in rainwater harvesting connection because of individual interest and efforts of Government bodies, NGOs, electronic officers etc., to give proper information's and awareness programmes regarding importance of Rain Water Harvesting.

**Fig. 2.** Rain water harvest connections in Bangalore city

As we mentioned earlier there are many reasons why peoples are not interested in RWH. But government has to take some initiatives and popularize the RWH programmes in the Bangalore city.

Bangalore Water Supply and Sewerage Board (BWSSB) is the premier governmental agency responsible for sewage disposal and water supply to the city of Bangalore. The BWSSB was constituted under the act of the Karnataka state legislature and the board came into existence on October 2, 1964. The BWSSB Act 1964 & BWSS rules 1964 amended from time to time. The BWSSB has recently introduced an amendment to its Act and has made rainwater harvesting mandatory for certain sites.

The Bangalore Water Supply and Sewerage (Amendment) Act, 2009, 72A-Obligation to provide rain water harvesting structure states that "Within nine months from the date of commencement of the Bangalore Water Supply and Sewerage (Amendment) Act, 2009 every owner or occupier of a building having a sital area of 2400 square feet and above or every owner who propose to construct a building on a sital area of 1200 square feet and above shall provide for rain water harvesting structure in such manner, with such conditions as may be provided in the regulations, failing which the Board

may cause such rain water harvesting structure and recover the cost from the owner or occupier, as the case may be, arrears of land revenue.”

Non-compliance: what if I have not implemented rain-water harvesting? If you have a BWSSB connection and your property falls under any of the regulations and have not yet implemented rainwater harvesting, the BWSSB can impose a levy of additional water supply and sewerage charges as per the BWSSB Amendment to Regulations (2015).

Penalties introduced for residential and non-residential defaulters (BWSSB Amendment to Regulations 2015) - Residential buildings: additional charges of 25% of total water and sanitary charges will be levied for first 3 months and thereafter 50% of total water and sanitary charges till the RWH is provided. Non-residential buildings: additional charges of 50% of total water and sanitary charges for first 3 months and thereafter additional charges of 100% of total water and sanitary charges till the RWH is provided.

Conclusion

Rain water harvesting is one of the important method of storing and recharging of water. After the rainy seasons

concrete forest like Bangalore is difficult to get the water. BBMP region is covered by the built-up area, places like this it is difficult to save the water so some important measures have to be taken like Rain Water Harvesting and recharging underground waters etc. the Local government has to create the awareness programmes among the public to install more and more Rain water harvesting points in their houses and apartments. Those who are installing RWH point government should encourage them to give more subsidy and other benefits. Government and non-government organization have participated in these issues and educate the people regarding the new concepts.

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