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**ASSESSING THE POTENTIALITY OF RAINWATER HARVESTING SYSTEMS IN PUNE CITY****RAJESHWARI SHINDE****RESEARCH SCHOLAR****SINHGAD INSTITUTE OF BUSINESS ADMINISTRATION****SINHGAD COLLEGE OF COMMERCE & RESEARCH****KONDHWA (BK)****DR. VIJAYA S. NAWALE****VICE PRINCIPAL****SINHGAD INSTITUTE OF BUSINESS ADMINISTRATION****SINHGAD COLLEGE OF COMMERCE & RESEARCH****KONDHWA (BK)****ABSTRACT**

Water is a very critical for improved health and for the pursuit of various socio-Economic activities. Despite its immense usefulness, we fail to conserve the most valuable resource. Rainwater harvesting is increasingly viewed as a major strategy for enhancing the present condition of water crises specially in the dry seasons. PUNE is blessed with abundance of rains; the only concern is to tap this valuable resource water which pours in the form of rains during the rainy season. While this technology is being promoted and initiated by the PMC as a compulsion to meet the daily requirement of water by the urban population of the city, the effective implementations and working of the systems is still a big question? The purpose of this paper is to study rainwater harvesting and its sustainability and effectiveness, for residential complexes in PUNE city. An attempt is made by the researcher to identify affordability, constraining bottle necks and the efficacy of the system. A questionnaire survey was conducted amongst the registered rainwater harvesting system users under the PMC. The study concludes that adoption of rainwater harvesting technologies has certainly made the residential societies self-sustainable and is need of the hour to meet the increasing need of the growing population. Convenient sampling technique is been adopted for the purpose of the survey.

**KEYWORDS**

registered Rwhs under PMC, residential complexes, non portable use, sustainability, water shortage.

**ACRONYMS**

<b>RWH</b>	Rainwater harvesting
<b>RHWS</b>	Rainwater harvesting systems
<b>MLD</b>	Million liters per day
<b>GEF</b>	Green Energy Foundation
<b>mm</b>	millimeter
<b>PMC</b>	Pune municipal corporation
<b>Sq m</b>	square meter
<b>TMC</b>	Thousand Metric Cubic feet

**INTRODUCTION**

Water shortage is considered one of the most important and sensitive issues these days. Where increasing water deficiency and quality deterioration of the available water is evident. The majority of fresh water supplies in the world and scarce groundwater resources have to be very meticulously used to preserve this commodity for the alarming population growth. Future population growth and its associated water demands are expected to place severe pressure on these limited water reserves. Consequently, rainwater harvesting becomes of great importance in the socio-Economic development of the city like PUNE, where water sources are scarce or polluted. We today wholly and solely depend upon the dams for our day to day water supply. Yes!!! The government has shouldered the responsibility by making necessary compliances for the builders who build the housing societies with regards to Rain Water Harvesting (RWH).

The rain-gods have begun smiling on PUNE, but Puneites are not counting their blessings. Despite there being water scarcity in many parts of the city, citizens don't seem keen to harvest rainwater. The city has saved only 12 million litres a day (MLD) of water through rainwater harvesting. This came to light from a study conducted by the Green Energy Foundation (GEF). But there still is space to aggravate the use of rain water through efficient conservation of rainwater through Rain water harvesting systems (RHWS).

Water shortage is one of the critical problems in PUNE City. This problem is not new one, and it cannot be solved overnight. The water table is lowering day by day, and the recharge of groundwater table is facing difficulties because of the pavements and concrete roads. Rainwater harvesting is an effective option not only to recharge the groundwater aquifer but also to provide adequate storage of water for future use. Certainly this reservoir of water underneath the ground could be of great use for flourishing days, as well critical period of the year. This system is a suitable sustainable option for providing water. It is almost the only way to upgrade one's community water supply. The installers of RWHS have installed the RWHS to meet the compliance put forth by the government for housing societies build up after 2008. But meeting this compliance has certainly helped in bringing about the natural researching of the water table beneath the ground.

**LITERATURE REVIEW****WHAT IS RAINWATER HARVESTING?**

Rainwater harvesting is a gathering, collection and storing, of rainwater. It is used to provide water for both portable as well as non portable use. Rainwater is collected from the roofs of houses, housing societies, tents and local institutions, or from specially prepared areas of ground. Roof rainwater is usually of good quality compared to land surface and does not require treatment before consumption. Household rainfall catchment systems are appropriate in areas with an average rainfall of greater than 200mm per year, and no other accessible water sources.

Thus an attempt was made by the researcher to understand the efficacy of rainwater harvesting systems in PUNE city.

**BENEFITS OF RAINWATER HARVESTING**

Rainwater harvesting is a simple and primary technique of collecting water from natural rainfall. At the time of a water crisis, it would be the most easily adaptable method of mitigating water scarcity. The system is applicable for both critical and normal situations. It is an environmentally friendly technique that includes efficient collection and storage that greatly helps local people. The associated advantages of rainwater harvesting are that

- i. It can curtail the burden on the public water supply, which is the main source of city water



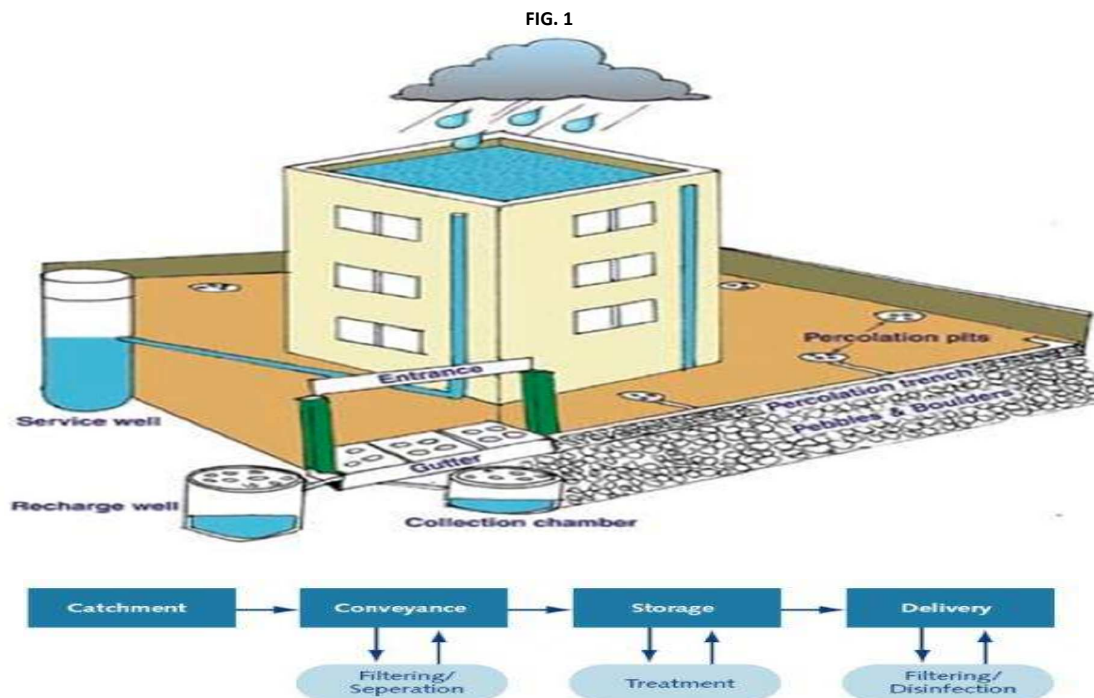
- ii. It has both potable as well as non potable usage
- iii. Its cost of installation is low compared to the water purchased by the housing societies by the tankers in the lean season
- iv. Groundwater level is highly recharged during rainfall.
- v. It brings about sustainability despite of adversities.

**RWHS:** 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.

1. Rainfall is the main source of water which is to be preserved for future use.
2. Catchments: The catchment of a water harvesting system is the surface which directly receives the rainfall and provides water to the system. It can be a paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground.
3. Coarse mesh at the roof to prevent the passage of debris.
4. Delivery systems (gutters) to transport the water from the roof or collection surface to the storage reservoir.
5. First-flushing A first flush device is a valve that ensures that runoff from the first spell of rain is flushed out and does not enter the system. This needs to be done since the first spell of rain carries a relatively larger amount of pollutants from the air and catchment surface.
6. Filter The filter is used to remove suspended pollutants from rainwater collected over roof. A filter unit is a chamber filled with filtering media such as fibre, coarse sand and gravel layers to remove debris and dirt from water before it enters the storage tank or recharges structure. Charcoal can be added for. Additionally there are a wide variety of systems available for treating water either before, during and/or after storage (e.g. biosand filter, SODIS, chlorination; or in general HWTS).
7. An extraction device (depending on the location of the tank) may be a tap, rope and bucket, or a pump or a infiltration device in the case the collected water is used for well or groundwater recharge
8. Storage facility there are various options available for the construction of these tanks with respect to the shape, size and the material of construction.

\*Shape: Cylindrical, rectangular and square.

\*Material of construction: Reinforced cement concrete, (RCC), ferrocement, masonry, plastic (polyethylene) or metal (galvanised iron) sheets are commonly used.



**PMC initiative:** PUNE Municipal Corporation (PMC) introduced rain harvesting under the Eco-housing project scheme. The scheme was introduced in 2008. Rainwater harvesting is mandatory for all buildings that are being constructed on plots that are more than 5,000 sq m in size. PMC is doing its part by promoting rainwater harvesting by offering 10 per cent rebate in property tax to citizens who implement the technique.

As per the GEF report, the city consists of 6.40 lakh housing units. Out of that, only 479 townships (Housing societies) are saving water through the rainwater harvesting system. The city needs 590 Thousand Metric Cubic feet (TMC) of water per day. Currently, PMC supplies only 512 TMC. If people save rainwater, they will collect 112 to 115 TMC extra water per day. GEF founder Sharmila Oswal said, "If we assume that 50 per cent of the PMC area is being developed with 40 per cent of it as open area/pavement, and the city collects 40 per cent of rain falling over it, the quantity of rainwater that can be harvested through surface run-off harvesting, works out to 68 MLD which is 11 per cent of the total water demand. By using percolation tanks, the ground water level can be increased up to 1 meter for an area of 1 sq km. totally, around 32 per cent of the total water requirement in PMC areas can be met through rainwater harvesting."

"The city needs rainwater to be harvested. For this, the PMC has to create awareness about this system through the proper media. We have conducted a study throughout the city area. We collected data on rainfall, water supply in every area and so on. We have sent a proposal to PMC asking that a committee for rainwater harvesting, be set up," she added.

She further said, "Due to lack of awareness, people in PUNE are not interested in rainwater harvesting. Builders take rebates in development charges by implementing the project. But no one maintains it and so the system has failed. We have submitted our report to PMC and hope to promote awareness, education and implementation of rainwater harvesting in PUNE with the help of PMC. To tackle the water problems of the city, we have to take initiative now." (*Published in e paper of Times of India 13/06/2010*)

### NEED/IMPORTANCE OF THE STUDY

the research study at hand will help the society as well as the government in the following manner,

1. Help in identifying the defaulter.
2. Furnish information to the government in framing improvised policies related to RWHS.
3. Difficulties confronted by the installers in the functioning of the system will be better understood and ways to overcome these bottlenecks could be generated.
4. The perception of the end users and the use of RWH could be identified.

**STATEMENT OF THE PROBLEM**

“Assessing the Potentiality of Rainwater Harvesting Systems in PUNE city”. The research study tried to focus upon the effectiveness of RWHS in bringing sustainability in the supply of water, to the housing societies in PUNE city.

**OBJECTIVES OF THE STUDY**

The objectives of this study are as follows:

- 1) To know the general benefits and limitations of rain water harvesting.
- 2) To identify the causes for adoption of RWHS.
- 3) To study Rainwater Harvesting Systems with regards to ;
  - Cleaning
  - Maintenance
  - Usage
- 4) To identify challenges in managing such systems.

**HYPOTHESIS**

The below mention hypothesis was considered for the study.

- Ho:** Registered and installed under the PMC are not utilized.  
**H1:** Registered and installed under the PMC are effectively utilized.

**RESEARCH METHODOLOGY**

For the purpose of the study the following research methodology was taken in consideration

**Sample size:** 12 RWHS in PUNE city which are registered under PMC.

**Sampling Technique:** Convenient Sampling was been adopted for the purpose of the study.

**Tool for collection of data:** A structured questionnaire was used which was framed taking into consideration the view point of the experts of RWHS.

**RESULTS & DISCUSSION**

The structured questionnaire shed light on the functionality of the RWHS

1) **Is your RWHS system in Use**

	Yes	No
Is your RWHS system in Use	11	1

**Interpretation:** - Almost all of the RWHS installers have been using the system. This is clearly indicated by 92% of the respondents.

2) **Why was the RWHS installed (Multi choice)**

	Seasonal scarcity of water, Conservation of depleting ground water resources	To meet government compliance	Seasonal scarcity of water, Unreliable PMC water supply	Seasonal scarcity of water	Seasonal scarcity of water, To meet government compliance
Why was the RWHS installed	2	6	1	1	1

**Interpretation:** - Most of the housing societies have opted for RWHS in order to meet the compliance. But at the same, a few have installed the system to meet the water scarcity.

3) **Source of water frequently used**

	Borehole/well	Municipal tap..	Rainwater harvested	Tap(PMC supply) & rain water harvested
Source of water frequently used	4	1	2	4

**Interpretation:** - Most of the housing societies have been using PMC as well as RWH. At the same a large no of the housing societies are also residing on only the bore well and a small percent uses rainwater occasionally and relies completely on PMC for water supply.

4) **Have you faced water crisis despite of RWHS?**

	Yes	No	To some Extent
Have you faced water crisis despite of RWHS?	2	6	3

**Interpretation:** - It is very much evident from the above analysis that despite the presence of RWHS, there still is the shortage of water for use.

5) **Are you aware of any regulations, permit requirements, or incentive programs within your jurisdiction related to rainwater harvesting?**

	Yes	No
Are you aware of any regulations, permit requirements, or incentive programs within your jurisdiction related to rainwater harvesting	5	6

If yes mention	Reasons
Tax Benefits	4

**Interpretation:** Nearly 55% of the respondents are not aware of the incentive rules and regulations with regards to RWHS, may be they were the ones who are mostly the plumbers or the care takers who looked after the water supply to the housing societies. Whereas some 45% are aware of tax rebate they get due to installation and working of the RWHS.

6) **What type of rainwater harvesting is in use**

	Surface runoff is collected	Roof rainwater	Both surface and roof water is collected
What type of rainwater harvesting is in use	1	2	8

**Interpretation:** Mostly the housing societies prefer both surface as well as roof rainwater harvesting methods for collecting the rain water, which is indicated by 73% of the respondents

7) How long can the rain water harvested can be used

	Available till the next rains	Finished before dry season starts
How long can the rain water harvested can be used	7	3

**Interpretation:** The rainwater harvested is available up to the next rains. So, one can conclude that it is the best source of water supply during the deficit time of the year. This is indicated by 70% of the respondents.

8) Is the rainwater harvested used for potable use?

Portabel use of rainwater harvestd	Use	Don't use
	0	11

**Interpretation:** - From the above analysis it is very much clear that the rain water harvested is not been used for portable use which is indicated by 100% of the respondents.

9) What are your intended uses for the rainwater harvested water? (Check all that apply)

	Response
Washing cars,	11
Toilet flushing	9
Washing Clothes	9
Gardening and for landscape	11
Washing utensils	9
Cleaning of floors	9
Any other (fire extinguishing)	1

**Interpretation:** From the above analysis it is very much clear that non portable use of Rain water harvested is mainly for landscaping and washing of cars which is emphasized by 19% of the respondents respectively.

10) To what level is the RWHS satisfactory

To what level is the RWHS satisfactory [Quality is good]	Response
Highly satisfied	6
Satisfied	6
Partially Satisfied	1

**Interpretation:** From the above analysis it is very much evident that the functionaries are satisfied towards the quality working of the system.

11) What type of storage been used to store the rain water harvested?

If yes what type of storage tank is been used	Response
Plastic	
Metal	Nil
Concrete	9
Any other	Nil

**Interpretation:** The above analysis indicate that concrete tanks are been used in order to store the rainwater which is harvested. But it is as much evident that a small percentage has been using the water harvested directly when required by using the borwell.

12) How frequently is the storage tank of RWHS been cleaned

How frequently is the storage tank of RWHS been cleaned	Response
Annually	1
Twice a year	9
Other	2

**Interpretation:** Cleaning of the tank is done twice a year by majority of the RWHS installers.

13) How frequently is the catchment area been cleaned

Cleaning of the catchment area	Response
Throughout the year	3
Once in six months	2
Once in three months	5
Before the onset of rainy season	1

**Interpretation:** The catchment area i.e. the floors as well as the terrace and gutters are cleaned regularly at an interval of 3 months or through the year whenever there is the need to clean it which is indicated by 46% and 27% respectively.

14) Is it difficult to clean inside the jar/storage tank?

	Agree	Disagree	Neither agree nor disagree
Is it difficult to clean inside the jar/storage tank ?	3	5	0

**Interpretation:** - There is a mix response when it comes to cleaning of the storage. Some are of the view that, it is difficult to clean where as some claim that there is ease in cleaning interiors of the tank

15) Level of Users satisfaction towards RWH systems

Overall user satisfaction	Response
Highly satisfied	6
Satisfied	5

**Interpretation:** The above analysis it is very much clear that the installers are highly satisfied with the RWHS.

16) Filtration procedure before entering the tank

Filtration procedure of RWHS before entering the storage tank	
Not filtered	2
using bio filters	1
using net	0
using sedimentation tank	8

**Interpretation:** The RWHS which are installed generally go for sedimentation tanks for filtration before entering the storage tanks. At the same it is worth to be noted that some go for non-filtered water may be they are the ones who treat the water later on before usage.

**17) What is the impact of rainwater harvesting in your dug well/tube well/hand pump?**

What is the impact of rainwater harvesting in your dug well	
yes	11
no	0

**Interpretation:** The water table has certainly increased where rainwater harvesting is done. This is indicated by 100% of the respondents.

**18) Social, traditional beliefs have an impact on RWH water usage**

Does the tradition, social culture belief obstruct you	Yes	No
	1	9

**Interpretation:** Social, traditional, and cultural factors hardly have any impact on the usage of Rainwater which is used.

**19) Level of Users satisfaction towards RWH systems**

	highly satisfied	satisfied	dissatisfied	highly dissatisfied
Quality (level of user satisfaction towards RWHS system)	3	5	2	0

**Interpretation:** The above analysis indicates that the housing societies are satisfied with the Quality of output brought about by the RWHS. Which has been concluded by a majority of the respondents. But one has to note that there is slight dissatisfaction towards the system by the end users of RWHS which is indicative of the fact that a good no of end users is dissatisfied.

**FINDINGS**

*Above analysis sheds light on the below mention facts:* No matter the installers of RWHS have installed the system in order to meet the compliance put forth by the government. They have been regularly utilizing the water harvested by the RWHS as they found the system offers sustainability towards the supply of water through the year. But at the same it was noted that they have been using it for only non portable use. And at regular intervals there is the cleaning and maintenance which is given due preference by the end user. Thus it is evident from the above analysis that the users are satisfied as it mitigates the water crises situation.

**RECOMMENDATIONS/SUGGESTIONS**

The following are the recommendation the researchers would like to propose,

- 1) The quality of water should be upgraded so that portable use can be done.
- 2) Moreover, guidelines and education should be given to the caretakers of the system.
- 3) Regular monitoring should be done by the PMC.
- 4) A separate committee needs to be appointed by the PMC who tries to understand the problems faced by the installers and according rigorous research should be done in order to improve the quality and quantity of water extracted.
- 5) The best utilizers of the system should also need to be appreciated for conserving this resource effectively and using the scarce resource efficiently.

**CONCLUSION**

The RWHS are effectively utilized. Water is collected in a well maintained catchment system from the rains during the rainy. The water later is used for non portable use. The overall quality of RHWS was quite satisfactory and most of them are in working conditions No matter most of the installers have installed the RWHS to meet the compliance put forth by the government in housing societies build up after 2008. The systems are well maintained because of its effectiveness in giving sustainable dependency for the water requirement is proven. The effective utilization of RWHS is proved on the basis of,

- Purpose of installation of the RWHS by the end user.
- Use of rainwater for various non portable usages.
- Sufficiency of the RWH during the scarcity of water supply.

Which proves alternative hypothesis stated by the researcher, it also indicates that RWHS has good potential for sustainable water supply.

**LIMITATION OF THE STUDY**

Reluctance and non-availability of the concern persons who could give the information on behalf of the Housing Societies which are registered under PMC for installation of the Rainwater Harvesting.

**SCOPE FOR FURTHER RESEARCH**

Rainwater is one of the advantageous methods of using natural water in a sustainable manner. Rain is a blessing of nature. Densely populated cities like PUNE with a water crisis and adequate rainfall should adopt this technology. Cities like PUNE, where water is a major concern during summers, should introduce this system along with its traditional water supply system. Natural recharging through RWH is the only answer to the water crises in the city. Regular maintenance of harvested water might make it suitable for daily consumption. Water shortages will become the most concerned issue all around the world in the future. Therefore, city planners should rethink of the possibilities, outcome, and benefits of a rainwater harvesting system and should create policies to make the system easily available to everyone. The following research could be made in future.

1. This study focused only on rainwater harvesting system on a small scale basis. Further research could be performed on large scale residential, commercial or industrial sector
2. Case studies could be investigated to evaluate the effectiveness of RWHS.
3. A comprehensive cost-benefit analysis should be performed on different climate regions to get essential insight on the Economic viability of rainwater harvesting system (RWHS).
4. Research could also be done to enhance the quality of rainwater harvested and increase its potable use.

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