



ROOFTOP RAINWATER HARVESTING A GOOD SOCIAL INITIATIVE, BUT A NON SUSTAINABLE OPTION FOR MODERN URBAN LANDSCAPE- PUNE CITY A CASE STUDY



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Abstract

Rainwater harvesting has been made compulsory for all new projects that are being implemented within and around urban centers, Pune is no exception to this rule. The government is offering incentives both to builders and the buyers to promote Rainwater harvesting. This revival of the traditional practices of Rainwater harvesting is in response to meeting the ever increasing short-fall of clean drinking water which the prevailing government infrastructure is unable to meet. Rather than planning for a sustainable growth pattern based on the available resources and infrastructure capabilities, Rainwater harvesting is being projected as the means of achieving sustainability for meeting the demands of clean water.

Even though Rainwater harvesting is definitely a social responsibility of every citizen, as it ensures that the natural groundwater system is maintained. The roof top waters could also be diverted to artificial storage and used for meeting the raw water demand, which would be another obvious conclusion any normal person could arrive at, but the reality is very different and shocking.

The present paper tries to highlight the issues related to the shortfalls, inefficiencies of the implementation of Rainwater harvesting systems as a sustainable solution to meet the ever increasing demand for water in the summer months due to increasing urban population.

Keywords

Rainwater harvesting, Sustainable development, water demand

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Introduction

The last decade has seen an exponential increase in the urban sprawl; this is true for all big cities. With rapid urbanization, which spread to areas where the availability of basic amenities such as Clean Drinking water could not be arranged by the Municipal authorities led to the increased stress on Groundwater to meet the daily requirements, which in the initial stages was restricted only to the fringe areas, but within a short span has led to groundwater resources complementing the municipal water supply which is grossly inadequate because of the unexpected increase in population within urban centres in the last decade.

The Government Authorities being influenced by the western models for Artificial Groundwater Recharge as an easy solution to tackle these problems have made it mandatory for new projects to implement Artificial Ground Water Recharge measures, and also offer tax concessions to existing societies where Artificial Groundwater Measures are implemented.

Currently Rainwater harvesting has been made compulsory for all projects that are being implemented within and around many urban centers, Pune is no exception to this rule. The government is offering incentives both to builders and the buyers to promote Rainwater harvesting. This revival of the traditional practices of Rainwater harvesting is in response to meeting the ever increasing short-fall of clean drinking water which the prevailing government infrastructure is unable to meet. Rather than planning for a sustainable growth pattern based on the available resources and infrastructure capabilities, Roof top Rainwater harvesting is being projected as the means of achieving sustainability for meeting the demands of clean water.

Even though Rainwater harvesting is definitely a social responsibility of every citizen, as it ensures that the natural groundwater system is maintained. The roof top waters could also be diverted to artificial storage and used for meeting the raw water demand, which would be another obvious conclusion any normal person could arrive at, but the reality is very different and shocking.

The Important Issue

Supported by our understanding and as per the instructions and guidance set in within the “Manual on norms and standards for environment clearance of large construction projects; Ministry of Environment and Forests, Government of India”, which is based on the National Building code, 2005. Page 83, Section 2.9.3.2 at implementation stage

Point no 3. Design storage/recharge structures:

Rainfall pattern and quantity is the prime determinant of the type of structures to be constructed for harvesting rainwater in a site. The number of annual rainy days also influences the need and design for rainwater harvesting.

The fewer the annual rainy days or longer the dry period the more is the need for rainwater collection in a region. However, if the dry period is too long, big storage tanks would be needed to store rainwater. Hence in such regions, it is more feasible to use rainwater to recharge groundwater aquifers rather than for storage.

Page 84, Section 2.9.2.3

Artificial recharge structures In urban areas with the rainfall limited during the monsoon period (usually from 15-90 days) rooftop rainwater cannot be stored and used as mentioned above and is best

used for recharging the ground water (NBC,2005).

And as it has been clearly mentioned by A.K. Gupta Professor, Track IRICEN, Pune in his book entitled “Rainwater Harvesting” published by Indian Railways Institute of Civil Engineers, 2006. Page 9, Chapter 2: Methods of Rainwater harvesting, section

2.1.1 Storing rain water for direct use

In place where the rains occur throughout the year, rainwater can be stored in tanks. However, at places where rains are for 2 to 3 months, huge volume of storage tank would have to be provided. In such places, it will be more appropriate to use rain water to recharge ground water aquifers rather than to go for storage.

If the strata are impermeable, then storing rain water in storage tanks for direct use is a better method. Similarly, if the ground water is saline /unfit for human consumption or ground water table is very deep, this method of rain water harvesting is preferable.

Keeping this in mind if one were to resort to rainwater harvesting and recharge the ground, and the aquifer is once again filed to capacity; one would think that the problem gets solved.

According to Lalwani 2004 & Singhal, 1997 the storage volume within the hard rock aquifers of the deccan basalts is limited, and the aquifers normally are recharged to full capacity, in spite of this due to the over exploitation of the system the borewells tend to have a remarkable decrease in the yield that can be derived from them, and this leads to water scarcity and shortage especially in the summer months of April and May.

If one was to disregard the norms set by the government agencies for creating a storage to harvest rainwater, to meet the fresh water demand in the summer months which due to the present trend of ever increasing of building heights with increase in FSI and increasing the number of floors permitted to be built within metropolitan areas to accommodate the ever increasing population without evaluating the available infrastructure and availability of clean drinking water is really an impossible task.

The Problem

Theoretically speaking if 100% rainwater that falls on every roof is diverted in to a storage, in the case of Pune city where rainfall is 700 mm (figure 1), and plot is 1000 m², which would have a storage tank created and hope to use this water during the summer months.

The major constraints for achieving this other than the problems one would have to face to ensure that the quality of water does not deteriorate due to contamination are:

1. Space – Space being a major constraint, to accommodate such a huge structure within the area and in a scenario where extra space means extra investment it is a costly solution.
2. Tank Size: With an average annual rainfall of around 700 mm in Pune (Figure 1) as per the Table 1, one would require a Tank capacity size of 700 m³ (approximate dimensions would be 15m x 12m and 4 m deep)
3. Cost: Disregarding land cost one would require about Rupees 4,200,000.00, considering construction cost @ 6 Rs. /liter.
4. There is always a problem of ensuring that the water that is stored in tanks does not get contaminated.



5. *One cannot predict the weather, and with drought being a common recurring phenomenon the availability of water by Rainwater harvesting is always a big question mark.*

The Reasoning

Even after one was to disregard these problems, rooftop rainwater harvesting is really not a sustainable option, the reasons for this being:

1. *Every few years the civic authorities revise the development rules and as there is a constraint of spreading laterally, building permissions are given to increase the number of floors to accommodate the increase in floor space Index (FSI) this gives rise to an increasing number of tenements and number of people living within the same existing roof top catchments areas*

2. *As number of tenements increase, the amount of water requirement increases and beyond a ratio of 1 : 70, as nearly 70 sq m of area is required per person with 100% efficiency of collection to meet yearly water demand and to meet 2 months water requirement an average of nearly 12 sq m of roof area per person is essential to be maintained or there would be a deficit in available water that is harvested. (FIGURE 2)*

Conclusion

In present day times of water stress due to failure of monsoons which has limited the access to clean water, the problem has amplified due to the uncontrolled urbanization in the last decade, rainwater harvesting does seem to be a viable option to supplement the existing water sources, but to promote rooftop harvesting as a sustainable solution to overcome this deficit in fresh water availability in the summer months is definitely not viable long-term or short-term option.

Rainwater harvesting is definitely a social responsibility of every citizen, as it ensures that the natural groundwater system is maintained, but here the benefits are limited, it helps in reducing the surface run-off during the monsoon seasons controlled by the recharge and storage capacity of the aquifers, but this artificial induced storage is not necessarily available during the summer months, especially when one understands that groundwater is always in a dynamic state and is always flowing. Storing, this water in artificially constructed tanks is also not a viable option as availability of water is not guaranteed, and the amount of water that can be stored is far less than what would be required in actual.

References

1. *A.K. Gupta, Rainwater Harvesting- pub. Indian Railways Institute of Civil Engineering, Pune, August, 2006.*
2. *CGWB - UNESCO, Rainwater Harvesting and Artificial Recharge to Groundwater: A Guide to Follow. Central Groundwater Board – International Hydrological Program (IHP), New Delhi. 2000*
3. *CGWB Manual on Artificial Recharge of Ground water, Government of India, Ministry of Water Resources, September 2007.*
4. *CPWD, Rainwater Harvesting and Conservation Manual, New Delhi. 2002*
5. *IMD, Pune , http://imdpune.gov.in/weather_forecasting/clmt_normals/clm_index.html*
6. *Lalwani, A, Efficacy of Rooftop Rainwater harvesting for Artificial Recharge to Groundwater*

within the Deccan Basalts in Urban Areas, (Abstract) Workshop on Rainwater Harvesting in Urban areas, Organized by Epicons Friends of Concrete, Mumbai, April 2004

7. National Building Code, Bureau of Indian Standards, 2005.

8. Singhal, B.B.S. , Hydrogeological characteristics of Deccan trap formations of India, Hard Rock Hydrosystems (Proceedings of Rabat Symposium S2, May 1997).IAHS Publ. no. 241, 1997.

FIGURE 1 : Climatological Information for Pune
25 years average (1982-2006)

Months	Av. Annual Rainfall (mm)	Rainy Days
Jan	1.7	0.2
Feb	1.5	0.1
Mar	0.6	0.1
Apr	9.8	0.9
May	30.0	2.2
Jun	171.4	9.6
Jul	171.0	12.2
Aug	139.5	9.8
Sept	141.7	7.9
Oct	85.8	4.7
Nov	21.5	1.2
Dec	7.4	0.4
Total	781.9	49.4

Modified After:

IMD, Pune , http://imdpune.gov.in/weather_forecasting/clmt_normals/clm_index.html

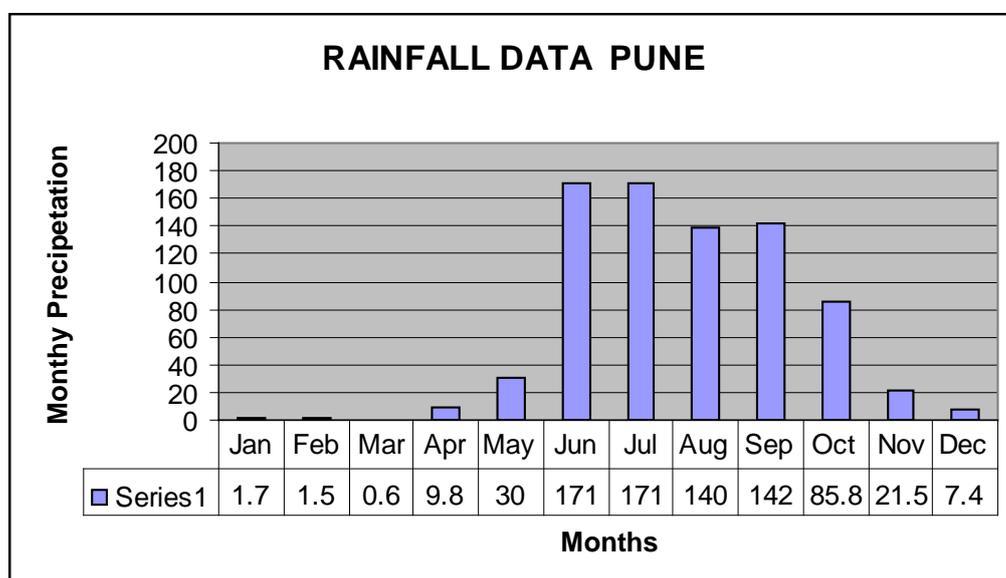
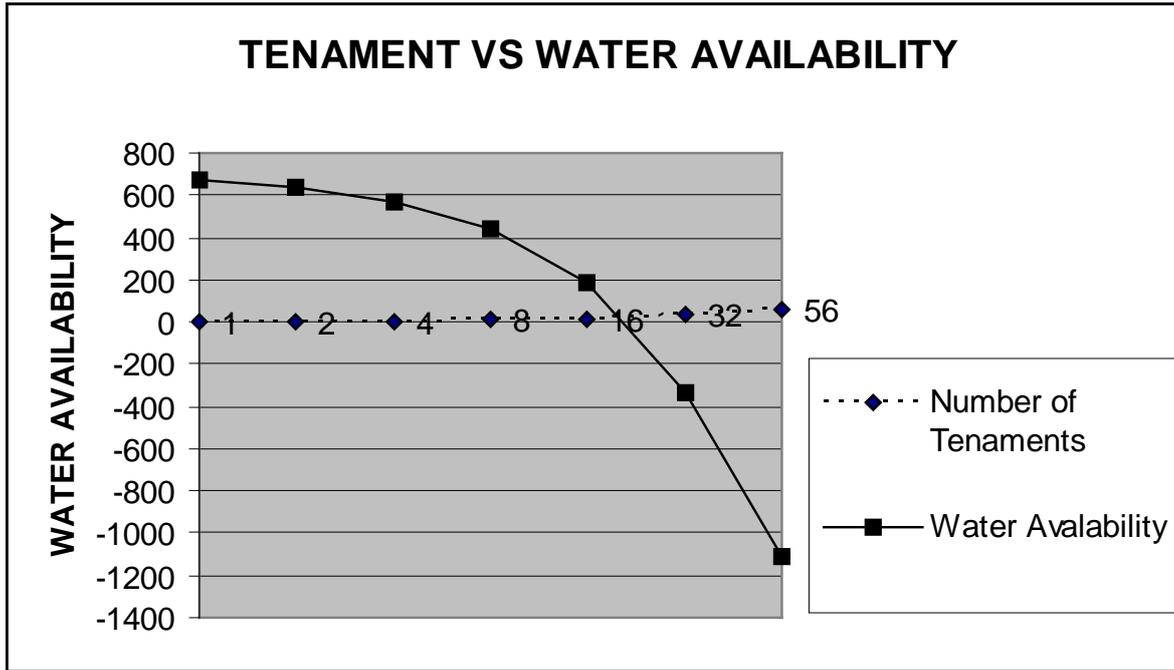




FIGURE 2 WATER AVAILABILITY CHART



Note: 4 residents per tenement

Average Annual Rainfall (In mm)	Roof Size (in meter ²)	RAIN WATER HARVESTING POTENTIAL (In meter ³)	TANK SIZE (In meter ³)	Number of Tenements (7 floor Bldg, 8 flats / floor)	Cost of Tank (@ Rs 6/liter)
700	1000	700	700	56	4,200,000.00

No of Tenements	No of people	Daily water Requirement (@135 l/p/day) (in meter ³)	Monthly Water Requirement (In meter ³)	2 Summer Month Water Requirement (In meter ³)	Yearly water Requirement (In meter ³)	Cost of storage tank (Rupees)	Deficit In summer water (In meter ³)	Deficit In yearly water (In meter ³)
1	4	0.54	16.2	32.4	194.40	4,200,000	667.60	505.60
2	8	1.08	32.4	64.8	388.80	2,100,000	635.20	311.20
4	16	2.16	64.8	129.6	777.60	1,050,000	570.40	-77.60
8	32	4.32	129.6	259.2	1,555.20	525,000	440.80	-855.20
16	64	8.64	259.2	518.4	3,110.40	262,500	181.60	-2,410.40
32	128	17.28	518.4	1036.8	6,220.80	131,250	-336.80	-5,520.80
56	224	30.24	907.2	1814.4	10,886.40	75,000	1,114.40	-10,186.40



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