DOMESTIC ROOF TOP RAINWATER HARVESTING - A CASE STUDY OF VILLAGE

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Abstract

Madgyal is a small village located at distance of 25 Kms from Jath city, District – Sangli, state-Maharashtra (India). It lies between North latitude 17°02'56.94" and East longitude 75° 13'8.14".The paper describes a collaborative research effort aimed at the adaptation and development of affordable technologies for capturing and retaining rainwater runoff including that from roof tops; and using this as a valuable source of water to supplement the water needs of households in drought area. The Project will verify the extent to which adoption of the adapted technologies could help greatly in conserving water resources in the semi-arid regions in developing countries and at the same time helping to alleviate poverty by improving the quality of life of women and children in these regions. The rainwater harvesting systems will be designed. It is envisaged that the systems would enable poor households in the community to supplement their water supply needs as well as engage in small scale backyard gardening; extend their cropping seasons through improved security of water resources, ultimately enhancing food security and contributing to poverty reduction.

Keywords: *Rainwater harvesting; poverty reduction; collaborative research; water reuse*

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1. INTRODUCTION AND OVERVIEW

The concept of rainwater harvesting involves 'tapping the rainwater where it falls'. A major portion of rainwater that falls on the earth's surface runs off into streams and rivers and finally into the sea. An average of 8-12 percent of the total rainfall recharge only is considered to recharge the aquifers. The technique of rainwater harvesting involves collecting the rain from localized catchment surfaces such as roofs, plain / sloping surfaces etc., either for direct use or to augment the ground water resources depending on local conditions. Construction of small barriers across small streams to check and store the running water also can be considered as water harvesting. In Urban areas, the roof top rainwater can be conserved and used for recharge of ground water. This approach requires connecting the outlet pipe from rooftop to divert the water to either existing wells/ tube wells/bore well or specially designed tank. The urban housing complexes or institutional buildings have large roof area and can be utilizing for harvesting roof top rainwater to recharge aquifer in urban areas. In Madgyal areas, ground water is the major source of drinking water. In a typical domestic roof top rainwater harvesting system, rainwater from the roof is collected in a storage vessel or tank for use during periods of scarcity. Such systems are usually designed to support the drinking and cooking needs of the family and comprise a roof, a storage tank and guttering to transport the water from the roof to the storage tank. In addition, a first flush system to divert the dirty water, which contains debris, collected on the roof during non-rainy periods and a filter unit to remove debris and contaminants before water enters the storage tank are also provided. Accurate estimate of surface area of the catchment is a necessary prerequisite for planning the scheme.

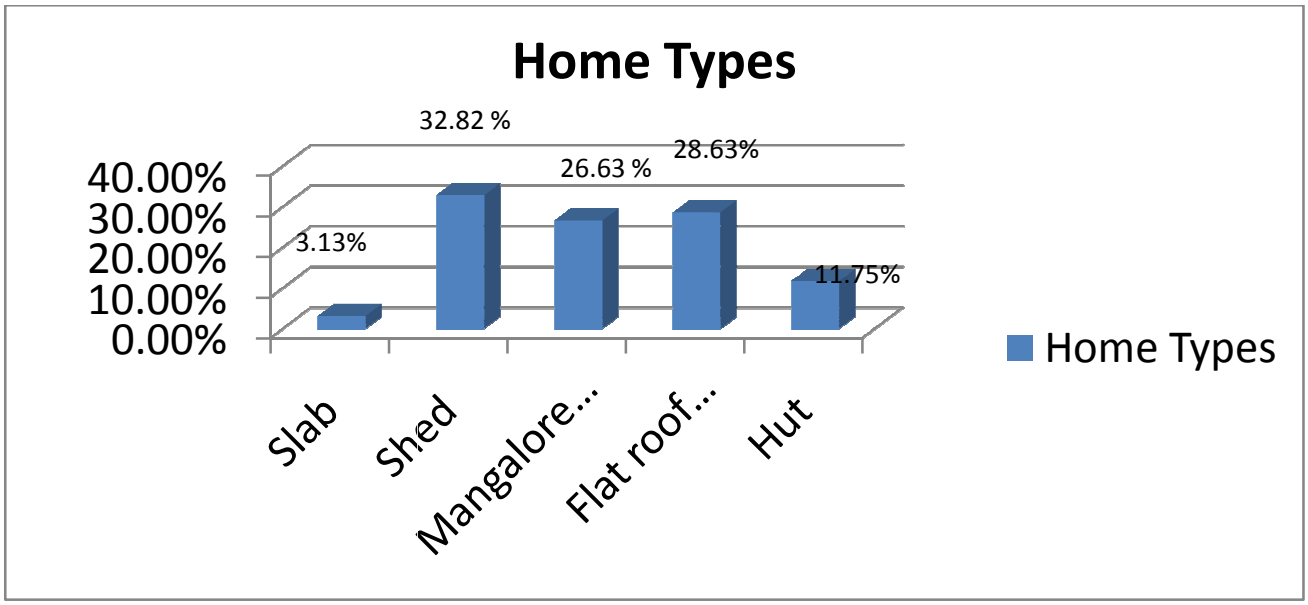
Rainfall in the country is typically monsoonal in nature. In Madgyal village it varies from 160mm to700mm with average yearly rainfall 380mm. Rainfall data is very important data in planning the roof top rainwater harvesting for study area. It is a meteorological parameter to decide a quantitative approach for arriving at water availability in an area. Climate is a determining factor for the management of all aspects. Rainfall data for 10 years is collected from metrological department.

1.1 Drinking Water

The water sources in the village are not perennial. The village women and children travel half kilometer a day during June to January for fetching water from nearby wells and tube well. The situation is worse in winter and summer seasons (during January to May). On an average they cover 4 Kms to and fro to fetch water for daily domestic requirements. Men do not participate in rainy season for fetching water; however, a thin participation is there during the months of January and May. It indicates that this area is drought area and requirement for roof top rainwater harvesting system.

1.2 Residential Status (Housing Condition)

Residential states means the housing condition in Madgyal village is very important. In the Madgyal village there are five main types of home- slab, shed, Mangalore tile, flat roof soil type and hut. As per socio-economic survey, show the % and types of homes. Slab (3.14%), Mangalore tile (26.63%), flat roof soil type (28.63), shed (32.82%) are available. For the type home, watershed management technique like roof top rainwater harvesting technique is to be suggested.



1.3 Problems of Water Scarcity

After socio-economic survey observed following points. The water shortage in the Madgyal village has led to various socio-economic problems related to their daily life. In this section an attempt is made to recognize and understand these issues, in the form of an alternative technology for development. What are the consequences of water scarcity? Which groups suffers more from this problem? How are the social, economic, health conditions? Interviews and focused group discussions helped us to understand the following issues with reference to water scarcity in the village.

1. The lack of water availability in the region post –monsoon, has resulted in the shortage of drinking water in the village.
2. The lack of drinking water has resulted in increased burden on women in the summer seasons; they have to walk 2 to 6 Km daily to fetch drinking water. The parents usually engage their daughter's in the water fetching work, which has resulted in the low education rate among the women because parents do not send their daughters to the school.
3. The lack of clean drinking water also resulted in the spread of various waterborne diseases among the villagers like jaundice, dehydration etc.
4. The lack of water availability also resulted in low agriculture production due to no availability of water for irrigation purposes.
5. Water scarcity in the village also resulted in the lack of fodder production and even the common pasture land in the nearby areas of village dried up in the summer season due to low water level. This has severely affected the livestock in the village.
6. Shortage of water also resulted in various changes in the social condition of the village. The people from outside villages are generally doing not prefer to marry their daughter in the village. They felt that if they give their daughter in marriage in the village then her entire life would be devoted to the task of fetching the water.
7. Water scarcity over a long period has led to an increase in migration of people to the urban areas. The villagers generally migrate to other areas in the summer season for working cutting of sugar cane etc.

To solve these entire problems or to reduce intensity of problem water availability as well as water management is very important. To overcome these problem watershed management techniques such as roof top rainwater harvesting, is essential. These techniques improve water availability also increase the ground water table.

Design Details

Size of storage tank (in liters) = No. of persons in the household X Period of water scarcity
(In days) X Per capita water requirement (in lt. /day)

Assume 6 people in one household & per capita water requirement 6 lit/day

Period of water scarcity for the domestic needs = 120 day
Size of storage tank (in liters) = 6*120*6
= 4320 lit say 5000 lit
Average annual rainfall =38.2cm
Dia. of collecting pipe =0.1m
Size of tank= 5000litr.

Shed Type Home
Roof area= 60 Sq. m.
Annual available water =Roof area*rainfall*runoff coefficient
=60 *0.38*0.9
= 20.52 cu. m.
Total no of shed home=282
Total available water=282*20.52
=5786 cu. m.

Mangalore Tile Home
Roof area= 120 Sq. m
Annual available water =Roof area*rainfall*runoff coefficient
= 120*0.38*0.8
= 36.48 cu. m

Total no of Mangalore tile home=203
Total available water=203*36.48
=7405 cu. m

Slab Type Home
Roof area= 94.5 Sq. m
Annual available water =Roof area*rainfall*runoff coefficient
= 94.5*0.38*0.9
= 32.31 cu. m.
Total no of Slab type home=27
Total available water=27*32.31
=872 cu. m.

Flat Roof Soil Type Home
Roof area= 72 Sq. m
Annual available water =Roof area*rainfall*runoff coefficient
= 72*0.38*0.6
= 16 cu. m.
Total no of Flat soil type home=246
Total available water=246*16
=4038 cu. m.
Total water available in one monsoon= 18101 cu. m.

CONCLUSIONS

One of the most logical steps towards this goal would be acknowledging the importance of rainwater harvesting. This should not only encompass rooftop rainwater harvesting but also storm water harvesting systems. A planned approach is hence needed in order to fully utilize the potential of rainwater to adequately meet our water requirements. Hence, an equal and positive thrust is needed in developing and encouraging the water harvesting systems. We have to catch water in every possible way and every possible place it falls.

It can be concluded from above findings that rainwater, if conserved and utilized using the rainwater harvesting technology, can be an effective tool of replenishing ground water resources

There is a need for advocacy for more adoption of rain water harvesting to the larger community members, both at policy and lower levels to foster adaptation strategies to climate change impacts through rain water harvesting technology.
• This study recommends that if villagers in Madgyal village adopt the improvement strategies identified by this study, water availability in the area will highly be improved.
• Increase in water availability will improve agricultural yield and their livelihood at large. Through that way, the adaptation to climate change impacts will therefore be possible.

REFERENCES

[1]. Deusdedit Kibassa, Indigenous Rain Water Harvesting Practices for Climate Adaptation and Food Security in Dry Areas: The Case of Bahi District, African Technology policy studies Network, 2013, Pp-1-19.
[2]. Amos Kabo-Bah1*, Robert Andoh2, Samuel Nii Odai1 and Kwabena Osei2, "Affordable Rainwater Harvesting Systems: A Collaborative Research Effort" 11th International Conference on Urban Drainage, Edinburgh, Scotland, UK, 2008, Pp-1-10
[3]. Bharat R. Sharma and Christopher A. Scott "Watershed Management Challenges: Introduction and Overview'' International Water Management Institute, South Asia Regional Office, New Delhi/Patancheru, India, 2005 Pp.1-21
[4]. Suhas P. Wani and Y.S. Ramakrishna ''Sustainable Management of Rainwater through Integrated Watershed Approach for Improved Rural Livelihoods'' International Water Management Institute, South Asia Regional Office, New Delhi/Patancheru, India, 2005 Pp.39-60
[5]. Hiroaki FURUMAI*, Jinyoung KIM**, Masahiro IMBE***, and Hiroyuki OKU "Recent application of rainwater storage and harvesting in''
[6]. Texas Manual on Rainwater Harvesting. Texas Water Development Board. Austin, Texas.
[7]. * R. Amarnath Babu "Roof Top Rain Water Harvesting System In Deccan Plateau Region, Andhra Pradesh, India.''
[8]. Arun Kumar Dwivedi1 and Sudhir Singh Bhadauria2 "Domestic Rooftop Water Harvesting- A Case''ARPN Journal of Engineering and Applied Sciences, VOL. 4, NO. 6, AUGUST 2009, Pp-31-38.
[9].Aditya Kumar Patra, Sneha Gautam,"A pilot scheme for roo ftop rainwater harvesting at Centre of Mining Environment, Dhanbad ''International Journal Of En vironmental Sciences Volume 1, No 7, 2011 , Pp-1542-1548.
[10]. Book- WATER By Dr.R .Nagrajan