Rain Water Harvesting and Its Methods

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***Abstract*— Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, the land surface or rock catchments using simple techniques such as jars and buckets as well as more complex techniques such as underground dams. Rainwater harvesting — collecting and storing rain for later use — is an ancient practice. It is still used in many rural places throughout the world, and today it is making a comeback in urban centres as an additional source of water Commonly used systems are constructed of three principal components; namely, the catchment area, the collection device, and the conveyance system.**

Keywords*— *Rain water harvesting , Catchment area, Conveyance system , Surface runoff, Filtration

I. INTRODUCTION

The application of an appropriate rainwater harvesting technology can make possible the utilization of rainwater as a valuable and, in many cases, necessary water resource. Rainwater harvesting has been practiced for more than 4, 000 years, and, in most developing countries, is becoming essential owing to the temporal and spatial variability of rainfall. Rainwater harvesting is necessary in areas having significant rainfall but lacking any kind of conventional, centralized government supply system, and also in areas where good quality fresh surface water or groundwater is lacking. Annual rainfall ranging from less than 500 to more than 1 500 mm can be found in most Latin American countries and the Caribbean. Very frequently most of the rain falls during a few months of the year, with little or no precipitation during the remaining months. There are countries in which the annual and regional distribution of rainfall also differ significantly. For more than three centuries, rooftop catchments and cistern storage have been the basis of domestic water supply on many small islands in the Caribbean. During World War II, several airfields were also turned into catchments. Although the use of rooftop catchment systems has declined in some countries, it is estimated that more than 500 000 people in the Caribbean islands depend at least in part on such supplies. Further, large areas of some countries in Central and South America, such as Honduras, Brazil, and Paraguay, use rainwater harvesting as an important source of water supply for domestic purposes, especially in rural areas.

In many cases, groundwater or surface water may be unavailable for drinking water. The groundwater level may be too deep, groundwater may be contaminated with minerals and chemicals such as arsenic or salt, surface water may be contaminated with faeces or chemicals. In these cases, rainwater harvesting can be an effective and low-cost solution.

The good thing about rainwater is that it falls on your own roof, and is almost always of excellent quality. Several studies have shown that water from well-maintained and covered rooftop tanks generally meets drinking water quality standards. It enables households as well as community buildings, schools and clinics to manage their own water supply for drinking water, domestic use, and income generating activities. It provides the luxury of "water without walking", relieving the burden of water carrying, particularly for women and children. Each 20 litre container of clean water might save a kilometers long walk to the nearest source of clean water, and as fetching water on cold, wet and slippery days is particularly unpleasant. This convenience is available at every house on which rain falls, whether on a mountaintop or an island in a salty sea. Another option is to use water from different sources. Water that is salty or has arsenic might still be good enough for washing and sanitary purposes. High-quality rainwater, caught and stored in a tank can then be used for drinking and cooking. Normally,debris, dirt and dust get deposited on the roof during non-rainy periods.When the first rains arrive, this unwanted material will be washed into the storage tank. This may cause contamination of water collected in the storage tank thereby rendering it unfit for drinking and cooking purposes. Therefore, a first flush system can be Incorporated in the Roof top Rainwater Harvesting Systems (RRHS) to dispose of the first flush so that it does not enter the tank. There are two such simple systems. One is based on a simple manually operated arrangement whereby, the down pipe is moved away from the tank inlet and replaced again once the first flush water has been disposed. In another simple and semi automatic system, separate vertical pipe is fixed to the down pipe with a valve provided below the T junction. After the first rain is washed out through the first flush pipe the valve is closed to allow the water to enter the down pipe and reach the storage tank.

II. BASIC COMPONENTS OF RAINWATER STORAGE SYSTEM

All rainwater harvesting systems, simple or complex, have the same basic components:

1). Collection Area : Roof surfaces provide an opportunity for rainwater capture.

2). Conveyance System : This is used to transfer water and is comprised of gutters or flat roof drainage holes, and downspouts and piping.
3). Water Storage : It may be above or below ground and can be comprised of a single container or multiple containers. A *storage system* to hold the rainwater for future use — a barrel, a cistern or a tank.
4). Filtration : To keep debris out of the system.
*5)*A *distribution system* : To get the water from storage to where it is being used — this can range from a watering can to full integration with the existing plumbing system in the house.

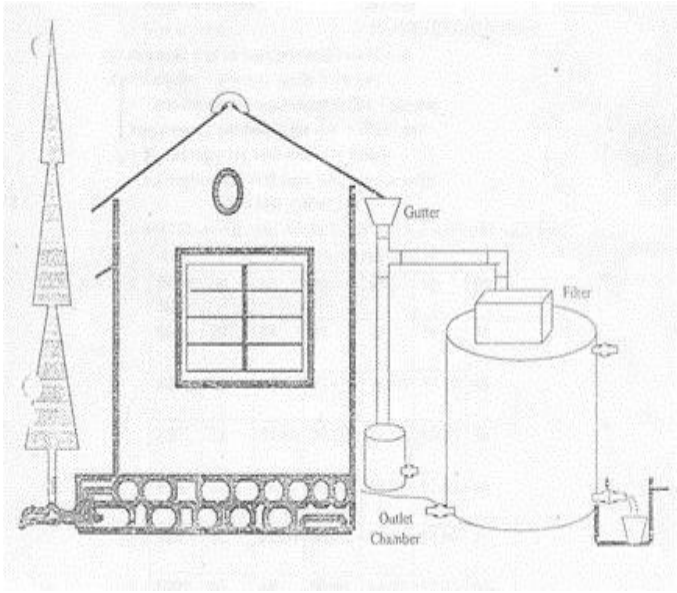

Fig. 1 Component of rain water storage system

III. METHODS OF RAINWATER HARVESTING

Broadly there are two ways of harvesting rainwater.

- Surface runoff harvesting
- Roof top rainwater harvesting

Various methods of rainwater harvesting are described in this section.

A. 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. Surface runoff can be generated either by rainfall,snowfall or by the melting of snow, or glaciers.
Snow and glacier melt occur only in areas cold enough for these to form permanently. Typically snowmelt will peak in the spring and glacier melt in the summer, leading to pronounced flow maxima in rivers affected by them. The determining factor of the rate of melting of snow or glaciers is both air temperature and the duration of sunlight. In high mountain regions, streams frequently rise on sunny days and fall on cloudy ones for this reason.
In areas where there is no snow, runoff will come from rainfall. However, not all rainfall will produce runoff because storage from soils can absorb light showers. On the extremely ancient soils of Australia and Southern Africa,[4] proteoid roots with their extremely dense networks of root hairs can absorb so much rainwater as to prevent runoff even when substantial amounts of rain fall. In these regions, even on less infertile cracking clay soils, high amounts of rainfall and potential evaporation are needed to generate any surface runoff, leading to specialised adaptations to extremely variable (usually ephemeral) streams.

Fig. 2 surface runoff

B. Roof Top 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 ground water level of the area.

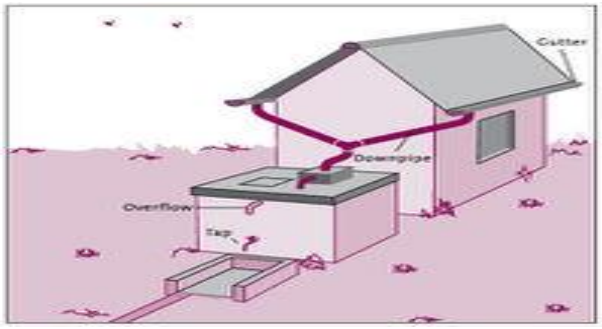

Fig. 3 roof top for rain water harvesting

IV. RAINWATER HARVESTING IN DIFFERENT TYPE OF BUILDINGS

A. Sloping roofs

Roofs made of corrugated iron sheet, asbestos sheet or tiles can be utilised for harvesting the rainwater. Gutters and channels can be fixed on the edges of roof all around to collect and transport the rain water from the roof to the storage tank. Gutters can be prepared in semi-circular and rectangular shapes. Locally available material such as plain Galvanized Iron sheets can be easily folded to required shapes to prepar semi-circular and rectangular gutters. Semi-circular gutters of PVC material can be readily

prepared by cutting the PVC pipes into two equal semi-circular channels. Bamboo poles can also be used for making gutters if they are locally available in sufficient quantity. Use of such locally available materials reduce the overall cost of the system.

FOR THATCHED ROOFS :STEP BY STEP APPROACH

1).If the roof is thatched, polythene sheets can be used for collecting the rainwater

Fig. 4 when polythene bags are used

2).The collected rainwater is filtered through a filter filled with pebbles in the bottom and coarse sand on the top

Fig. 4 filtration

3)The filtered water is collected either in storage tank of existing sump and the overflow water may be diverted to percolation pit nearby.

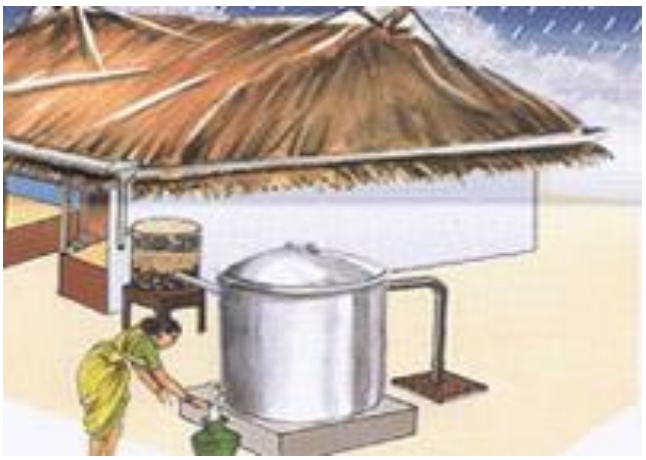

Fig. 4 rain water is stored in storage tank

FOR SLOPING /TILED :STEP BY STEP APPROACH

1)In a slopped/tiled house the rainwater from the roof is collected through the gutter in the roof.

Fig. 5 rain water collected in gutter

2)The collected water is filtered through a filter filled with pebbles in the bottom and coarse sand on the top.

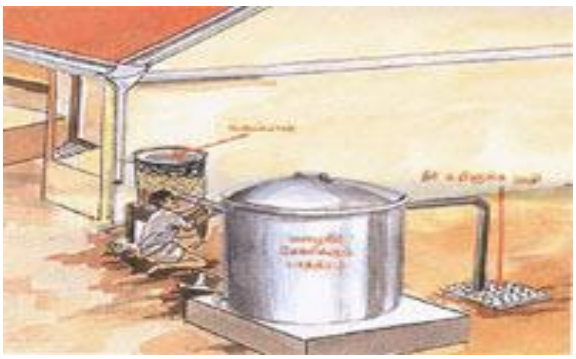

Fig. 6 rain water is stored in storage tank

3)The filtered water is collected either in a storage tank or existing sump. Over flow water may be diverted to an existing open well / bore well or percolation pit.

Fig. 7 rain water storage

2)FOR FLAT ROOF

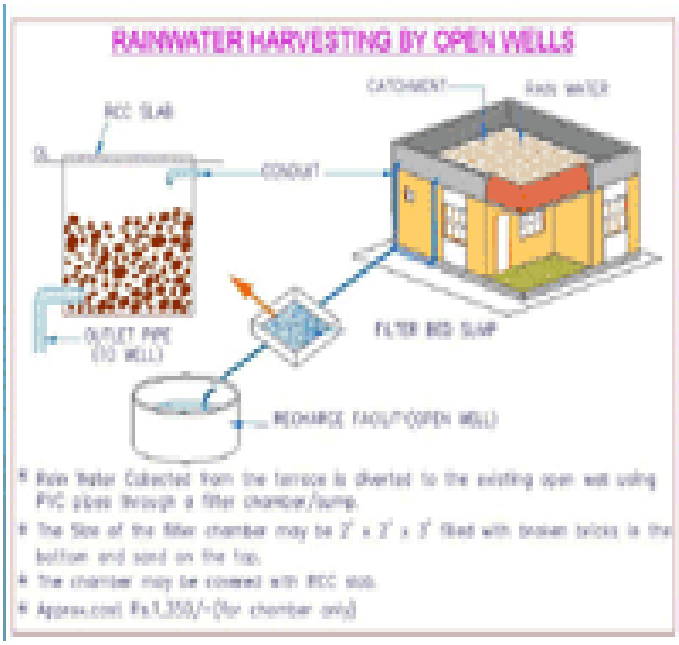

Fig. 8 rain water storage in flat slab

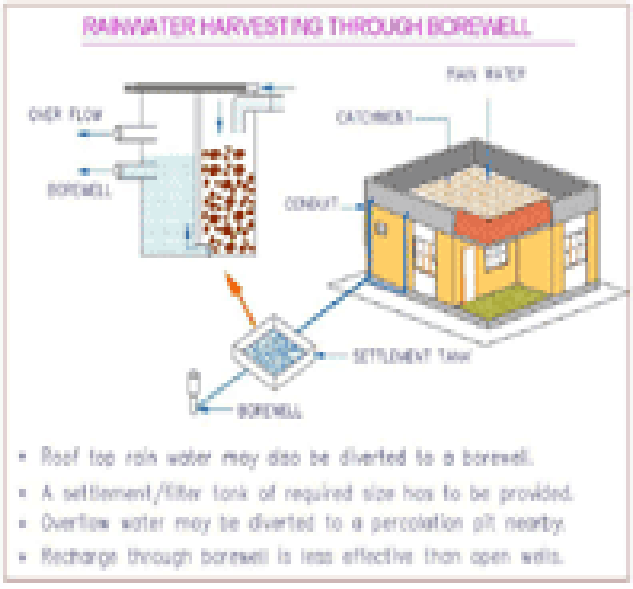

Fig. 9 rain water storage in flat roof

V. CONCLUSIONS

Rainwater harvesting is the most promising alternatives for supplying freshwater in the face of increasing water scarcity and escalating demand. The pressures on rural water supplies, greater environmental impacts associated with new projects, and increased opposition from NGOs to the development of new surface water sources, as well as deteriorating water quality in surface reservoirs already constructed, constrain the ability of communities to meet the demand for freshwater from traditional sources, and present an opportunity for augmentation of water supplies using this technology. There is a need for the water quality aspects of rainwater harvesting to be better addressed. This might come about through: Development of first-flush bypass devices that are more effective and easier to maintain and operate than those currently available. Greater involvement of the public health department in the monitoring of water quality. Monitoring the quality of construction at the time of building. Other development needs include: Provision of assistance from governmental sources to ensure that the appropriate-sized cisterns are built.

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