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RAIN WATER HARVESTING

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ABSTRACT

Major parameters and optimum storage volumes of rooftop rain water harvesting systems (RRWHSs) have not been investigated in detail in Taiwan. Accordingly, the four major parameters of RRWHSs were herein identified and elucidated using a simulation method. Because the performance of the RRWHSs is sensitive to the runoff coefficient, a field experiment was conducted to determine the runoff coefficient more precisely for various types of roofs. A simulation model including production theory was developed and employed to estimate the most cost effective combination of the roof area and the storage capacity that best supplies a specific volume of water. Consequently, the expansion path of optimum solutions for different volumetric reliability of water supply can be determined. Additionally, the method based on the marginal rate of substitution can be used for determining the rational volumetric reliability. The procedures developed herein constitute an effective tool for preliminarily estimating the most satisfactory storage capacity of any specific roof area and for determining the rational reliability of a corresponding water supply.

The largest environmental challenge that Jordan faces today is the scarcity of water. Current water use already exceeds renewable supply. Many methods have been suggested to increase the sources of water supply; one alternative source is rainwater harvesting. Rainfall harvesting from rural/urban catchments has not received large attention in Jordan. In the absence of run-off sewer systems in most Jordanian rural and urban areas, rainfall harvesting from roads, parking lots and rooftops can increase water supply for various domestic uses and help combat the chronic water shortages in the country. The objectives of this paper are to (1) evaluate the potential for potable water savings by using rainwater in residential sectors of the 12 Jordanian governorates; and (2) provide some suggestions and recommendations regarding the improvement of both quality and quantity of harvested rainwater. Results show that a maximum of 15.5 Mm^3/y of rainwater can be collected from roofs of residential buildings provided that all surfaces are used and all rain falling on the surfaces is collected. This is equivalent to 5.6% of the total domestic water supply of the year 2005. The potential for water harvesting varies among the governorates, ranging from 0.023×10^6 m^3 for the Aqaba governorate to 6.45×10^6 m^3 for the Amman governorate. The potential for potable water savings was estimated for the 12 governorates, and it ranged from 0.27% to 19.7%.Analysis of samples of harvested rainwater from residential roofs indicated that the measured inorganic compounds generally matched the WHO standards for drinking water. On the other hand, fecal coliform, which is an important bacteriological parameter, exceeded the limits for drinking water.

The thermal performance of the refrigerant-charged integrated solar water heater was analyzed to show its applicability in Nigeria, using data of several sunny and cloudy days.

METHODOLOGY

1. 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.

2.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.

3.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.

4.Recharging of bore wells

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchment, intensity of rainfall and recharge rate. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure.

First one or two shower should be flushed out through rain separator to avoid contamination.

4.Recharge pits

Recharge pits are small pits of any shape rectangular, square or circular, contracted with brick or stone masonry wall with weep hole at regular intervals. Top of pit can be covered with perforated covers. Bottom of pit should be filled with filter media.

The capacity of the pit can be designed on the basis of catchment area, rainfall intensity and recharge rate of soil. Usually the dimensions of the pit may be of 1 to 2 m width and 2 to 3 m deep depending on the depth of pervious strata.

These pits are suitable for recharging of shallow aquifers, and small houses.

5.Soakway or Recharge shafts

Soak away or recharge shafts are provided where upper layer of soil is alluvial or less pervious. These are bored hole of 30 cm dia. up to 10 to 15 m deep, depending on depth of pervious layer. Bore should be lined with slotted/perforated PVC/MS pipe to prevent collapse of the vertical sides.

At the top of soak away required size sump is constructed to retain runoff before the filters through soak away. Sump should be filled with filter media.

INTRODUCTION

It was very difficult to imagine few decades before that you will require to buy drinking. The use value of water was never undermined, but its about time that even its exchange value is given due importance. Fresh water today is a scarce resource, and it is being felt the world over. More than 2000 million people would live under conditions of high water stress by the year 2050, according to the UNEP (United Nations Environment Programme), which warns water could prove to be a limiting factor for development in a number of regions in the world. About one-fifth of the world's population lacks access to safe drinking water and with the present consumption patterns; two out of every three persons on the earth would live in water-stressed conditions by 2025. Around one-third of the world population now lives in countries with moderate to high water stress—where water consumption is more than 10% of the renewable fresh water supply, said the GEO (Global Environment Outlook) 2000, the UNEP's millennium report. Pollution and scarcity of water resources and climate change would be the major emerging issues in the next century, said the report. These issues would be followed by problems of desertification and deforestation, poor governance at the national and global levels, the loss of biodiversity, and population growth, said the report - The Observer of Business and Politics, 12 October 1999.

The reality of water crisis cannot be ignored. India has been notorious of being poor in its management of water resources. The demand for water is already outstripping the supply. Majority of the population in the cities today are groundwater dependent. In spite of the municipal water supply, it is not surprising to find people using private tube wells to supplement their daily water needs. As a result, the groundwater table is falling at an alarming rate. Extraction of groundwater is being done unplanned and uncontrolled thus this has resulted in: Hydrological imbalance Deterioration in water quality Rise in energy requirements for pumping Rain Water Harvesting, is an age-old system of collection of rainwater for future use. Butsystematic collection and recharging of ground water, is a recentdevelopment and is gaining importance as one of the most feasible and easy to implement remedy to restore the hydrological imbalance and prevent a crisis.

Technically speaking, water harvesting means A system that collects rainwater from where it falls rather than allowing it to drain away. It includes water that is collected within the boundaries of a

property, from roofs and surrounding surfaces. Experts suggest various ways of harvesting water: • Capturing run-off from rooftops • Capturing run-off from local catchments • Capturing seasonal flood water from local streams • Conserving water through watershed management

Local water harvesting systems developed by local communities and households can reduce the pressure on the state to provide all the financial resources needed for water supply. In addition, involving people will give them a sense of ownership and reduce the burden on government funds.

The scarcity of water is a well-known fact. In spite of higher average annual rainfall in India (1,170 mm, 46 inches) as compared to the global average (800 mm, 32 inches) it does not have sufficient water. Most of the rain falling on the surface tends to flow away rapidly, leaving very little for the recharge of groundwater. As a result, most parts of India experience lack of water even for domestic uses. Surface water sources fail to meet the rising demands of water supply in urban areas, groundwater reserves are being tapped and over-exploited resulting into decline in groundwater levels and deterioration of groundwater quality. This precarious situation needs to be rectified by immediately recharging the depleted aquifers.

Hence, the need for implementation of measures to ensure that rain falling over a region is tapped as fully as possible through water harvesting, either by recharging it into the groundwater aquifers or storing it for direct use.

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