RAINWATER HARVESTING (RWH)

Abstract

As we all are aware about the increasing rate of population day by day in the world, and how much the importance of water in our life. With the increasing population, drinking water demand also be increasing. Maximum population in the world depend on Surface and groundwater resources to fulfill their drinking water requirements. Utilization of resources are faster than they can be recharged. The main aim of Rain water harvesting is come into practice to mitigate the variation between utilization and recharge the ground water & surface water resources. Rainwater harvesting is an old practice that is being adopted by many nations as a viable decentralized water source. Rainwater harvesting is the tool to increase the inadequate water demand now a days.As the population increases day by we are are facing water shortage.Where small farmers depend on Monsoon but the rainfall season is only for few months approx four to five months.Rain water harvesting technique not only fulfill our drinking water requirements but also help to irrigate crops specially desert area.This paper reviews the methods, design of rainwater harvesting systems, and its impacts adopted in all parts of the world.

Keywords: Rainwater harvesting (Rainwater Harvesting), Mitigate, Ground water Recharge, Resources, Desert area, Stormwater Utilization, Irrigation.

Introduction

As the world population increases, the demand increases for quality drinking water. Surface and groundwater resources are being utilized faster than they can be recharged. Rainwater harvesting is an old practice that is being adopted by many nations as a viable decentralized water source. Individual rainwater harvesting systems are one of the many tools to meeting the growing water demand. Rainwater harvesting is an environmentally sound solution to address issues brought forth by large projects utilizing centralized water management approaches. Population growth all over the world is causing similar problems and concerns of how to supply quality water to all. As land pressure rises, cities are growing vertical and in countryside more forest areas are encroached and being used for agriculture. In India the small farmers depend on Monsoon where rainfall is from June to October and much of the precious water is soon lost as surface runoff. While irrigation may be the most obvious response to drought, it has proved costly and can only benefit a fortunate few. There is now increasing interest in the low cost alternative-generally referred to as 'Rain Water Harvesting' (Rainwater Harvesting).Rainwater harvesting is the tool to increase the inadequate water demand now a days. As the population increases day by we are are facing water shortage. Where small farmers depend on Monsoon but the rainfall season is only for few months approx four to five months.Rain water harvesting technique not only fulfill our drinking water requirements but also help to irrigate crops specially desert area

Rainwater harvesting

The harvesting of rainwater has the potential to assist in alleviating pressures on current water supplies and stormwater drainage systems. The same techniques sometimes have different names in different regions, and others have similar names but, in practice, are completely different (Oweis 2004). Consequently, there are a dozen different definitions and

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classifications of water harvesting techniques, and the terminology used at the regional and international levels has not yet been standardized (Nasr 1999). Rainwater collection has the potential to impact many people in the world. As water harvesting is an ancient tradition and has been used for millennia in most dry lands of the world, many different techniques have been developed. Water harvesting is the collection of runoff for productive purposes. According to Kim et al. (2005), rainwater harvesting may be one of the best methods available to recover the natural hydrologic cycle and enable urban development to become sustainable.

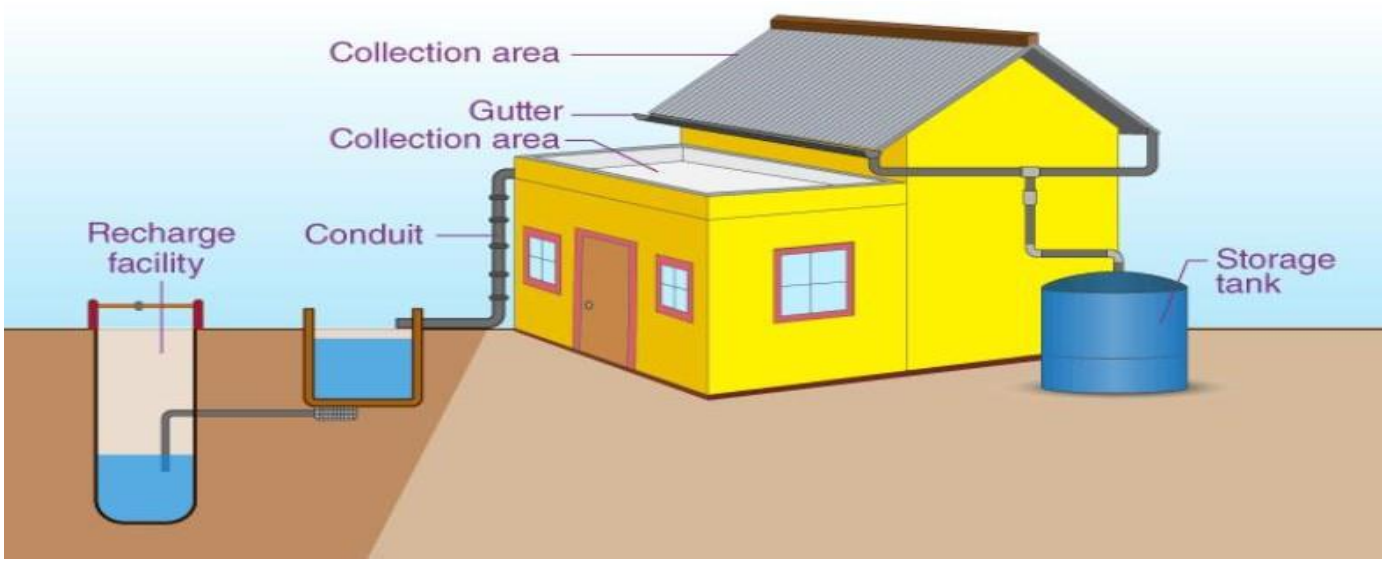

Fig-1

Advantages of rain water harvesting :-

- It is good for laundry use as rainwater is soft and lowers the need for detergents.
- It can be used to recharge groundwater.
- *It minimizes the runoff which blocks the storm water drains.*
- Rainwater is a clean and free source of water in comparison to other .
- Rainwater is necessary for plants and gardens due to chlorinated property.
- It can supplement other sources of water supply such as groundwater or municipal water connections system.
- Reduced flood flows and topsoil loss.
- It is free; the only cost is for collection and use.

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- It reduces the contamination of surface water with sediments, fertilizers and pesticides from rainwater run-off resulting in cleaner lakes, rivers, oceans and other receivers of storm water.
- It reduce the water supply cost.
- It can provide an excellent back-up source of water for emergencies situations.
- It is socially acceptable and environmentally responsible.
- It uses simple technologies that are less expensive and easy to maintain.
- It is used in those areas which face insufficient water resources.

Need of Rainwater Harvesting System:-As urban water supply system is under huge pressure for supplying water to the increasing population day by day.

- As water is becoming scarce, it is the need of the day to attain self-sufficiency to fulfill the water needs to ever increasing population.
- Groundwater is getting depleted and polluted.
- Soil erosion resulting from the unchecked runoff.

In general, Rainwater Harvesting systems for crop production are divided into three different categories basically determined by the distance between catchment area (CA) and cropped basin (CB) (utilization area):In-situ Rainwater Harvesting, internal (Micro) catchment Rainwater Harvesting and External (Macro) catchment Rainwater Harvesting (Hatibu and Mahoo 1999). Health hazards due to consumption of polluted water. i.e., storage within the soil profile and storage structures. The size of catchment yields two categories, i.e., macro catchments and micro catchments (within field).To give the general overview of the three categories, a short summary extracted from Hatibu and Mahoo (1999) for each is presented below.

Methods of rainwater harvesting

- Rainwater stored for direct use in above ground or underground sumps / overhead tanks and used directly for flushing, gardening, washing etc. (Rainwater Harvesting)
- Recharged to ground through recharge pits, dug wells, bore wells, soak pits, recharge trenches, etc. (Ground water recharge)

Rainwater harvesting studies all over the world

Crotchety (1991) defined it as the collection of runoff for productive use.Oweis (2004) defined it as the concentration of rainwater through runoff into smaller target areas for beneficial use.Rainwater harvesting is an ancient practice that has been increasingly receiving attention in the world, fueled by water shortages from droughts, pollution and population growth (Nolde 2007; Meera and Ahameed 2006).

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Kahinda (2008) defined Rainwater Harvesting is the collection, storage and use of rainwater for small- scale productive purposes. Mati (2006) defined Rainwater Harvesting as the deliberate collection of rainwater from a surface known as catchment and its storage in physical structures or within the soil profile.

Runoff may be harvested from roofs and ground surfaces as well as from intermittent or ephemeral watercourses and thus water harvesting falls into two broad categories: Water harvesting techniques which harvest runoff from roofs or ground surfaces named Rainwater Harvesting and all systems which collect discharges from water courses named flood water harvesting (Critchley *et al.* 1991). Rainwater Harvesting technologies and systems can be classified in several ways, mostly based on the runoff generation process, size of the catchment and type of storage.

The project utilized a number of GIS data sets including rainfall, land use, land slope, and population density to identify four major commonly adaptable Rainwater Harvesting technologies: roof top Rainwater Harvesting, surface runoff collection from open surfaces into were found to be effective for rising of water table in observation wells, located in the middle and lower reach of the watershed.Gitte and Pendke (2002) conducted a study on the water conservation practices, water table fluctuations and ground water recharge in watershed areas.A study by Ngigia (2005) in the Laikipia district, Kenya showed that improved farm ponds provide one of the feasible options of reducing the impacts of water deficit that affect agricultural productivity in semi-arid environments in Sub- Saharan Africa.

The study revealed that water conservation measures recover the full investment costs within 4 years United Nations Environment Programme (Mati *et al.* 2006) conducted a study to determine if Rainwater Harvesting technologies can be mapped at continental and country scales.The overall groundwater recharge due to corresponding rainfall was in the tune of 3.76 to 8.85 cm in the influence of area of soil and water conservation structure.

Main objective is to analyse their technical and economical feasibility as well as their affordability for future users. In detail, two small-scale Rainwater Harvesting systems are examined: roof catchments using corrugated iron roofs as rain collection areas and ground catchments using treated ground surfaces.Sturm.M in their paper entitled Rainwater Harvesting as an Alternative Water Resource in Rural Sites in Central Northern Namibia described the results of the investigations on rainwater harvesting (Rainwater Harvesting) in central northern Namibia which are part of the trans-disciplinary research project Curve Waters. On the basis of hydro-logical and technical as well as social and cultural conditions, appropriate solutions for Rainwater Harvesting are developed, discussed, and evaluated.

Cheng C.L et.al in their paper Regional rainfall level zoning for rainwater harvesting systems in northern Taiwan stated that Rainwater harvesting systems had been widely accepted as solutions to alleviate the problems of water shortages. The main objective of this paper is to recharge of aquifer by roof top rain water. He observes that in certain areas, the amount of total and fecal coliform were observed high in harvested tube well water than normal tube well water. The reason of this increases was poor cleanliness of roof top and poor efficiency

of filter for bacterial removal. The author concludes that quality mounting of rainwater harvesting is an essential prerequisite before using it for ground water recharge.

Rain water harvesting studies in India

Singh and Thapaliyal (1991) assessed the impact of watershed programme on rain fed agriculture in Jhansi district of Uttar Pradesh and indicated that the underground water table in the area showed a significant increase, the average annual increase in the water table being 3.7 meters. A shift in the construction of water harvesting structures.

Narayanagouda (1992) observed that a higher percentage of farmers had not adopted the practice of stabilization of bunds with vegetative species.He reported that the adoption level of soil and moisture conservation practices was higher among the participants of Chitravati watershed in Kolar district of Karnataka as compared to non-participants. However, lack of conviction and difficulty to establish were the dominant reasons for their lack of adoption.

Hazra (1997) in his observation of crop yield performance in Tejpura watershed reported that, due to soil and water conservation works and water storage structures, the wells , earlier used to fetch water for about 1 to 2 hours, fetched water for more than 8 to 10 hours due to the increased ground water table by 10 - 23 feet after the construction of water storage structures.

Bisrat (2000) in his study on economic analysis of watershed treatment through groundwater recharge of Basvapura micro watershed in Kolar district of Karnataka revealed that average yield of borewell increased from 1150 gallons per hour to 1426 gallons per hour that is by 24% due to construction of water harvesting structures.

Naidu (2001) in his study on Vanjuvankal watershed of Andhra Pradesh noticed that, because of water harvesting structures and percolation ponds the ground water level in watershed area showed a rise by 2 - 3 meters.

Deepak Khare et al (2004) have reviewed the impact assessment of Rainwater Harvesting on ground water quality at Indore and Dewas, India. The roof top rainwater was used to put into the ground using sand filter as preliminary treatment system. This lead to a reduction in the concentration of pollutants in ground water which indicated the effectiveness of increased the city by not allowing municipal sewage and industrial effluents in these tanks. The impact assessment of roof top improve the quality and quantity of Ground Water. He finally suggests that, wherever natural tanks are not existing, community recharge pits are to be constructed at hydro geologically suitable location.

Ravikumar et al (2003) describe the roof top rainwater harvesting in Chennai Airport using GIS. They explain the estimation of surface runoff using SCS method and design of rainwater harvesting structures in Chennai Airport Terminal buildings. Thematic maps were digitized in map Info GIS software and roof drainage delineation was done in GIS environment. Based on the topography and lithology of airport. the artificial recharge structures like recharge shaft, recharge well and recharge pit were designed and located.

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Kadirvelu (2002) describe the impact assessment of Rainwater Harvesting in madras University-Marina campus. He designed Rainwater Harvesting structures on the basis of the in situ soil conditions. It was constructed on the study area. The benefit cost ratio is also analyzed on the basis of construction cost of Rainwater Harvesting and the population to be served by the harvested rain.The frequent monitoring of three open wells was carried out. The water levels during the pumping before and after the implementation of Rainwater Harvesting are monitored. The water levels and the water quality are compared with the observation well which is situated near the study area and maintained by the Tamil Nadu Water Supply and Drainage Board . Finally, he concluded from the results that the quantity and quality are improved. The benefit cost ratio is also arrived to 2.38. The impact of Rainwater Harvesting is positive in the study area in view of improved in quantity, quality and benefit cost.

Rainfall analysis for the period of 1901-1990 for Amod, Jambusar and Vagra was carried out (Khandelwal et al. 2002) to determine the onset and withdrawal of effective monsoon, rainfall depth-duration relationship, irrigation and surface drainage requirement, as well as to develop design parameters for rainwater harvesting structures for cotton and pigeon pea under rainfed conditions were also determined using the CROPWAT model. Water requirement and irrigation scheduling results showed area from pulses to cereals and from cereals to pulses was observed in Rabi and Kharif seasons, respectively on the unit catchment area basis in Gujarat, India.

According to Muralidharan et al. (2007) precipitation is the principal source of replenishment of moisture in the soil through the infiltration process and subsequent recharge to the groundwater through deeper percolation. The amount of infiltrated moisture that will eventually reach the water table is accounted as the natural groundwater recharge. In this study an attempt on correlating the rainfall amount and subsequent rise in water level yielded an exponential relation indicating that daily rainfall exceeding 40 mm/day results in significant rise in water level.

Venkatesh and Jose (2007) conducted a rainfall study on the coastal and its adjoining areas in Karnataka State. It is observed that, the maximum rainfall occurs on the windward side ahead of the geographical peak. Further, mean monthly rainfall distribution over the zones has been depicted to enable agricultural planning in the study area.The statistical analyses conducted included cluster analysis and analysis of variance. The study revealed that there exist three distinct zones of rainfall regimes in the study area, namely,Coastal zone, Transition zone and Malanad zone.

Sreekanth et al. (2009) used a prediction model to forecast ground water level at Maheshwaram watershed, Hyderabad, India. The model efficiency and accuracy were measured based on the root mean square error (RMSE) and coefficient of determination (R2). The model provided the best fit and the predicted trend followed the observed data closely (RMSE = 4.50 and R2 = 0.93).

Anand (2000) in his study conducted in Bidar district of Karnataka revealed that the major problems/reasons for non-adoption or partial adoption of watershed technology include, lack of capital for contour bund and land leveling, unawareness of technology for compartment bunding and live bunds , lack of knowledge and hard sub-surface soil in opening of ridges and furrows and plantation of horticulture and forest tree species.

Naik (2000) reported the major reasons for non-adoption of water harvesting structures and grade stabilization structures in the Kanakanala and Indawar- Hullalli watersheds in Northern Dry Zone of Karnataka that non availability of credit and high interest rates were severe problems (69 percent each) followed by long gestation period (68%), high hiring charges of improved implements (65 percent) and small holdings (61 percent) etc. in the non-watershed area.

Nirmala (2003) reported that the farmer perception and constraints analysis under impact study of watershed development programme on socioeconomic dimensions in Ranga Reddy district of Andhra Pradesh and found that technologies were beneficial in the form of increased income (58.33 percent), increased moisture (51.66 percent) and increased productivity (48.33 percent) along with increased employment generation. Reduced so i l erosion integrated ground water recharge etc. were other benefits of technology as perceived by the farmers. Further she observed that the major reasons for non-adoption of structures in non-watershed area were lack of capital (51.6 percent) technical know-how (46.60 percent), size of holding (45 percent) followed by problems of irrigation, inadequate input availability non-availability of labour, inadequate extension services and poor quality of land etc.

Benefits of rainwater harvesting

- **Water Conservation:** Rainwater harvesting reduces dependency on municipal water supplies and helps meet increasing water demand.
- **Flood Prevention:** By reducing runoff, rainwater harvesting minimizes the risk of road flooding.
- **Groundwater Recharge:** Recharging groundwater helps maintain the water table and improves
- water quality through dilution.

Uses of harvested rainwater

Rainwater can be used for:

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- **Irrigation:** Ideal for plants as it lacks chlorine
- **Non-Potable Uses:** Toilet flushing, laundry, car washing
- **Potable Uses:** After proper filtration and disinfection

Conclusion

Rainwater Harvesting is a eco-friendly technique which helps to recharge surface and ground water resources. During rainy season Rainwater Harvesting technique help to manage storm water, runoff water etc that can be utilize in summer season. According to our point of view Govt. should provide educational and training program specially such area where scarcity of water occurs in summer season. Like Rajasthan, MP etc. It is no denying that sustaining and recharging the groundwater along with judicious use of the limited fresh water resources is the need of the hour. If sufficient measures are not taken up immediately, we will face a crisis which will be detrimental to the very survival of mankind. Efficient management of water resources and education about judicious utilization of water resources along with measures of harnessing, recharging and maintaining the quality of water and water bodies has to be taken up on war footing.

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