RAIN WATER HARVESTING (A DETAILED REVIEW).

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Abstract: The rapid development of cities and consequent population explosion in urban areas has led to depletion of surface water resources. For fulfilment of daily water requirement, indiscriminate pumping of ground water is being resorted to, leading to lowering of ground water table. At the same time the rain water is not being conserved which ultimately goes waste. To avoid this imbalance, conservation of rain water in the form of rain water harvesting is the only solution. This study gives the detailed account of various aspects of rainwater harvesting.

Keywords: Rainwater; Evaporation; Water table; Rain Water harvesting.

I. INTRODUCTION

Rainwater is a free source of nearly pure water and rainwater harvesting refers to collection and storage of rainwater and other activities aimed at harvesting surface and ground water. It also includes prevention of losses through evaporation and seepage and all other hydrological and engineering interventions, aimed at conservation and efficient utilisation of the limited water endowment of physiographic unit such as a watershed. In general, water harvesting is the activity of direct collection of rainwater. The rainwater collected can be stored for direct use or can be recharged into the ground water. Rain is the first form of water that we know in the hydrological cycle, hence is a primary source of water for us Rivers, lakes and ground water are all secondary sources of water. In present times, we depend entirely on such secondary sources of water. In the process, generally, it is forgotten that rain is the ultimate source that feeds all these secondary sources. Water harvesting means making optimum use of rainwater at the place where it falls so as to attain self-sufficiency in water supply, without being dependent on remote water sources. Cities get lot of rain, yet cities have water shortage. Why? Because people living there have not reflected enough on the value of the raindrop. The annual rainfall over India is computed to be 1,170 mm (46 inches). This is higher compared to the global average of 800 mm (32 inches). However, this rainfall occurs during short spells of high intensity. Because of such intensities and short duration of heavy rain, most of the rain falling on the surface tends to flow away rapidly, leaving very little for the recharge of ground water. This makes most parts of India experience lack of water even for domestic uses. Ironically, even Cherrapunji, India, which receives about 11,000 mm of rainfall annually, suffers from acute shortage of drinking water. This is because the rainwater is not conserved and is allowed to drain away. Thus it does not matter as to how much rain falls at a place, if it is not captured or harvested there for use. This highlights the need to implement measures to ensure that the rain falling over a region is tapped as fully as possible through water harvesting, either by recharging it into the ground water aquifers or storing it for direct use. Many urban centres in Asia and other regions are facing an ironical situation today. On the one hand there is an acute water scarcity and on the other, streets are generally flooded during rains. This has led to serious problems with quality and quantity of ground water. One of the solutions to the urban water crisis is rainwater harvesting - capturing the runoff. The advantage of Rainwater Harvesting is more where surface water is inadequate to meet our demand and exploitation of ground water resource has resulted in decline in water levels in most part of the country. This study explains various aspects of rainwater harvesting.
II. NEED FOR RAIN WATER HARVESTING

Water is one of the most essential requirements for existence of living beings. Surface water and ground water are two major sources of water. Due to over population and higher usage levels of water in urban areas, water supply agencies are unable to cope up demand from surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tube wells by house owners. Even water supply agencies have resorted to ground water sources by digging tube-wells in order to augment the water supply. Replenishment of ground water is drastically reduced due to paving of open areas. Indiscriminate exploitation of ground water results in lowering of water table rendering many bore-wells dry. To overcome this situation bore wells are drilled to greater depths. This further lowers the water table and in some areas this leads to higher concentration of hazardous chemicals such as fluorides, nitrates and arsenic. In coastal areas like Chennai, over exploitation of ground water resulted in seawater intrusion thereby rendering ground water bodies’ saline. In rural areas also, government policies on subsidized power supply for agricultural pumps and piped water supply through bore wells are resulting into decline in ground water table. The solution to all these problems is to replenish ground water bodies with rain water by man-made means.

III. BENEFITS OF RAINWATER HARVESTING

Rainwater harvesting provides the long-term answers to the problem of water scarcity. Rainwater harvesting offers an ideal solution in areas where there is sufficient rain but inadequate ground water supply and surface water resources are either lacking or are insufficient. In hilly areas, rainwater can be used by humans, vegetation and animals. Rainwater harvesting system is particularly useful in remote and difficult terrain as it has the ability to operate independently. The whole process is environment friendly. There are a number of ways in which water harvesting can benefit a community – water harvesting enables efficient collection and storage of rainwater, makes it accessible and substitutes for poor quality of water. Water harvesting helps smooth out variation in water availability by collecting the rain and storing it more efficiently in closed stores or in sandy riverbeds. In doing so, water harvesting assures a continuous and reliable access to water. A water harvesting system collects and stores water within accessible distance of its place of use. While traditional sources are located away from the community particularly in peri-urban areas, collecting and storing water close to households, villages or pastures greatly enhances the accessibility and convenience of water supplies. The rainwater collected can be stored for direct use or can be recharged into the ground water to improve the quality of ground water and rise in the water levels in wells and bore wells that are drying up as well as reduce the soil erosion as the surface runoff is reduced. Rainwater harvesting is an ideal solution to water problems in areas having inadequate water resources and helpful in mitigation of the effects of drought and attainment of drought proofing. Water harvesting provides an alternative source for good quality water (rainwater is the cheapest form of raw water) seasonally or even the year round. This is relevant for areas where ground water or surface water is contaminated by harmful chemicals or pathogenic bacteria or pesticides and/or in areas with saline surface water. The rainwater harvesting systems can be both individual and community/utility operated and managed. Rainwater collected using various methods has less negative environmental impacts compared to other technologies for water resources development. The physical and chemical properties of rainwater are usually superior to sources of ground water that may have been subjected to contamination. Rainwater is relatively clean and the quality is usually acceptable for many purposes with little or even no treatment. Rainwater harvesting technologies are flexible and can be built to meet almost any requirements. Construction, operation, and maintenance are not labour intensive. Predictions regarding global warming could have a major effect in significantly increasing water demand in many cities. At the same time increased evaporation from reservoirs and reduced river flows in some areas may decrease the available surface water supplies. A greater uncertainty regarding yields from major reservoirs and well fields is likely to make investments in the diversification of water sources, better water
management and water conservation even more prudent in future. The role of rainwater harvesting systems as sources of supplementary, back-up, or emergency water supply will become more important especially in view of increased climate variability and the possibility of greater frequencies of droughts and floods in many areas. This will particularly be the case in areas where increasing pressure is put on existing water resources. In urban areas, scarcity and accelerating demand of water is a major problem and it can be reduced by rainwater harvesting, using various existing structures like rooftops, parking lots, playgrounds, parks, ponds, flood plains, etc. to increase the ground water table, which saves the electric energy to lift the ground water because one metre rise in water level saves 0.40 kilowatt hour of electricity. Subsequently it can also reduce storm drainage load and flooding in city streets. As cities continue to grow in the future such problems are likely to become increasingly common. Since cities comprise numerous impervious surfaces designed to encourage rainwater runoff the scope for rainwater collection is substantial. Atmospheric pollution remains a major constraint as it contaminates both the rainwater and catchment surfaces making rainwater unsuitable for drinking in many cities around the world. Nevertheless, rainwater can still be used for non-potable uses such as toilet flushing, clothes washing and gardening. Furthermore, greater use of rainwater in urban areas could in future significantly strengthen the lobby to clean up the urban atmosphere entirely.

IV. SOURCES OF RAINWATER HARVESTING.

Rainwater can be harvested from the following surfaces:

Roof tops: If buildings with impervious roofs are already in place, the catchment area is effectively available free of charge and they provide a supply at the point of consumption.

Paved and unpaved areas: i.e., landscapes, open fields, parks, storm water drains, roads and pavements and other open areas can be effectively used to harvest the runoff. The main advantage in using ground as a collecting surface is that water can be collected from a larger area. This is particularly advantageous in areas of low rainfall.

Water bodies: The potential of water bodies such as lakes, tanks and ponds to store rainwater is immense. The harvested rainwater can be used not only to meet water requirements of the city; it also recharges ground water aquifers.

Storm water drains: Most of the residential colonies have proper network of storm water drains. If maintained neatly, these offer a simple and cost effective means for harvesting rainwater.

V. QUALITY CONSIDERATIONS IN UTILISING RAINWATER

It is generally believed that rainwater can provide clean, safe and reliable water which can be consumed without pre-treatment. This however may be used in some areas that are relatively unpolluted. Rainwater collected in many locations contains impurities. Therefore, in order to ensure quality of water, the collection systems will have to be properly built and maintained and the water shall also have to be treated appropriately for intended uses. Once rain comes in contact with a roof or collection surface, it can wash many types of bacteria, molds, algae, protozoa and other contaminants into the cistern or storage tank. Indeed, some samples of harvested rainwater have shown detectable levels of these contaminants. Health concerns related to bacteria, such as salmonella, e-coli and legion Ella, and to physical contaminants, such as pesticides, lead and arsenic, are the primary criteria for drinking water quality analysis. Falling rain is generally free of most of these hazards. But, if the rainwater is intended for use inside the household, either for potable uses such as drinking and cooking or for non-potable uses including showering and toilet flushing, appropriate filtration and disinfection practices should be employed. If the rainwater is to be used outside for landscape irrigation, where human consumption of the untreated water is less likely, the presence of contaminants may not be of major concern and thus treatment requirement can be less stringent or not required at all. Depending on where the system is located, the quality of rainwater itself can vary, reflecting exposure to air pollution caused by industries such as cement kilns, gravel
quarries, crop dusting and a high concentration of automobile emissions. In many parts of the globe, “Acid Rain” has also affected the quality of the collected water, to the point where it now usually requires treatment. Rainwater quality varies for a number of reasons. While there are widely accepted standards for drinking water, the development of approved standards for water when it is used for nonpotable applications would facilitate the use of rainwater sources. In terms of physical-chemical parameters, collected roof water, rainwater and urban storm water tend to exhibit quality levels that are generally comparable to the World Health Organisation (WHO) guidelines for drinking water. However, low pH* rainwater can occur as a result of sulphur dioxide, nitrous oxide and other industrial emissions. Hence air quality standards need to be reviewed and enforced. In addition, high lead values can sometimes be attributed to the composition of certain roofing materials – thus it is recommended that for roof water collection systems, the type of roofing material should be carefully considered. A number of collected rainwater samples have exceeded the WHO values in terms of total coliform and faecal coliform. The ratios of faecal coliform to faecal streptococci from these samples indicated that the source of pollution was the droppings of birds, rodents, etc.

VI. CONCLUSION
Rainwater harvesting can help solving the water crisis to a great extent. Rainwater harvesting provides water during droughts, can help mitigate flooding for low lying areas and reduce demand on wells which may enable ground water levels to be sustained. It provides portable water as rain is free from salinity and other undesirable impurities.

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