

## RAIN WATER HARVESTING–TROPICAL CLIMATIC CONDITIONS, INDIA

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### ABSTRACT

Rainwater harvesting, in its broadest sense, is a technology used for collection and storage of rainwater for human use from rooftops, land surfaces, rock catchments etc... using simple techniques. It involves utilization of rainwater for the several different kinds of purposes as per the need. The method of rainwater harvesting has been into practice since ancient times. It is the best possible way to conserve water and awaken the society towards the importance of water.

The method is simple and cost effective too. It is especially beneficial in the areas, which faces the scarcity of water. During the monsoons lots of water goes waste into the gutters, and this is when Rain water Harvesting proves to be the most effective way to conserve water.

We can collect the rainwater into the tanks and prevent it from flowing into drains and being wasted. It is practiced on the large scale in the metropolitan cities. Rainwater harvesting comprises of storage of water and water recharging through the technical process.

The Study aims to discuss on the Rainwaterharvesting.The Rainwater collected from the paved areas within the boundary/ periphery of the built form such as terrace areas, balconies, stilt floors etc...

The study aims to discuss different 'methods of water harvesting' and on 'the rate of water harvesting' which highly depends onclimatic conditions and the prevailing soil properties.

**KEYWORDS:** Water, Maintenance, Built Forms, Methods of Water Harvesting, Soil Properties

### INTRODUCTION

Water is essential for life and plays a major role in creating earth's climate. It holds a vital role during the daily life of all living beings on earth. The human being is availing the water from various water sources like surface water sources and ground water sources depending on the geographical conditions of the terrain. It is the fact that 70 percent of the total human body is the water and with out the water availability the human being cannot live more than weekdays, due to the natural hydro cycle the same water existed on earth billions of years ago still exist today.

#### Rainwater and Harvesting

Being the primary natural water source on earth, due to the natural hydro cycle of mother nature, water falls on ground by the name 'Rainwater' after the precipitation which a part in the natural Hydro cycle. Depending on the percolation and the runoff rate, changes will take place in the ground water availability, which is widely known as Ground water table. The change in runoff will change the flow of stream flow, erosion patterns and the sediment patterns of the surrounding areas.

Harvesting the rainwater is the direct collection of water where it falls, further making it either to recharge into the ground or by storing it for usages. The rainwater if collected directly or with a minimal flow on the ground, will have minimal impurities and can be treated easily at the treatment plant. The main aim of the rainwater harvesting is to minimize the water flow into the drains and seas and get recharged in to the ground such that it elevates the ground water table<sup>[1]</sup>.

### **Climatic Region- Tropical Climate**

This zone of climate will have the temperatures between 18°C to 45°C. The Rainy season is from June to September and the annual rainfall is between 750mm to 1500mm<sup>[2]</sup>.

### **NEED OF STUDY**

Due to over population and higher usage levels of water in urban areas, water supply agencies are unable to cope up demand from available surface sources especially during summer seasons. 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.

The replenishment of ground water is drastically reduced due to paving of open areas. Indiscriminate exploitation of ground water results in lowering of ground water table (GWT) rendering many bore-wells dry, which has led to drilling of bore wells of greater depth. This further lowers the water table and such frequent fluctuations in GWT results in presence of higher concentration of salts in ground water. In coastal areas, the over exploitation of ground water results in seawater intrusion thereby rendering fresh ground water bodies' saline<sup>[4]</sup>.

In rural areas also, government policies on subsidized power supply for agricultural pumps and piped water supply through bore and open dug wells are resulting into decline in GWT. The solution to all these problems is to replenish ground water bodies with rainwater by manmade means<sup>[3]</sup>.

### **BENEFITS OF RAINWATER HARVESTING**

The Rainwater's environmental advantage and purity over other water alternatives makes it the sustainable option, even though the precipitation cycle may fluctuate from year to year. The collection of rain water not only leads to conservation of water but also energy since the energy input required to operate a centralized water system designed to treat and pump water over a vast service area is bypassed. Rainwater harvesting also lessens local erosion and flooding caused by runoff from impervious cover such as pavement and roofs, as rain water is captured and stored. Rain water quality almost exceeds that of ground or surface water as it does not come into contact with soil and rocks where it dissolves salts and minerals. The Rain water is not exposed to many of the pollutants that often are discharged into surface waters such as rivers, and which can further contaminate groundwater. However, rainwater quality can be influenced by characteristics of area where it falls, since localized industrial emissions affect its purity. Thus, rainwater falling in non-industrialized areas can be superior to that in cities which are dominated by heavy industry or in agricultural regions where crop dusting is prevalent<sup>[5]</sup>.

### **FACTORS EFFECTING GROUND WATER RECHARGE**

The following factors affect the ground water recharge in a given location:

- Availability, source and quality of water.
- Nature of surface soil. The greatest volumes and rates of recharge are possible in thick formations of pervious sands, gravels and porous rocks.

- Depth to aquifer.
- Geologic structure and capacity of the ground-water reservoir.
- The presence of aquicludes which are impermeable or slowly permeable formations Over lying an aquifer and prevent or reduce natural recharge.
- Movement of ground water.
- Location of withdrawal area.
- Pattern of pumping draft.

## SOIL PROPERTIES

The Krishna district consists of Black cotton soil, which is a very fertile land. Black cotton soil (BC soil) is a highly clayey soil. The black color in Black cotton soil (BC soil) is due to the presence of titanium oxide in small concentration. The Black cotton soil (BC soil) has a high percentage of clay, which is predominantly montmorillonite in structure and black or blackish grey in colour. Expansive soils are the soils, which expand when the moisture content of the soil is increased. The clay mineral montmorillonite is mainly responsible for expansive characteristics of the soil. The expansive soils are also called swelling soils or black cotton soils.

The structures on Black cotton soil (BC soil) develop undulations at the road surface due to loss of strength of the sub-grade through softening during monsoon. The physical properties of Black cotton soil (BC soil) vary from place to place, 40 % to 60 % of the Black cotton soil (BC soil) has a size less than 0.001 mm. At the liquid limit, the volume change is of the order of 200 % to 300% and results in swelling pressure as high as 8 kg/cm<sup>2</sup> to 10 kg/cm<sup>2</sup>. As such Black cotton soil (BC soil) has very low bearing capacity and high swelling and shrinkage characteristics<sup>[6]</sup>.

The rate of percolation of rainwater depends a lot on the soil properties. The BC soil, as its clay content is high, the porous characteristic will be less compared to sandy soil and other kind of soils. Due to the higher presence of clay content, the soil will retain the moisture content for a longer period, which helps the water to recharge into the ground.

## STUDY AREA

The study area is in the city of Vijayawada, State of Andhra Pradesh, India containing the built forms under the residential usage. The study area containing an area of 9.82 acres, developed for a residential colony as a plotted area according to the norms of local authority with 12m wide bitumen top roads along with road shoulder containing 103 built forms

### Description about the Built Form

In the residential colony as mentioned above having 103 units, majority of the units are having approximately 110 sqmtrs of roof area and approximately 57 sqmtrs of paved area around the built form with in the plot area of 167 Sqmtrs. The rainwater collected directly from the rooftops and the paved area can be collected and harvested with minimal or lower percentage of impurities.



**Figure 1: The Picture Giving the Information Regarding the Paved Area with in the Unit Level around the Built Form. Photo by Author**



**Figure 2: The Picture Giving the Information about the Road Shoulder Beside to the Bitumen Road in the Colony. Photo by Author**



**Figure 3: The Picture Giving the Information about the Road Shoulder Beside to the Bitumen Road in the Colony. Photo by Author**

### **Observations**

- The built form is constructed with framed structure with reinforced cement concrete.
- The rain water pipe network connects the terrace with under ground drainage.
- The rain water collected from the paved area at ground floor level is connected to the underground drainage.
- The paved area was done very meticulously in such a way that nowhere it stagnates and flows towards the drainpipe.

- Due to the paved areas, there is no scope for the rainwater to percolate into the ground at each unit level.
- Due to the non-availability of soil with in the plot area, the interested residents are developing the plants in the plant boxes.
- Road shoulder of 2m is present through out the layout, which is covering all 103 plots.
- The Rainwater collected from the roads is being percolated into the ground through the road shoulder.
- Road shoulder has been paved at afew residential units.
- BC soil though the rate of percolation is slow, retains lot of water due to its higher clay content.
- On ideal conditions, the moisture content of the BC soil will is high, i.e. retention capacity of BC soil is high.

## RECOMMENDATIONS

- Policy decision has to be brought into the force for the Domestic Rain Water Harvesting.
- Awareness has to be created among the citizens about the Rainwater harvesting.
- The Rainwater harvesting by storage method is the most ideal method to follow as all the paved areas in the built forms were connected with pipe network.
- In addition to the rain water harvesting by storage mode, the excess water if diverted to the soil available in the road shoulder space by direct Recharge mode, it helps in enhancement of Ground water table.
- The Practice of Rainwater harvesting not only enhances the ground water table but reduces the pressure on the local authority in supply of fresh water to the community.
- The Practice of Rainwater harvesting either by direct recharge mode or storage mode reduces the pressure on drainage systemalso

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