International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 434-442 www.ijaem.net ISSN: 2395-5252

Rain Water Harvesting

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Submitted: 01-05-2022 Revised: 04-05-2022 Accepted: 08-05-2022

ABSTACT: Water is as important for survival of human beings as food, air etc, but hardly any attention is paid for its economical use and conservation of this precious resource. Due to indiscriminate pumping of groundwater, the water table is going down abnormally. Rains are the main source of water and if rainwater is harvested, the scarcity of water can be eliminated altogether, Water is the most important and most precious compound on earth. Human being and all living things cannot survive without water. The water supplies and reservoirs need to be protected. The discharge of polluted water can cause various diseases and health problems in man and the environment. Rainwater harvesting is a generally utilized term covering each one of those systems whereby rain is collected and utilized close to where it first achieves in the earth. The term has been connected to make precipitation permit the ground as opposed to keep running off its surface to types of flood control to the development of little repositories. Rain falls into rooftops and after that keeps running off.

Keywords – rainwater, scarcity, ground water, precipitation, runoff, health.

I. INTRODUCTION:

The world population is growing at an astonishing rate and so is the demand for water. To meet these increasing water demands, groundwater is being used on a large scale all over the world Due to utilization of groundwater at greater extent, the groundwater is depleting at a faster rate at which it can be naturally recharged.As a result of this exploitation, many groundwater tables are various places around the world have already been exhausted or are on the verge of exhaustion. Cities and villages are growing and so there is an increase in agricultural activities. To meet the water demands for these agricultural activities against groundwater sourcessuch as wells, tube wells, etc.

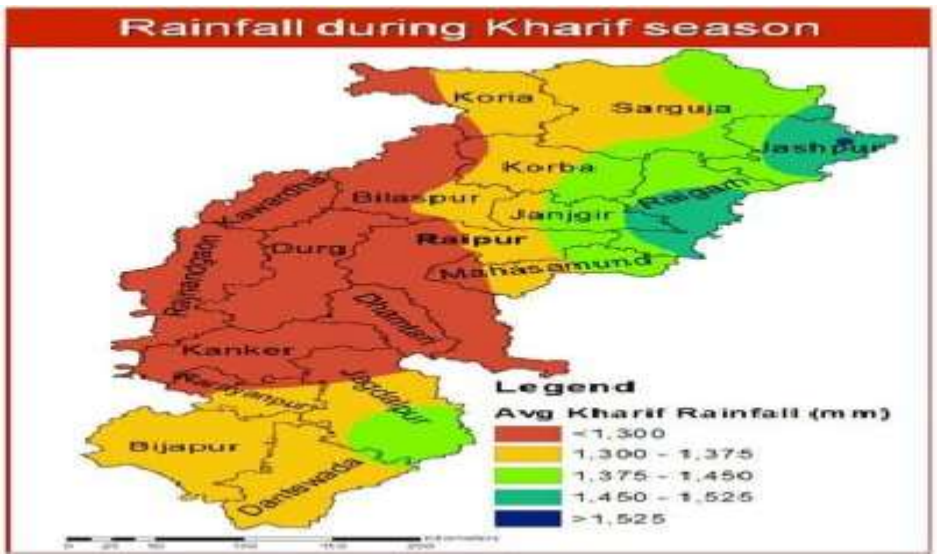

Figure1:- rainfall during kharif season

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During monsoon season, the majority of rainwater gets wasted due to surface runoff; the water from rooftops go directly into the sewer and the water from stormwater runoff also goes to the sewer and ultimately goes to waste. To tackle all of these issues, rainwater harvesting is an environmentally sound solution.

By implementation of rainwater harvesting systems, the water can be collected,stored and used at a later stage. This can ensure that not all rain water gets wasted and that the water is available for an extended period of time and not only in monsoons.Water harvesting is not a new concept; rather it has beeninto practice since ancient times. Various water harvesting techniques and methods have been developed and improved from time to time to increase the efficiency of these systems. Though rain water harvesting is not a new concept, yet it is not being implemented in a large scale, asit should have been.Rain water harvesting is the collection of rainwater and its storage. The stored rainwater can be used for various activities as well as for groundwater recharge.

Due to over population and higher usage levels of water in urban areas, water supply agencies are unable to cope up with demand from surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tube wells by house owners. Replenishment of groundwater 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.

Rain water harvesting and storage is not a contemporary practice but has been a part of human civilization since ancient historic times. Studies by the Central Ground Water board suggest that the groundwater in many parts of India would dry up till the year 2025, and hence an effective and efficient way is required to cope up with the decreasing groundwater levels.

Groundwater is an essential source of water for drinking, irrigation, municipal uses, and industrial processes, due to its relative abundance and high quality. For many parts of the country, it is the only freshwater option, and other areas heavily rely on groundwater during droughts.

1.2 OBJECTIVE OF STUDY

- To avoid flooding of roads.
- To reduce run-off loss.
- To raise the water table by recharging ground water.
- To reduce groundwater contamination.
- To supplement ground water supplies during lean seasons.
- To argue the ground water storage and control decline of water level.
- To reduce groundwater pollution & to improve the quality of groundwater.
- To meet the ever increasing demand for water & to reduce the soil erosion.

1.3 NEED OF RAIN WATER HARVESTING

Increasing water needs/demands

- The rapid rise in human population has made optimum use of fresh water imperative.
- Urban water supply systems in particular are under tremendous pressure to meet the needs of the population as well as industry and large-scale construction.
- The increased need for water results in lower groundwater tables and depleted reservoirs. Many piped water supply systems fail.
- Consumption of polluted water is beset with health hazards.
- The use of rainwater is a useful alternative.

2 Variations in water availability

- The availability of water from sources such as lakes, rivers and shallow groundwatercan fluctuate strongly.
- Unchecked rainwater runoff is causing soil erosion.
- Collecting and storing rainwater can provide water for domestic use in periods of watershortage.
- Rainwater may also provide a solution when the water quality is low or varies duringthe rainy season in rivers and other surface water resources (for example inBangladesh).

3 Responsibilities towards protecting Nature

- Using more of rainwater helps to conserve & augment the storage of groundwater.
- It helps to arrest sea water intrusion in coastal areas.
- It helps to avoid flood & water stagnation in urban areas.
- Reduced water and electricity bills come together and work closer. It allows for the decentralized control and community management of water.
- It will provide productive employment to the rural poor in their own village.

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4 Quality of water supplies

- Water supplies can become polluted either through industrial or human wastes or byintrusion of minerals such as arsenic, salt (coastal area) or fluoride.
- Rainwater is the ultimate fresh water.
- Rainwater is generally of good quality.

1.4 REASONS OF RWH

- Rain water harvesting measures are essential when the ground water is brackish or has a high Iron or Fluoride content.
- Rain water harvesting measures should begin four months before the monsoon is to arrive.
- Concentrated water demand in urban areas for various purposes like households,institutions (e.g. schools and colleges, hospitals, offices, markets and shopping malls), factories, and even water park.

1.5ADVANTAGES OF RWH

- Augments groundwater table.
- Reduces runoff which chokes drains and avoid flooding of roads.
- Provides self-sufficiency to water supply and to supplement domestic waterrequirement during summer and drought conditions.
- It reduces the rate of power consumption for pumping of groundwater. For every 1 m rise in water level, there is a saving of 0.4 KWH of electricity.
- In the desert, where rainfall is low, rainwater harvesting has been providing relief to people.

1.6 DISADVANTAGES OF RWH

- Supplies can be contaminated by bird/animal droppings on catchment surfaces and guttering structures unless they are cleaned/flushed before use
- Poorly constructed water jars/containers can suffer from algal growth and invasion by insects, lizards and rodents. They can act as a breeding ground for disease vectors if they are not properly maintained.
- Certain types of roofs may seep chemicals, insects, dirt or animal droppings that can harm plants if it is used for watering the plants.
- Rainwater harvesting systems require regular maintenance as they may get prone to rodents, mosquitoes, algae growth, insects and lizards.

II. METHODOLOGY

2.1 CATCHMENT AREA

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore, the catchment is the area, which actually contributes rainwater to the harvesting system. The catchment of water harvesting system is the surface that receives rainfall directly and drains the water system. Any roofing material is acceptable for collecting of water. The effective catchment area and the material used in constructing the catchment surface influence the collection efficiency and water quality. Catchment surfaces and collection devices should be cleaned regularly to remove dust, leaves and bird droppings so as to minimize bacterial contamination and maintain the quality of collected water. One of the most important components of RWH system is catchment, which is used for holding rainwater. Roof provide an ideal catchment surface for harvesting rainwater. The roof surface may be constructed of many different materials, which include but are not limited to concrete, tiles, galvanized corrugated iron sheets and corrugated plastic. If a building or house with an impermeable roof, which will not allow water to pass through and are resistant to rainwater, if it is installed in the catchment area then it is catchment is available free of charge. Painted roofs are not often used for collecting rainwater but has a nontoxic content and does not cause water pollution. An impermeable roof will yield a high runoff of good quality water that can be used for all domestic purposes.

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Figure 5- catchment area of study

2.2 RUNOFF COEFFICIENT

The collection of rainwater is usually represented by runoff coefficient (RC). The runoff coefficient for any catchment is the ratio of the volume of the water that runs off a surface to the volume of rainfall that falls on the surface. A runoff coefficient of 0.8 that the 80% of rainwater will be collected, so the higher the runoff coefficient, the more the rainwater will be collected.

2.3 PAVED AREA

Area covered in pavements having a hard surface, as of concrete or asphalt such as Roof top paved road, driveway. The runoff coefficient of paved area is 0.7 that 70% of rainwater can be harvested in the paved area.

2.4 UNPAVED AREA

Area that are not covered in pavements which has no hard surface of concrete or asphalt such as green surface area. The runoff coefficient of unpaved area is 0.2 that 20% of rainwater can be harvested in the unpaved area.

2.5 ROOF TOP AREA

Roofed area where catchment area covered with tiles, concrete surface can hold the rainwater of 80% of harvested water in required place. The runoff coefficient of roof top area is 0.8

2.6 CONVEYANCE

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of each drain should have wire mesh to restrict floating material. The roof top water collection through delivery system from the roof top catchment usually consists of gutters hanging from the side of the roof sloping towards a down pipe and tank. This delivery system issued to transport the rain water from the rainwater from to the storage reservoir. As much as 90 percent of or more of the rain water collected on the roof will be drained to the storage tank if the gutter and down pipe system is properly fitted and maintained. The water from storage tank is delivered to the treatment unit through delivery pipe system. In delivery system there are uses of pumps to take out water from tank and deliver for many purposes. Again, transportation system is used to deliver the water for the

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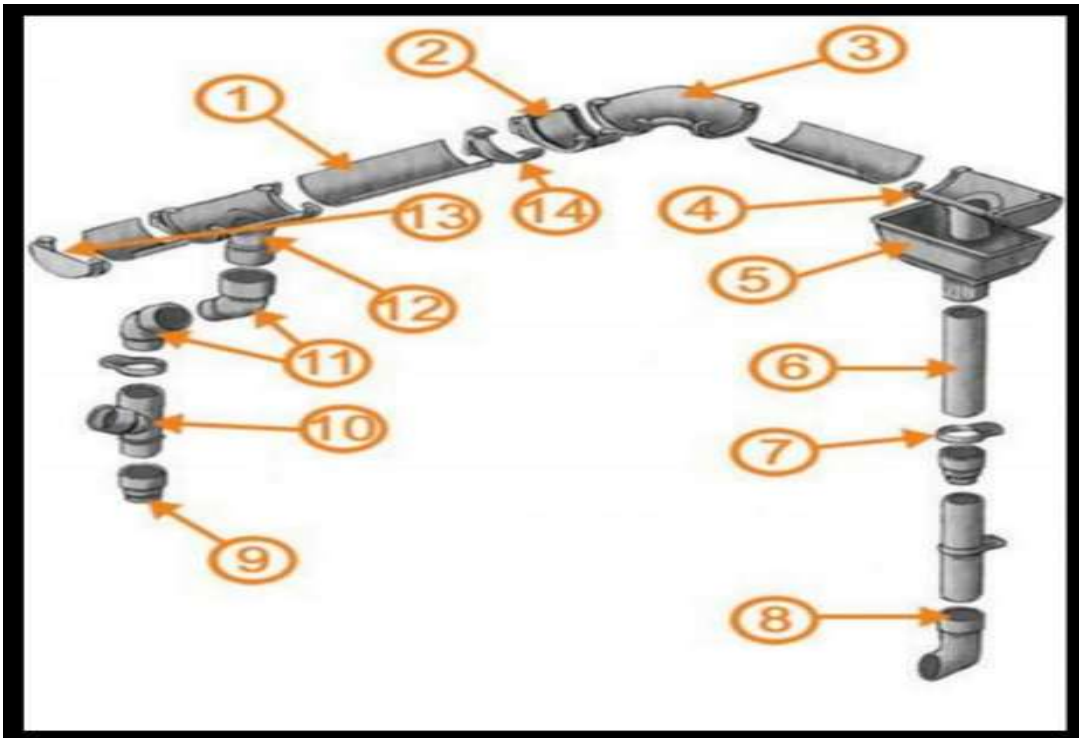

Figure Pipes

III. STUDY AREA & DATA COLLECTION

3.1 LOCATION OF STUDY AREA

Figure : study area

3.2 RAINFALL DATA ACQUISITION

Durg's climate is classified as tropical. The summers are much rainier than the winters in Durg. This climate is considered to be Aw according to the Köppen-Geiger climate classification. The average annual temperature in Durg is 26.5 °C | 79.7 °F. About 1323 mm | 52.1 inch of precipitation falls annually.Precipitation is

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the lowest in December, with an average of 8 mm | 0.3 inch. The greatest amount of precipitation occurs in July, with an average of 390 mm.Between the driest and wettest months, the difference in precipitation is 382 mm | 15 inch. The variation in temperatures throughout the year is 15.2 °C | 27.3 °F

3.3 FORMULAE TO DERIVE RAINWATER HARVESTING SYSTEM

The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area. And the amount that can be effectively harvested is called the water harvesting potential. The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:

Harvesting potential or Volume of water Received (m3) = Area of Catchment (m2) X Amount of rainfall (mm) X Runoff coefficient

Runoff coefficient for any catchment is the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface. Runoff coefficient accounts for losses due to spillage, leakage, infiltration, catchment surface wetting and evaporation, which will all contribute to reducing the amount of runoff. Runoff coefficient varies from 0.5 to 1.0. In present problem statement, runoff coefficient is equal to 1 as the rooftop area is totally impervious. Eco-Climatic condition (i.e.) Rainfall quantity & Rainfall pattern) and the catchment characteristics are considered to be most important factors affecting rainwater Potential.

3.4 YEARLY RAINFALL DATA- durg

YEAR	YEARLY RAINFALL (mm)
2012	1154.4
2013	1330.5
2014	1057.5
2015	846.0
2016	1088.9
2017	705.8
2018	865.8
2019	932.5
2020	1039.4
2021	936.9

Average yearly rainfall data in DURG district from 2012 to 2021. For ten years (2012– 2021) rainfall data of DURG is tabulated and listed above. In the year of 2013 the rainfall is about 1332 mm have highest rainfall for past ten years.

3.5 CATCHMENT OF A STUDY AREA

Catchment area = 120 m2

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Figure 6 :- catchment area of study

3.6 RUNOFF COEFFICIENT OF STUDY AREA

Hence the catchment of the study area is roofed surface (open area/ terrace)
80% of rainwater can be harvested in **Roof top area**
Runoff coefficient of open area = 0.8.

3.7 TOTAL DATA COLLECTED

CATCHMENT DATA	RAINFALL DATA	RUNOFF DATA
120	1004.25	0.8

3.8 CALCULATION

Volume of water Received **(m3)** = Area of Catchment (m2) X Amount of rainfall (mm) X Runoff coefficient
= 120 X 1004.25 X 0.8
= 96.408 cubic.

1m3 = 1000 litres
96.408 = 96408 litres

10% increase for storage tank
=106.0488 m3

Consider dimension of tank = 5*5*4.3 =107.5 m3
Thus, total volume of rain water is harvested in open area (Roof top) is 96,408 liters per year.

Daily usage of harvested rainwater for per day = Volume of water received / 365
= 96,408 / 365
Daily usage of harvested rainwater for per day = 264.13 liters per day.
Daily consumption of harvested rainwater for per day usage 264.13 liters per day.

IV. CONCLUSION

It can be concluded that the rainwater recharge improves the quality of groundwater and its quality depends upon the amount of rainwater recharged and the environment of rainwater collection and recharging. Hence it was finally concluded that implementation of RAINWATER HARVESTING PROJECT to the campus of MALWA RESIDENCE will be the best approach to fight with present scenario of water scarcity in

all aspects, whether it is from financial point of view or from optimum utilization of land surface. By implementation in water harvesting project in MALWA RESIDENCE campus we can make little noble cause for rain water conservation which will be beneficial to the persion who is living in MALWA RESIDENCE . The rooftop water collection can be used to fulfil the daily drinking demand. By installing rainwater harvesting system, every year huge amount of water will be saved and huge expenditures on procurement of water will be reduced the huge amount of precipitation occurring on the ground can be harvested and utilized for different purposed, if proper collection system is provided. As so many parts of the world facing the problems of water crises, one must understand the importance of water, and should made optimum use of water and adopt efficient methods of collecting and saving the rainwater. The procedure adopted in this study is proven to be costly as per the cost analysis, very easy as per methodology and very efficient as per the discharge calculated. Thus, it is concluded that implementation of RWH system of MALWA RESIDENCE campus would result in the form of the best approach to deal with present scenario of water scarcity and storing huge quantity of 96,408 liters in a year. And daily consumption of harvested rainwater for per day is 264.13 liters in campus. This harvested water helps their daily needs.

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