International Journal of Scientific Research and Engineering Development-– Volume 3 Issue 3, May – June 2020
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

OVERVIEW OF RAIN WATER HARVESTING (RWH) SYSTEMS FOR WATER CONSERVATION

[1]Smart Bello,[2]Okafor Michael,[3]Abu Maliki and [3]Abu Anthony Azor
[1]Department of Mechanical Engineering Technology, School of Engineering Technology.Auchi Polytechnic Auchi, Edo State.
[2]Department of Civil Engineering Technology, School of Engineering Technology.Auchi Polytechnic Auchi, Edo State.
[3]Department of Agricultural Technology, Auchi Polytechnic Auchi, Edo State

ABSTRACT
Most of the economically viable water harvesting projectsare already implemented or bigirrigation project have higher investment, environmental & social cost and transboundarywater issue to supply water to arid and semi-arid region (ASARs). So Rain Water Harvestingis the best alternative method to cope with water scarcity problem in ASARs where rainfall islow, not sufficient for good crop and plant growth due to uncertain nature of rainfall. The aim of paper is to discuss different case studies of RWH techniques that take place in ASARs tocope with water scarcity and increase benefit through irrigation. The study shows that RWHbenefit can be maximized through the enhance water saving, seepage control, selection ofsuitable crops, growing pattern, and irrigation methods. However concern should be given inirrigation water quality to minimize the impact on crop and human life by technique offiltration and initial water diversion.

KEYWORDS: Rainwater, Water harvesting, water conservation, rainwater harvesting, erosion control

INTRODUCTION
Rainwater harvesting is the deliberate collection of water from a surface known as catchment and its stockpiling in physical structures or inside the dirt profile. Rainwater is valued for its purity and softness. It has a practically neutral pH, and is freed from purging symptoms, salts, minerals, and other customary and man-made contaminants. Plants prosper submerged system with set aside water (Adekalu*et al.,* 2009). Mechanical assemblies last longer when freed from the ruinous or scale effects of hard water. Customers with consumable structures slant toward the unparalleled taste and cleansing properties of water. Archeological confirmation approves the storage of water as far back as 4,000 years earlier, and the possibility of water gathering in China may return 6,000 years. Leftovers of supplies filled in as exactly on schedule as 2000 B.C. for taking care of overflow from slants for rustic and private purposes behind existing are so far staying in Israel (Gould and Nissen-Petersen, 1999).

Rainwater harvesting and use systems have been set up for quite a long time. Rainwater harvesting alludes to the act of gathering rainwater from housetops, land surfaces, or rock catchments and putting away it for human use. Water assortment vessels are commonly situated inside open separations of their place of utilization (Adham*et al.,* 2016). Archeological proof of rainwater catch in China proposes that such systems were set up upwards of 6,000 years back. Proof of rooftop catchment systems and different innovations exhibit that in antiquated Rome, manors and entire urban areas were intended to exploit rainwater as the chief water hotspot for drinking and residential purposes. In 2000 BC, tanks to store slope overflow for household and rural purposes permitted home and development in the Negev desert in Philistine, a region accepting as meager as 100mm of downpour yearly. The most punctual proof of rainwater harvesting innovation in Africa originates from northern Egypt, where tanks somewhere in the range of 200 and 2,000 m^3 have been utilized for in any event 2,000 years—

many stay operational today. In Southeast Asia, rainwater assortment rehearses follow back to Thailand, where for a long time little scope assortment from roof troughs and straightforward canals into containers and pots has been typical. In South Asia, such practices go back to the ninth or tenth Century, where proof of housetop rainwater assortment and straightforward brush dam developments can be found (Adham et al., 2016). Rainwater harvesting has been rehearsed for such a long time inferable from the transient and extraordinary inconstancy of precipitation, and these antiquated practices are getting a charge out of a contemporary recovery. Rainwater is regularly better than wellsprings of groundwater that may have been exposed to pollution. In that capacity, as other water assets, rainwater harvesting is a choice to consider in the arranging of network situated water flexibly systems (Al-Adamat et al., 2012). Contingent upon neighborhood ecological conditions, water harvesting can give a strengthening or elective water flexibly, or it might be the main gracefully as is regularly the situation in urban territories. For instance, numerous urban areas in India have made housetop rainwater harvesting obligatory for civil structures, including New Delhi, Mumbai, Chennai, Bangalore, Hyderabad, and Indoor (Al-Adamat et al., 2012). The accompanying realities are figures holds for the ongoing pattern of downpour water harvesting:

- 60% of precipitation doesn't wind up in streams or springs, however is held in the dirt, accessible as 'green water' for plant-biological systems.
- An evaluated 25% of individuals in creating nation urban areas use water merchants, buying water at fundamentally more significant expenses than is charged for channeled water.
- In semi-parched locales, for example, sub-Saharan Africa and parts of Asia, every kilogram of grain delivered requires 5,000 liters of precipitation.
- Projections for 2025 demonstrate that the quantity of individuals living in water-focused on nations will build six-overlay, contacting billion influenced individuals.
- The normal separation that women in Africa and Asia stroll to gather water is 6 km, conveying a normal of 20kg burden on their heads.
- The populace in the Kibeira ghetto in Nairobi, Kenya, follows through on up to multiple times the cost that a normal American resident pays for one liter of water.
- Today, 1.1 billion individuals on the planet need access to safe water: around one-6th of the total populace.
- Today, 470 million individuals live in areas encountering extreme water deficiencies.

WHY HARVEST WATER?

Water resources are constrained, and water is turning into a rare ware because of expanded interest in relation to a quickly expanding worldwide populace, industrialization, urbanization, and worldwide environmental change (Ali *et al.,* 2010). Protection of water assets is essential, and water harvesting strategies are significant preservation devices. Water harvesting alludes to all exercises used to gather accessible water assets, to briefly store abundance water for use when required—e.g., in the midst of dry season. Water can be gathered from regular water sources, for example, rain,fog, spillover, or wastewater. In particular, rainwater harvesting is the procedure of gathering and putting away rainwater in surface or sub-surface springs before it is lost as surface spillover. This strategy is significant in regions with noteworthy precipitation however that come up short on an ordinary, concentrated flexibly system (Ali et al., 2010). Rainwater harvesting is especially significant in urban zones, where fast urbanization has brought about diminished penetration of rainwater into the subsoil, lessening groundwater reviving. In this specific circumstance, rainwater harvesting is fundamental to fulfill the needs of water for residential use, domesticated animals, and groundwater spring recharging.

Harvesting from housetop catchments and groundwater energizing ought to be made required in urban zones. Territories encountering outrageous rainfalls require great flood assurance and preoccupation structures, while regions inclined to extraordinary dry spell require noteworthy capacity limit, the making sure about of elective water assets, and apportioning plans grew well ahead of time (Ali et al., 2010).

TYPES OF WATER HARVESTING

Rainwater Harvesting: Rainwater collection is characterized as the technique for initiating, gathering, putting away and controlling neighborhood surface spillover for farming in bone-dry and semi-parched districts. Three sorts of water collecting are secured by water reaping (FAO, 2014).

- Water gathered from rooftop tops, patios and comparative compacted or treated surfaces is utilized for residential reason or nursery crops.

- Micro-catchment water gathering is a strategy for gathering surface overflow from a little catchment territory and putting away it in the root zone of a contiguous penetration bowl. The bowl is planted with a tree, a hedge or with yearly yields.

- Macro-catchment water gathering, additionally called collecting from outer catchments is where spillover from slope slant catchments is passed on to the editing zone situated at lower region on level landscape.

Flood Water Harvesting: Flood water reaping can be characterized as the assortment and capacity of brook stream for water system use. Rising water reaping, otherwise called 'huge catchment water gathering' or 'Spate Irrigation', might be grouped into following two structures:

- In instance of 'rising water gathering inside stream bed', the water stream is dammed and therefore, immerses the valley base of the flood plain. The water is compelled to penetrate and the wetted zone can be utilized for agribusiness or field improvement.

- In instance of 'rising water redirection', the aqueduct water is driven away from its characteristic course and passed on to close by editing fields (FAO, 2014).

Groundwater Harvesting: Groundwater collecting is a somewhat new term and utilized to cover conventional just as flighty methods of ground water extraction. Qanatsystems, underground dams and exceptional sorts of wells are a couple of instances of the groundwater reaping procedures. Groundwater dams like 'Subsurface Dams' and 'Sand Storage Dams' are other fine instances of groundwater collecting. They deter the progression of fleeting streams in a waterway bed; the water is put away in the dregs subterranean surface and can be utilized for spring energize (FAO, 2014).

CLASSIFICATION OF RAINWATER HARVESTING SYSTEMS

The catchment area is the first point of contact for rainfall (FAO, 2014). For the vast majority of tank-based rainwater harvesting systems, the catchment area is the roof surface and other suitable catchments, Rainwater-harvesting system can be classified into the following basic categories:

- Roof top rainwater harvesting technique: used to harvest water for domestic and animal water needs in both arid, semi arid and temperate regions.
- Micro-catchment techniques: In-situ water harvesting for crop production (Simple RWHS)
- Macro-catchment techniques: can be used to harvest water for animal and agricultural use (Complex RWHS)

Roof top rainwater harvesting technique:

In this method of rain water harvesting, the water intercepted by the roof top of buildings or sheds is directed with a piece of corrugated zinc or PVC is used to divert it into a storage facility.

Figure1: Roof top water harvesting and storage system
Source: (Frasier, 1985)

Micro catchment techniques

- In micro catchment techniques, runoff flows directly into the cropping area. The system collects rainwater and allows it to seep in the soil, where plant roots can reach it.
- The techniques are usually staggered in alternative rows so that overflow from one row runs in to the next down the slope.
- In Micro catchment techniques the catchment is not more than three times the size of the cropping area. Its size depends on the amount of water that needed to be retained

Macro-catchments rainwater harvesting

- These are techniques which are either large scale or water is collected over a distance of 150 m (external catchment system).
- In macro catchment techniques, a channel connects the catchments with the cropping area. It covers a much larger area than micro catchments.
- In this technique, water is collected in catchments, and then it is transported to a separate place where it is stored and used. The catchment area is usually several times larger than and may be hundreds of meters away from the cropping area

COMPOSITION OF RWH SYSTEM

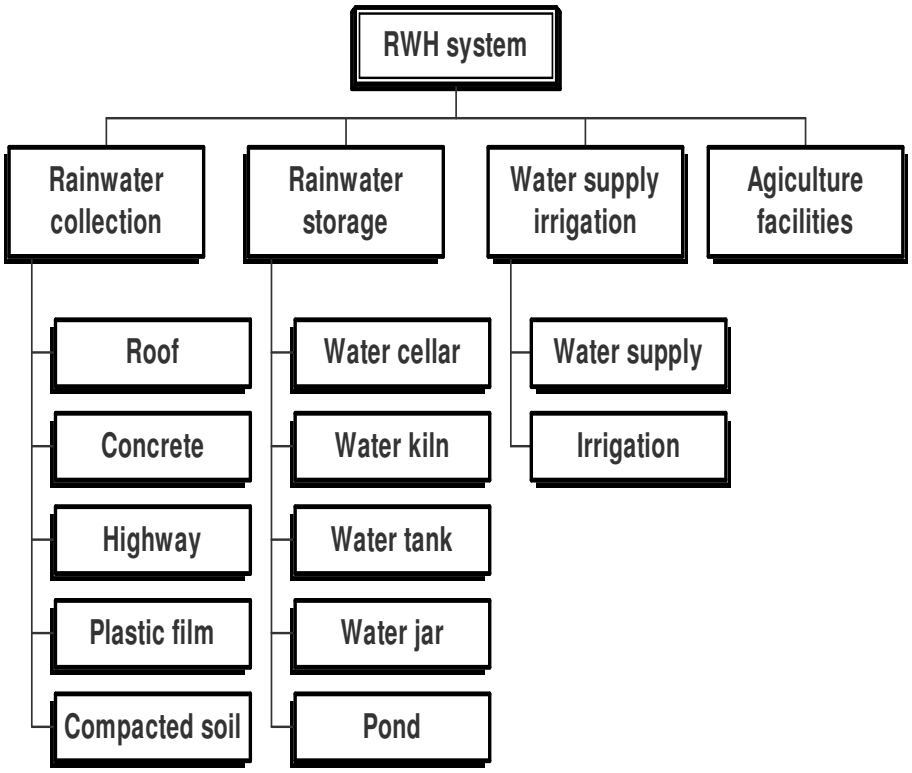

Figure 2: Composition of rain water harvesting system
Source: Igbadun, 2012

A catchment area is a natural or man-made unit draining runoff water to a common point. It could be:

- Roof catchment
- Rock catchment
- Paved ground catchment
- Roads
- Sand dams /dry river bed, etc.

Important points need to be considered for catchments area selection

- The catchment area must collect sufficient runoff water to meet the designed storage capacity or to meet the users' needs.
- The runoff water collected from the catchment area should be easily diverted to the tank.
- The catchment area should be located sufficiently away from pollution sources (toilets, animal sheds), and must be protected from contamination.
- The catchment must generate as little sediment as possible. Use suitable soil conservation measures to reduce the amount of silt that is carried into the tank.

Rooftop Collection Point

The roof of a structure or a house is a conspicuous decision for a catchment establishment (Figure 3). To oblige extra limit, one can manufacture an open-sided animal dwellingplace—called a

downpour outbuilding or a shaft horse shelter. Horse shelters can be utilized to store water tanks, siphons, channels, just as vehicles and devices. Housetop water systems are mainstream at the family and network level, as the water can be promptly utilized for residential purposes. An additional bit of leeway is that clients own, keep up, and control their systems, decreasing dependence on other network individuals. Water quality in these systems is identified with the rooftop material, climatic conditions, and the encompassing ecological conditions (Frasier, 1994, Gould and Nissen-Petersen, 1999, Lavee et al., 1997).

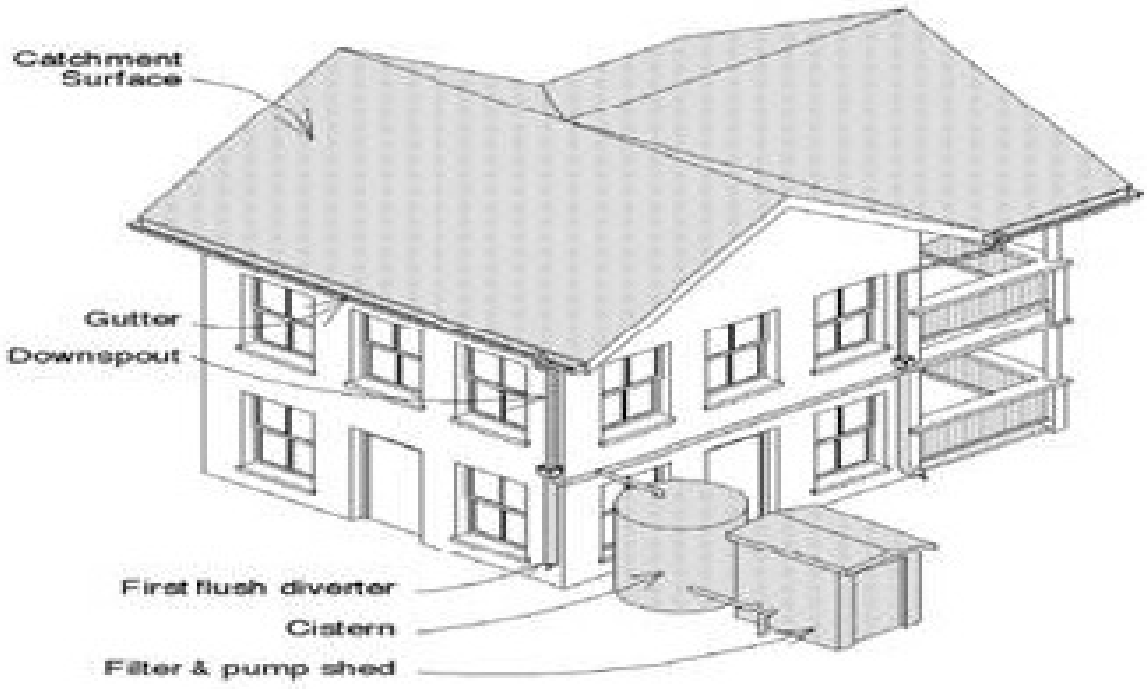

Figure 3: Roof catchment system
(source: Lavee*et al.,* 1997)

Paved ground or Rock Catchment

The top of a structure or a house is a conspicuous option for catchment establishment (Figure 3). To oblige extra limit, one can manufacture an open-sided animal dwellingplace—called a downpour outbuilding or a shaft horse shelter. Horse shelters can be utilized to store water tanks, siphons, channels, just as vehicles and devices. Housetop water frameworks are mainstream at the family and network level, as the water can be promptly utilized for residential purposes. An additional bit of leeway is that clients own, keep up, and control their frameworks, decreasing dependence on other network individuals. Water quality in these frameworks is identified with the rooftop material, climatic conditions, and the encompassing ecological conditions (Frasier, 1994, Gould and Nissen-Petersen, 1999, Lavee et al., 1997).

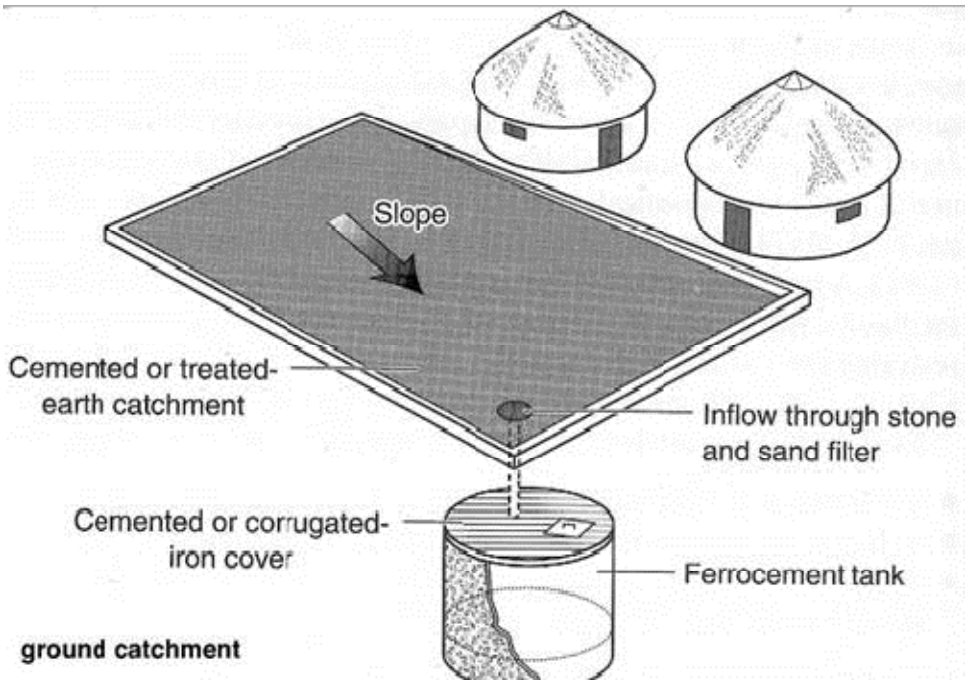

Figure 4: Ground catchment system
Source: (Mahmoud and Alazba, 2014)

DISTRIBUTION COMPONENTS

A few kinds of dischargesystems are utilized to pass on water from catchments to supplies for capacity, including canals, downpipes, coasts and surface depletes or channels. Conveyance frameworks are regularly the most fragile connection in water catchment frameworks. There must be alert to guarantee they are properly estimated and introduced around the whole rooftop catchment territory. Channels should possibly be utilized in the event that they can be handily cleaned or are self-cleaning, as they may get stopped up, keeping water from being gathered (Mahmoud and Alazba, 2014).

Leaf screens

Leaf Screens are important to evacuate the flotsam and jetsam that accumulates on the catchment surface and to guarantee satisfactory water quotable for consumable use. Work screen channels evacuate flotsam and jetsam when the capacity tank. To keep trash out of a water gathering framework, leaf screens can be introduced at purpose of drainpipe protection or in the downspout (Shadeed and Lange, 2010). These screens must be cleaned normally to be successful; else, they will get stopped up, blocking the progression of water into the tank. Flotsam and jetsam develop can likewise harbor microbes and the results of leaf rot (Nasri et al., 2004, Ouessar, 2007, Oweis*et al.,* 2012).

Channel type Filters

They are made of PVC or electrifies steel fitted with a treated steel or metal screen. This sort of channel is effectively open for cleaning. The channel is cut into the downspout pipe at a similar stature as, or somewhat higher than, the most noteworthy water level in the capacity tank (Oweis et al., 2012).

Sifter bushels

Are circular, confine like sifters that slip into the drop outlet of the downspout.

Cylinders or rolled screen

Embedded into drop outlet fill in as another technique for separating flotsam and jetsam. Screens have different framework sizes, from creepy crawly screen to equipment material.

First flush System

Contaminants—garbage, earth, and residue—gather on rooftops during dry periods. The underlying precipitation washes these contaminants into the capacity tank. Following this 'first flush,' the water is a lot of cleaner and more secure to drink. First flush water is isolating frameworks discard this tainted water to keep it from entering the capacity tank (Zhao, 1996).

Manual Method

In this framework, the downpipe is physically moved away from the tank channel for first flush and supplanted once the primary flush water has been occupied. This framework doesn't require additional innovation; notwithstanding, somebody must be available all through the underlying phases of precipitation occasions to evacuate the downpipe, in any case contaminants will enter the capacity tank (Pandey, 1991).

Self-loader Method: Simple down channel first flush gadget

Self-loader first flush structures don't rely upon humans. Downpipe first flush contraptions are made out of an alternate vertical channel affixed to the downpipe using a "T" crossing point. The hidden flush of precipitation runs off the housetop and washes into the chief flush downpipe, where it is held. Exactly when this downpipe is full, water streams into the combination downpipe and into the limit tank. Corrupted water in the fundamental flush tanks can be used for purposes other than drinking, e.g., cleaning, washing, and water framework).

CONCLUSION

The most economical viable river diversion project is already implemented and only alternative of RWH technique is left to combat with water scarcity method. From past millennium rainwater harvesting has been practice to solve the water scarcity problem. The common practices used in ASARs are micro- catchment, hill slope, tabias, tanks, hafer, macro catchment. The selection of types of rainwater harvesting depend upon the biophysical and socio-economic factor. Now a day's researcher used different methodologies based on geoinformatics and socio- economic factor for determining suitable sites and techniques for RWH. The selection of suitable crops, growing pattern, catchment characteristics and irrigation method is major factor that determine the economic viability of RWH project. The implementation of conservation techniques with efficient portable irrigation, assurance of water quality and minimization of seepage optimize the productivity of the harvested water. In my view, the RWH is the best solution ASARs to cope with water scarcity and increase productivity of agricultural land. Because it relatively cheap, environmentally safe, reasonably utilized, highly decentralized, empowering individuals and communities to manage their

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