RAINWATER HARVESTING AT ACEM,PUNE

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CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION OF THE PROJECT WORK

1.1.1 Concept of rainwater harvesting system:

Rainwater harvesting is a technology used to collect, convey and store rain water for later use from relatively clean surfaces such as a roof, land surface or rock catchment. RWH is the technique of collecting water from roof, filtering and storing for further uses. Rainwater Harvesting is a simple technique of catching and holding rainwater where its falls. Either, we can store it in tanks for further use or we can use it to recharge groundwater depending upon the situation[1]

Rainwater harvesting system is the ancient practice of collecting rainwater and storing it for later use. RWH systems are comprised of a roof catchment, conveyance network, rainwater storage tank, pump and fixtures where rainwater is utilized. Most systems also incorporate treatment technologies to improve the quality of rainwater before and/or after storage, and include provisions for periods of insufficient rainfall and times of excessive rainfall.

Individual and communities shall be given with sample technology of using rain water harvest instead exploitation of river and ground water through dams and tube wells. As water and river and aquifers is only a small portion of water available for consumption. There is inevitable growth of unbearable stress on in the water available in the natural sources.

Everybody wants happiness nobody wants pain, but one can't have a rainbow without a little rain. Everybody wants to use water nobody wants to save water. We generally receive rainfall in heavy showers followed by dry spells. We shall store or recharge ground water that received.

Water is the most common or major substance on earth, covering more than 70% of the planet's surface. All living things consist mostly of water. For example, the human body is about two- third water. For improving per capita water availability in the country, replenishment of ground water resources is a necessity which can be done very effectively through rainwater harvesting.

1.1.2 Assessment of rainwater harvesting system:

RWH mechanisms are designed after assessing the site conditions such as incident rainfall, sub-surface strata, their characteristics, infiltration test and suitability of conveyance and storage system.

1.1.3 Need of rainwater harvesting system:

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. In discriminate 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 groundwater table. The solution to all these problems is to replenish ground water bodies with rain water by manmade means.

1.1.4 Features of rainwater harvesting system:

RWH system provides sources of soft, high quality water reduces dependence on well and other sources and in many contexts are cost effective. RWH system is economically cheaper in construction compared to other sources, i.e. Well, canal, dam, diversion, etc.

1.1.6 Benefits of rainwater harvesting system:

a) Harness good quality water resource.
b) Save expenditure & efforts on water supply.
c) Ease in constructing system in less time.
d) Economically cheaper in construction compared to other sources.
e) Helps in utilizing the primary source of water and prevent the runoff from going into sewer or storm drains, thereby reducing the load on treatment plants.
f) Recharging water into the aquifers which help in improving the quality of existing groundwater through dilution.
g) Promotes adequacy of underground water.
h) Mitigates the effect of drought.
i) Reduces soil erosion as surface run-off is reduced.
j) Decreases load on storm water disposal system and also reduces flood hazards.
k) Improves ground water quality / decreases salinity (by dilution).
l) The cost of recharging subsurface aquifer is lower than surface reservoirs.

1.1.7Advantages of Rainwater Harvesting:

a) To meet the ever increasing demand for water. Water harvesting to recharge the groundwater enhances the availability of groundwater at specific place and time and thus assures a continuous and reliable access to groundwater.
b) To reduce the runoff which chokes storm drains and to avoid flooding of roads.
c) To reduce groundwater pollution and to improve the quality of groundwater through dilution when recharged to groundwater thereby providing high quality water, soft and low in minerals.
d) Provides self-sufficiency to your water supply and to supplement domestic water requirement during summer and drought conditions.
e) 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.
f) Reduces soil erosion in urban areas
g) The rooftop rainwater harvesting is less expensive, easy to construct, operate and maintain.
h) In saline or coastal areas, rainwater provides good quality water and when recharged to ground water, it reduces salinity and helps in maintaining balance between the fresh-saline water interfaces.
i) In Islands, due to limited extent of fresh water aquifers, rainwater harvesting is the most preferred source of water for domestic use.
j) In desert, where rainfall is low, rainwater harvesting has been providing relief to people. Design Considerations

1.1.8 Cleaning and Maintenance of rainwater harvesting system:

Open containers are not recommended for storing water for drinking purposes. A solid and secure cover is required to avoid breeding of mosquitoes, to prevent insects and rodents from entering the tank, and to keep out sunlight to prevent the growth of algae inside the tank. The storage tank should be checked and cleaned periodically. All tanks need cleaning and their designs should allow for thorough scrubbing of the inner walls and floors. A sloped bottom and the provision of a sump and a drain are useful for collection and discharge of settled grit and sediment. An entrance hole is required for easy access for cleaning. The use of a chlorine solution is recommended for cleaning, followed by thorough rinsing. Chlorination of the cisterns or storage tanks is necessary if the water is to be used for drinking and domestic uses. Dividing tanks into two sections or dual tanks can facilitate cleaning. Cracks in the storage tanks can create major problems and should be repaired immediately.

The extraction system (e.g., taps/faucets, pumps) must not contaminate the stored water. Taps/faucets should be installed at least 10 cm above the base of the tank as this allows any debris entering the tank to settle on the bottom, where if it remains undisturbed, will not affect the quality of the water. Rainwater pipes must be permanently marked in such a way that there is no risk of confusing them with drinking water pipes. The handle of taps might be detachable to avoid any misuse by the children. Periodic maintenance should also be carried out on any pumps used to lift water to selected areas in the house or building. The following devices are also desirable:
1) An overflow pipe leading to either infiltration plants, drainage pipes with sufficient capacity or the municipal sewage pipe system.
2) An indicator of the amount of water in the storage tank.
3) A vent for air circulation (often the overflow pipe can substitute).
4) Protection against insects, rodents, vermin, etc. May also be required.

1.2 PROBLEM STATEMENT

Rain water harvesting is most economical and beneficial need for water solving problem. The college campus of alard was constructed generally without rain water harvesting.so there was a scaricity in storage of water at alard campus.the total number of tube wells provided in the college were only two and in that tube wells only one is in working condition the other one completely ran out othe water storage.

The only tube well is having the entire load of water supply to the college.So for the other one this project of designing the rain water system in our college campus is to establish for the recharge of ground water.

1.3 OBJECTIVE

1.To Promote rain water harvesting by creating awareness among the people:

It can be purified to make it into drinking water, used for daily applications and even used in large scale industries. In short, Rainwater harvesting is a process or technique of collecting, filtering, storing and using rainwater for irrigation and for various other purposes.

2.To meet increasing demand of water:

These water demands are expected to increase in a changing climate due to changes in temperature and precipitation For example, an increase in temperature also increases the water consumption by people, animals, and plants to maintain their health.

3.To Decrease the flood on local and regional:

Crop losses through rain damage, waterlogged soils, and delays in harvesting are further intensified by transport problems due to flooded roads and damaged infrastructure. Insurance of the structure and its contents against flooding can reduce the number of floods on individuals or companies

4. To increasing availability of ground water during period:

High temperatures increase evaporation and decrease water levels in lakes, rivers and reservoirs. It also reduces soil moisture. Highly variable rainfall, especially it comes in bursts punctuated by long dry spells, can reduce the natural recharge of water reduces ground water levels.

1.4 SCOPE OF THE PROJECT WORK

Rainfall over India fluctuates widely. The advance of the monsoon into the country takes place in two main branches. The south west monsoon (June to Sep) is the principal rainy season, 75% all over the country and the Northeast monsoon over 25% of the country (Oct to Dec) and transitional rains. There is large variation in rainfall from region to region, season to season and year to year. The normal rainfall which is as low as 100mm in Western Rajasthan (at Banner and at Jaisalmer) is over 15000 mm at Cheeripunji in Meghalaya. The spatial unevenness, temporal variations in precipitation, high intensity with very few hours of rain has led to complex situation like the distinctly different monsoon and non-monsoon season and the high and low rainfall areas. The problem of large variation in water availability and growing demand leads to water harvesting The precious sources that water is, it is available in a highly irregular fashion. It is not available in places where we want it, when we want it and in what quantities we want it. The pace of development and the great increases.

Groundwater resources have been extensively developed and no further indiscriminate development should take place. Groundwater resource as a natural resource has the major benefit in meeting the emergency supplies during the water scarcity periods. "Dependence on groundwater to meet the needs of domestic, agricultural and industrial sectors resulted in lowering of groundwater level. As a consequence, drying up of dug wells and shallow bore wells are witnessed in many areas. In order to maintain the groundwater resources potential, a hydraulic equilibrium must be made between the availability and utilization. Measures dovetailing rainwater harvesting and artificial recharge will augment the groundwater resources. Hence, it is necessary to take up measures to conserve and augment the renewable natural groundwater resources".

Rainwater harvesting is being increasingly followed for meeting the drinking water needs in rural areas. Direct utilization of harvested water after proper treatment will play an Important role in areas where the groundwater is unsuitable, polluted and contaminated either due to human activities or by geological setup or there is no surface water or groundwater potential available. It is necessary to highlight many valuable technical details, type design, precautions to be observed while doing design and construction of various types of structures which will be quite useful for domestic, irrigation and other sectors who are interested in implementing Rainwater Harvesting and Artificial Recharge Techniques more scientifically in the different Geo-hydro-thermo Regimes and Agro Climatic Zones. At this juncture, measures are to be taken up by various Governmental and Non-Governmental Organizations as well as the public at large, so as to harvest the rainfall and maintain groundwater balance. Such measures will help to have reliable andsustainable groundwater resource for supplementing the domestic and industrial water supply needs of urban area.

Traditional and more scientific water harvesting systems are to be designed at cheaper cost to cover the minimum requirement for every people in their locality. Even in Villages those having population less than 500 depend upon the government agencies to meet their daily water requirement.

1.5 RESEARCH METHODOLOGY

A rainwater harvesting system comprises of components for - transporting rainwater through pipes or drains, filtration, and tanks for storage of harvested water.
The details of the components of rainwater harvesting system has shown in figure 1.1

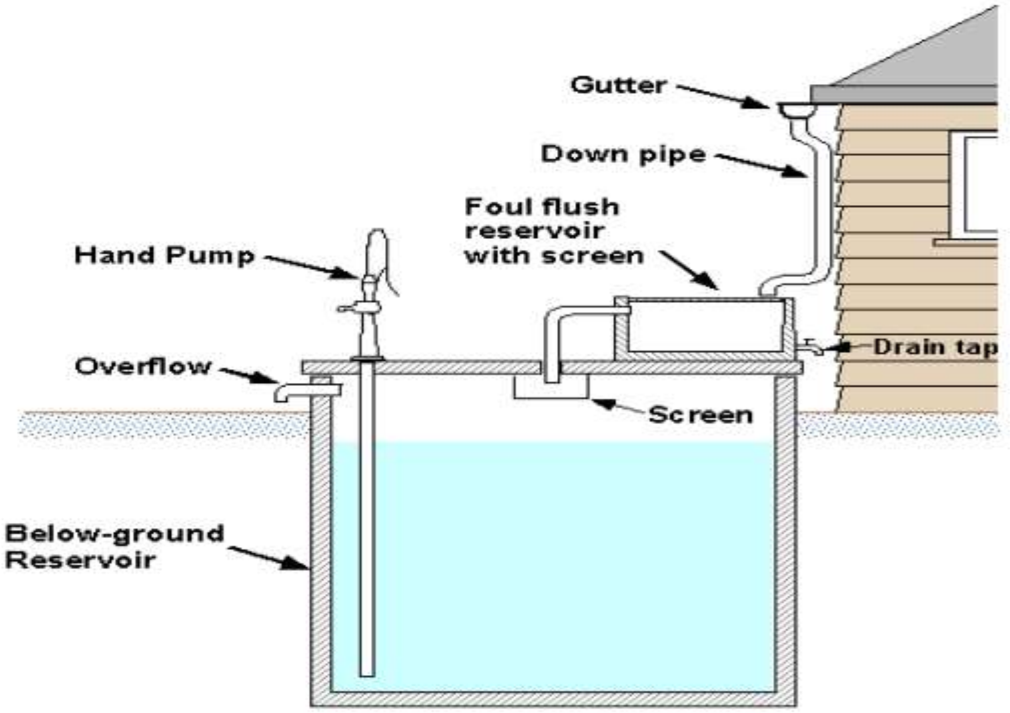


Figure 1.1 Rainwater harvesting system

The details of the various components of rainwater harvesting system are as follows:

a) Catchments:

The surface which directly receives the rainfall and provides water to the system is called catchment area. It can be a paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground. A roof made of reinforced cement concrete (RCC), galvanized iron or corrugated sheets can also be used for water harvesting.

b) Coarse Mesh / leaf screen:

To prevent the entry of leaves and other debris in the system, the coarse mesh should be provided at the mouth of inflow pipe for flat roofs as shown in Fig. 1.2 It prevents the passage of debris, provided in the roof. The details of the coarse mesh of rainwater harvesting system has shown in figure 1.2

Fig. 1.2 Coarse mesh

c) Gutter:

Gutter is channel which surrounds edge of a sloping roof to collect and transport rainwater to the storage tank. Gutters can be semi-circular or rectangular and mostly made locally from plain galvanized iron sheet. Gutters need to be supported so they do not sag or fall off when loaded with water. The way in which gutters are fixed mainly depends on the construction of the house, mostly iron or timber brackets are fixed into the walls.

d) Conduits:

Conduits are pipelines or drains that carry rainwater from the catchment or rooftop area to the harvesting system. Commonly available conduits are made up of material like polyvinyl chloride (PVC) or galvanized iron (GI).

e) First-flushing:

A first flush device is a valve which ensures flushing out of first spell of rain away from the storage tank that carries a relatively larger amount of pollutants from the air and catchment surface.

f) Filters:

The filter is used to remove suspended pollutants from rainwater collected from rooftop water. The Various types of filters generally used for commercial purpose are Charcoal water filter, Sand filter, Horizontal roughening filter and slow sand filter, Varun filter and Dewas filter.

As the collected water from roof top is to be used for human consumption directly, a filter unit is required to be installed in RWH system before storage tank. The filter is used to remove suspended pollutants from rain water collected over roof. The filter unit is basically a chamber filled with filtering media such as fiber, coarse sand and gravel layers to remove debris and dirt from water before it enters the storage tank. The filter unit should be placed after first flush device but before storage tank. There are various type of filters which have been developed all over the country. The type and selection of filters is governed by the final use of harvested rain water and economy. Depending upon the filtering media used and its arrangements, various types of filters are available as mentioned above. Some of them are described below

g) Storage facility:

There are various options available for the construction of these tanks with respect to the shape, material of construction and the position of tank and they are as follows –

i. Shape- Circular , square and rectangular.

ii. Material of construction-Reinforced cement concrete (RCC), Brick masonry, Ferro- cement etc.

iii. Position of tank-Depending on land space availability these tanks could be constructed above ground, partly underground or fully underground. Some maintenance measures like disinfection and cleaning are required to ensure the quality of water stored in the container.

h) Recharge structures:

Rainwater Harvested can also be used for charging the groundwater aquifers through suitable structures like dug wells, bore wells, recharge trenches and recharge pits. Various recharge structures are possible – some which promote the percolation of water through soil strata at shallower depth (e.g., recharge trenches, permeable pavements) whereas others conduct water to greater depths from where it joins the groundwater (e.g. recharge wells). At many locations, existing structures like wells, pits and tanks can be modified as recharge structures, eliminating the need to construct any fresh structures. Some of the few commonly used recharging methods are recharging of dug wells and abandoned tube wells, Settlement tank, Recharging of service tube wells, Recharge pits, Soak ways /Percolation pit , Recharge troughs, Recharge trenches, Modified injection well.

1.6 LIMITATIONS OF STUDY

1) Unpredictable rainfall:

   Rainfall is hard to predict and sometimes little or no rainfall can limit the supply of rainwater.It is not advisable to depend on rainwater alone for all your water needs in areas where there is limited rainfall.Rainwater harvesting is suitable in those areas that receive plenty of rainfall.
2) Initial high cost:

   Depending on system size and technology level, a rainwater harvesting system may cost anywhere between 20000Rs. To 200000Rs and benefit from it cannot be derived until it is ready for use. Like solar panels, the cost can be recovered in 10-15 years which again depends on the amount of rainfall and sophistication of the system.
3) Regular maintainance:

   Rainwater harvesting systems require regular maintenance as they may get prone to rodents, mosquitoes, algae growth, insects and lizards. They can become as breeding grounds for many animals if they are not properly maintained.
4) Storage limits:

   The collection and storage facilities may also impose some kind of restrictions as to how much rainwater you can use. During the heavy downpour, the collection systems may not be able to hold all rainwater which ends in going to to drains and rivers.

1.7EXPECTED OUTCOME

1) It is important to do drinking water purpose.
2) It is Easily to renewable water and it helps to reduce waste water
3) It can be used for several non drinking purposes
4) It reduces demand on ground water

CHAPTER-2

2. LITERATURE REVIEW

2.1 Studies carried out globally:

Today due to rising population and economic growth rate, demands for the surface water is increasing exponentially. Rainwater harvesting system is seems to be a perfect replacement for surface and ground water as later is concerned with the rising cost as well as ecological problems. Thus, rainwater harvesting is a cost effective and relatively lesser complex way of managing our limited resources ensuring sustained long-term supply of water to the community.

In order to fight with the water scarcity, many countries started harvesting rain. Major players are Germany (Biggest harvesting system in Germany is at Frankfurt Airport, collecting water from roofs of the new terminal which has an large catchment area of 26,800 m2), Singapore (as average annual rainfall of Singapore is 2400 mm, which is very high and best suited for rainwater harvesting application), Tokyo (RWH system reserves water which can be utilized for emergency water demands for seismic disaster), etc.

2.2 Studies carried out in India:

Today, only 2.5 per cent of the entire world's water is fresh, which is fit for human consumption, agriculture and industry. In several parts of the world, however, water is being used at a much faster rate than can be refilled by rainfall. In 2025, the per capita water availability in India will be reduced to 1500 cubic meters from 5000 in 1950.

Christopher *et*al. (2010) have explained the Alberta guidelines for residential rainwater harvesting Systems which happen developed with assistance from a rainwater harvesting task group made up of government and industry stakeholders.

Mudrakartha and Chopade. 2002 The United Nations warns that this shortage of freshwater could be the most serious obstacle to producing enough food for a growing world population, reducing poverty and protecting the environment. Hence the water scarcity is going to be a critical problem if it is not treated now in its peanut stage.

Handia, L., Tembo, J. M., and Mwindwa, C. (2002) Some of the major city where rainwater harvesting has already implemented is Delhi (Centre for Science and Environment's (CSE) designs sixteen model projects in Delhi to setup rainwater harvesting structures in different colonies and institutions), Bangalore (Rainwater harvesting)

Escorts-Mahle-Goetze, Designed by S. Vishwanath, Rainwater club, Thane (Thane Municipal Corporation (TMC) has announced a rebate of 5 per cent on property tax for those who have implemented the rainwater harvesting work in their house/bungalow/building).

Sundaravadivele*t*al. (2001) have focused rainwater harvesting (RWH) and recharging of groundwater is emerging as a sustainable strategy to cope with the increasing pressure on scarce freshwater resources. It is imperative that RWH practices have to be promoted nation-wide for a secure water future of our country.

Rani etal.(2010) have focused on water shortage is a big problem in Ethiopia. The main challenge is to develop an appropriate and affordable innovation that can help to bridge the gap between demand and supply of water. Thus, water transportation, operation and maintenance of supply system consume a big chunk of energy supply. The objective of this study is to evaluate the potential of rainwater harvesting and its suitability to meet the water requirements for Jimma zone, Ethiopia, besides to establish linkage between water and energy to achieve sustainable development. Rainwater samples were also analyzed to know the suitability of this water for different purposes. The important parameters analyzed were pH, EC, TS, TSS, TDS, DO and MPN. It has found from the analysis that rainwater harvested from roof-yard has quite safe for drinking purpose after chlorination, but the surface side rainwater has not suitable for drinking though it could be used for washing, cleaning and irrigation purposes.

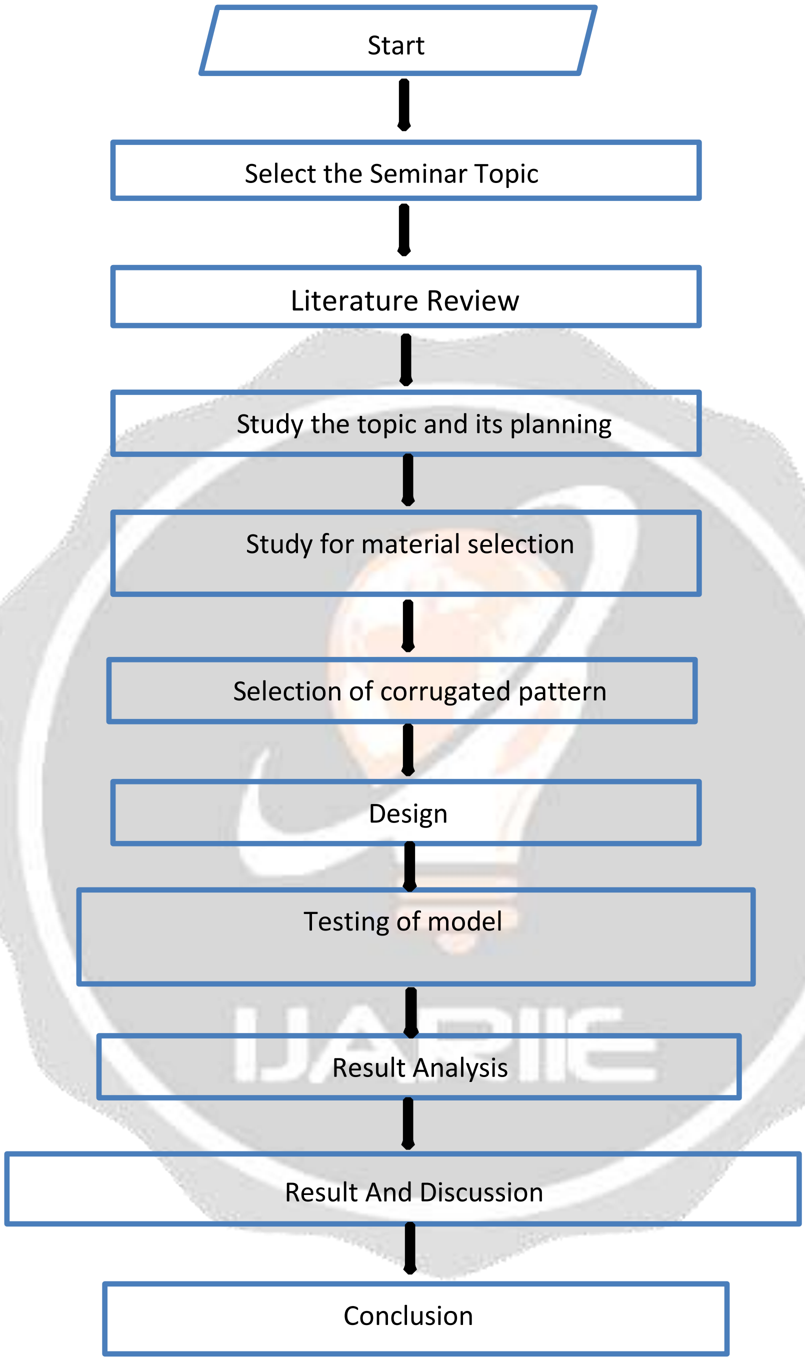
Gupta etal. (2006) have focused the rapid development of cities and consequent population explosion in urban areas has led to depletion of surface water resources. For fulfillment of daily water requirement, indiscriminate pumping of ground water is being resorted to, leading to lowering of ground water 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.

Chandraiahetal. (2011) have studied that, the urban cities in India are facing an ironical situation today. On one hand there is the acute water scarcity and on the other, the streets are often flooded during the monsoons. However, this rainfall occurs during short spells of high intensity. Because of such short duration of heavy rain, most of the rain falling on the surface tends to flow away rapidly leaving very little for recharge of groundwater there by worsening the urban water scenario. Water conservation by rainwater harvesting is cost effective relatively easier to carry out.

David etal. (2010) have focused on the relationship between adoption of household RWH technologies in rural Uganda (dependent variable), and the influence of independent variables (household characteristics such as age or monthly cash income, household perception including attitude or risk preference, and institutional and local community financial sources) that potentially influence technological adoption.

With above literature it is found that the rain water harvesting system can be developed with qualitative and quantitative approach for the case study under consideration.

CHAPTER-3
METHODOLOGY



CHAPTER-4
CASE STUDY

The most important consideration when designing and installing a RWH system are the pertinent provincial codes and regulations, standards, and municipal bylaws. Other considerations include how the design, installation and management of RWH systems can affect the quantity of water saved and the quality of rainwater harvested, as well as cold weather suitability of the system. The design and installation guidelines has been presented in several sections, organized by the different components of RWH systems.

The design and installation of RWH system includes followings:
1. Rainwater Catchment and Conveyance,
2. Rainwater Storage and Tank Sizing a

7.1 Rainwater Catchment and Conveyance:
7.1.1 Introduction:
A key component of rainwater harvesting is the collection of rainwater from a catchment surface and it's a tank for storage and future use. RWH systems most often utilize the roof of a building for collecting rainwater. While it is possible to collect rainwater from other surfaces, such as lawns, driveways or parking lots, these catchments are not addressed in this manual due to concerns surrounding the quality of rainwater collected. Once collected from the catchment surface, rainwater is transferred to the rainwater storage tank through the conveyance network.
While designing and installing a conveyance network, a number of issues must be considered, including:
1) Sizing and placement of conveyance network,
2) Site conditions and location/placement of storage tank,
3) Cold weather issues,
4) Rainwater quality.
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7.1.2 General:
1) When selecting the catchment for collecting rainwater
a) Only roof surfaces are recommended.
b) Collection from green roofs is not recommended.
c) Avoid sections of the roof with overhanging foliage, or trim where possible.
d) If rainwater collected from the catchment surface must be of very high quality.

2) To maximize the volume of rainwater collected by the RWH system
a) The catchment surface should be as large as possible.
b) If a roof catchment material is to be selected and installed in conjunction with the RWH system, material with minimal collection losses, such as steel, should be selected.
c) Convey rainwater using appropriately sized and sloped components, including gutters, downspouts, and/or conveyance drainage piping.
d) Where possible, multiple roof catchments can be connected to a central rainwater storage tank.

7.1.3 Catchment area:
a) In cases where an entire roof catchment or other catchment surface is utilized, catchment area can be determined using:
Catchment Area (m^2) = Length (m) x Width (m)
Where,
Length = Length of the catchment surface (m).
Width = Width of the catchment surface (m).

b) In cases where sections of one roof catchment or multiple catchment surfaces are utilized, the catchment area can be determined by summing the multiple smaller areas.

7.1.4 Plan the layout of the conveyance network:
a) For rainwater tanks located above ground.
i) Determine the location of the tank.
ii) Route downspout and/or conveyance drainage piping to the tank.
b) For rainwater tanks located below ground.
i) Determine the location of the tank.
ii) Plan route of conveyance drainage piping from the downspout to the tank.
iii) Ensure that there are no buried service lines (gas, electricity, water, storm water, wastewater, phone, or cable lines) in the area where digging will take place to accommodate the buried conveyance drainage pipes by contacting the municipality and service providers,
iv) For additional guidance on planning the layout of conveyance drainage piping for below ground tanks.

7.1.5 Conveyance drainage pipes:

a) Pipe material

i) PVC pipe (recommended)

ii) Pipe selected must be approved by applicable provincial codes and industry standards.

b) Pipe size and slope:

i) Ensure a minimum slope of 0.5-2% (the greater the slope the better) is maintained throughout the pipe length.

ii) Consult the applicable provincial codes and regulations pertaining to conveyance drainage pipe sizing.

c) Cleanouts:

i) Cleanouts are required on conveyance drainage pipes to facilitate cleaning of the conveyance drainage pipes.

ii) Consult the applicable provincial codes and regulations pertaining to size and spacing of cleanouts, manholes and location of cleanouts.

d) Borewell connection

Rainwater conveyance drainage piping should enter the borewell at a height no lower than that of the overflow drainage piping, or ideally, at a height 50 mm above the bottom of the overflow drainage pipe entering the borewell.

7.1.6 Installation of conveyance drainage pipe:

a) Above ground pipes shall be supported in accordance with applicable provincial codes and regulations.

b) Below ground pipes shall be located in a properly excavated space, be supported and properly backfilled in accordance with applicable provincial codes and regulations.

c) Pipe freeze protection:

i) Ensure that all buried pipes are located below the frost penetration depth. Consult local building authorities regarding regulations or rules of thumb for frost penetration depths.

ii) Provide insulation or heat tracing for pipes buried above the frost penetration depth or exposed above grade.

d) Underground non-metallic pipes should be installed with tracer tape at a height of 300 mm above the pipe for the purpose of locating as-installed piping.

e) Consult the pipe manufacturer’s installation instructions regarding recommended pipe bedding, support and backfilling procedures.

7.1.8 Ensure that there are no means of entry for small animals or insects into the rainwater storage tank from the conveyance network by,

a) Properly installing all sections of the conveyance network, such that they do not have any holes or other points of entry other than those required for water flow; and

b) Installing downspout-to-pipe transition fittings.

7.2 Rainwater Storage and Tank Sizing:

The reservoir that is used to store rainwater harvested from roof catchments is referred to as a rainwater storage tank, a rainwater cistern, or a holding tank. Rainwater storage tanks are available in variety of different materials, such as concrete, plastic, or fiberglass, and can be installed either above- or below-ground, or alternatively, directly integrated within a building (such as built into a basement wall or foundation).

As the central hub for RWH systems, rainwater storage tanks are directly connected to a number of pipes, which must be accommodated by perforations in the tank wall.

7.2.1 Design and Installation Guidelines:

1) Determine the rainwater storage tank capacity.

a) If the rainwater storage tank will be used for storm water retention and/or as part of a storm water management system, the tank shall be sized as required by local authorities.

b) For storage tanks used for rainwater harvesting purposes, use the Rainwater Harvesting System Design Tool.

c) If sizing the tank without reference to the Design Tool, consider:

i) The unused volume (typically referred to as the dead space) when selecting tank size. If unknown, assume 20% of tank capacity will be dead space.

ii) The collection losses from pre-storage treatment.

2) Determine the type of material utilized for the rainwater tank, based on:

a) Placement (above- or below-ground, or integrated storage).

b) Storage volume requirements.

c) Engineering specifications (see applicable codes, standards, and guidelines for applicable standards and consult with manufacturers for further specifications) and
d) Connected rainwater fixtures and desired quality. (See applicable codes, standards, and guidelines for applicable standards).

3) Determine the location of the rainwater storage tank.
a) For all rainwater storage tank locations ensure the location allows for,
i) Proper drainage of rainwater through the conveyance network.
ii) Proper drainage of make-up water through top-up drainage piping.
iii) Proper drainage of rainwater from the storage tank to an appropriate storm water discharge location.
b) For below ground storage tanks identify the area where the tank can be located.
i) Ensure the location is free from buried service lines. Contact service providers to determine the location of buried service lines (gas, electricity, water, storm water, waste water, phone, or cable lines).
ii) Ensure the location is permitted by applicable provincial codes and regulations based upon the minimum clearance requirements for buried tanks,
iii) Ensure the location is accessible for excavation equipment and the tank delivery vehicle. Consult the excavation contractor and tank supplier for exact requirements.
iv) Locate the tank such that the high water level in the tank is at a depth below the frost penetration depth (consult the tank manufacturer regarding the rated burial depth of the tank).
c) For above ground storage tanks, identify the area where the tank can be located
i) Ensure the location is permitted by applicable provincial codes and regulations and municipal zoning bylaws. Consult local building authorities for details.
ii) Ensure the location has sufficient space for access above and around the tanks for inspection and maintenance.
d) For rainwater storage tanks located within a building and/or integrated within a building, identify the area where the tank can be located,
i) Ensure the location is permitted by applicable provincial codes and regulations and municipal zoning bylaws. Consult local building authorities for details.
ii) Ensure the location has sufficient space for the required storage volume.
iii) Ensure the location has sufficient space for access above and around the tanks for inspection and maintenance.

TABLE- Average Rainfall summery for 2018

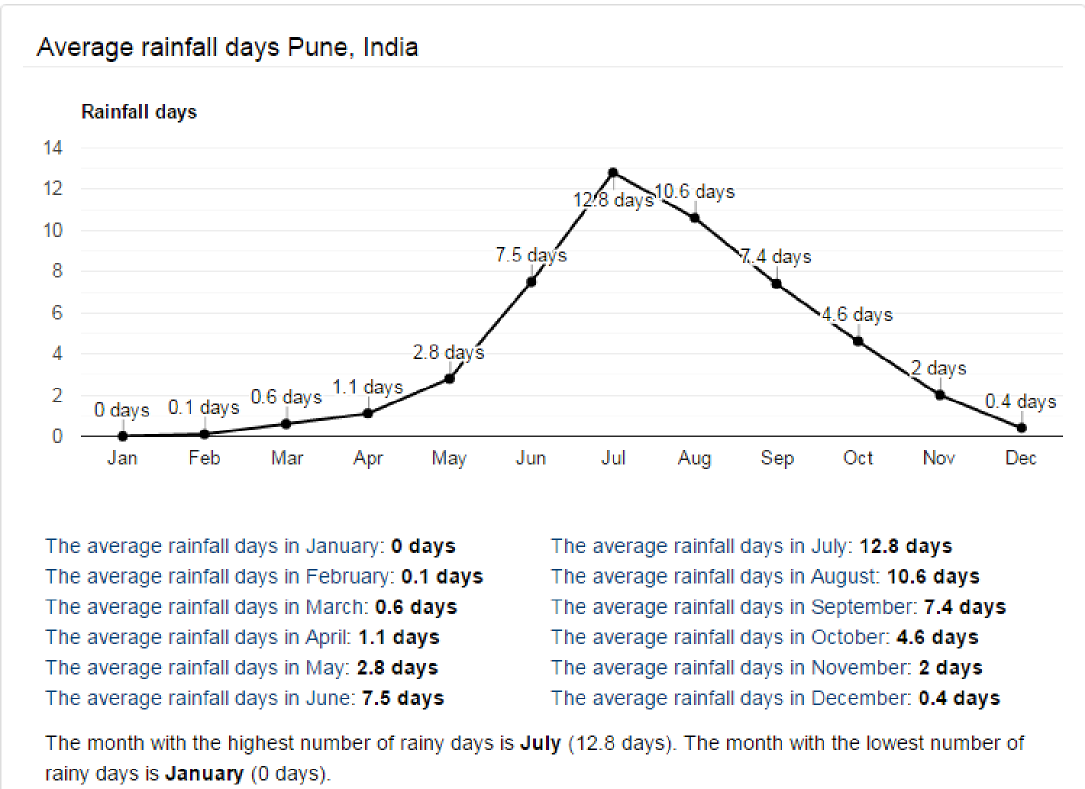
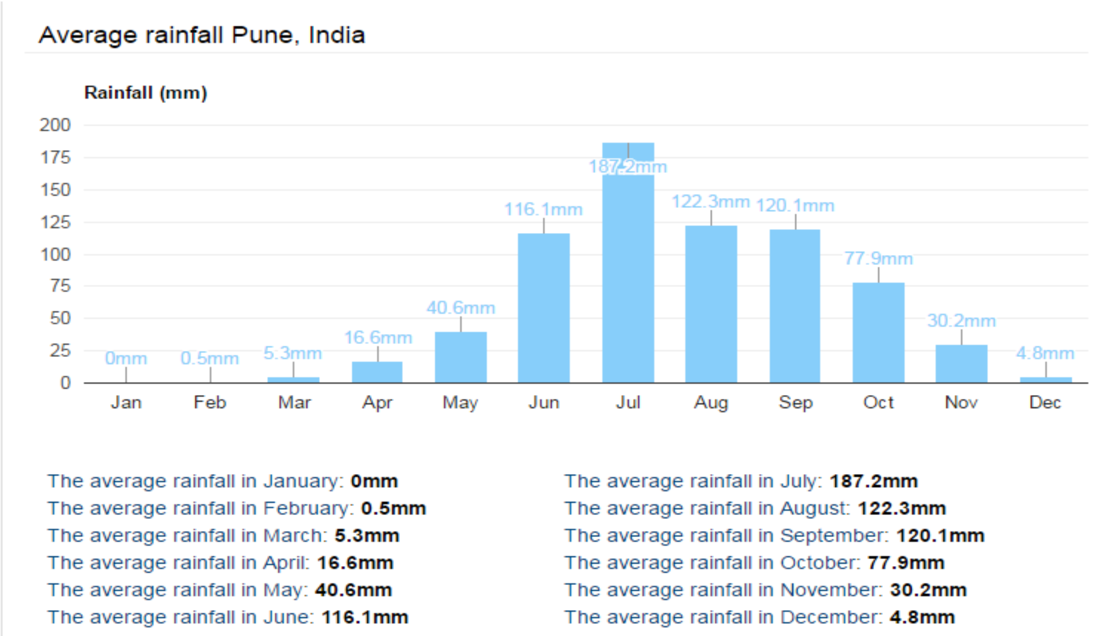


TABLE-AVERAGE RAINFALL SUMMARY IN 2018



CHAPTER-5
RESULT AND DISCUSSION

CHAPTER-6
CONCLUSION

Demand on water resources witness a substantial increase due to development, population increase, and global weather change. Adopting the concept of sustainability and conservation of water resources can help to cope with the global water shortage. Promotion of rainwater harvesting technique for domestic, landscaping, and agriculture can help to reduce the demand on water resources. Rainwater harvesting systems used in housing schemes can provide water for potable and non-potable uses. The potable uses include drinking, bathing, and cooking and dish wash. Usually the rainwater used for this purpose must be treated to remove the contaminants and generally the main required treatment processes are filtration and disinfection unless the rainwater contain heavy metals, then special treatment is required. Non-potable uses of rainwater harvesting include flushing toilets, watering garden, and washing floors and for such uses treatment is not required. The quantity of the rainwater collected is different from place to place depending on the weather condition.