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Comparative Analysis of Rainwater Harvesting in Institutional and Residential Areas: A Case Study of Latur Zone of Marathwada Region

A. M. Kamble*, U. R. Sonawane and S. N. Chavan

Department of Soil and Water Conservation Engineering, CAET, VNMKV, Parbhani -431402 (M.S.), India

**Corresponding author*

Abstract

This study presents the quantitative assessment of rainwater harvesting at two different scales — an educational institution (Dayanand College) and a residential house — over a four-month monsoon period. At Dayanand College, the total rainwater harvested was 282,856.64 liters in June, 550,459.4 liters in July, 978,699.04 liters in August, and 956,419.5 liters in September, culminating in a cumulative volume of 2,768,434.5 liters. Similarly, for a residential house, the harvested rainwater was 16,824.4 liters in June, 32,704 liters in July, 978,099.04 liters in August, and 70,904.9 liters in September, amounting to a total of 178,639.7 liters over the same period. These findings highlight the significant potential of rainwater harvesting in both institutional and residential settings, emphasizing the importance of its implementation for sustainable water resource management during the monsoon season.

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Keywords

Rainwater Harvesting, Dayanand College, Residential House, Water Conservation, Harvested Rainwater Volume

Introduction

Water is basic to the human health, welfare and economic development. It is equally vital for the preservation of wild life and natural environment. Fresh water is a central feature and can be a source of energy, avenue of transportation, means of production and aesthetics. It exerts a major influence on demographic patterns. Water is a finite and limited resource, and thus its efficient and effective use of water resources is necessary for sustainable economic and social development.

India is one of the few countries in the world endowed with abundant land and water resources. It is the seventh largest country in the world and Asia's second largest country, with an area of 3,287,590 km^2. Most of the Indian landmass is in the semiarid tropical belt characterized by seasonal rainfall lasting over a period of three to four months. The water resources of India are enormous but they are unevenly distributed in space, time and quantity.

Due to lack of proper water resources planning and budgeting, famine in the vast tracts of the western and southern peninsula plateau region and floods in northern and eastern India ravage the lives of millions of the human and animal populations (Kumar, 2004).

Famine, especially scarcity of drinking water, is causing havoc in Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. Shortage of water source has been a major problem for rapidly growing cities in country like India due to increase in

consumption of water. Hence it demands a flawless planning for managing the water resource. Rooftop Rainwater Harvesting (RTRWH) has proven to be the most economical and environmentally friendly method. An integrated study on rooftop storm water runoff for quantitative and qualitative analysis was conducted. This can resolve the water scarcity issue by accumulating about1,13,678.9m^3 of from rooftop in a year, and use it during the non-monsoon season. These findings can significantly influence the similar RTRWH initiatives in various government and private establishments for sustainable water management (Chiang *et al.,* 2013).

Average annual precipitation including snowfall over the country is 4000 billion cum. (BCM) in addition; it receives another 200 BCM from river flowing in from other countries (Roy, 2005). 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 (Pawar, 2014). 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 (Deshpande, 2013). 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.

Rainwater Harvesting is a simple technique of catching and holding rainwater where it falls. Either, we can store it in tanks or we can use it to recharge groundwater depending upon the situation and requirement. Ease in constructing system in less time. Economically cheaper in construction compared to other sources, i.e., dams, diversion, etc. Rainwater harvesting is the ideal situation for those areas where there is inadequate groundwater supply or surface resource. 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. Recharging water in to the aquifers which help in improving the quality of existing groundwater through dilution.

Rural Water Needs

Thousands of Indian villages still do not have any local source of drinking water. Women often have to walk many miles to collect a pot of drinking water of dubious quality. About 2.31 lakh villages in the country, were designated problem villages by the drinking water mission during sixth plan. Under rural needs mainly two sectors are there. First one is irrigation and second one drinking and livestock. It has been estimated that under irrigation sector the present demand is 630BCM and by the year 2025 it will increase to 770 BCM (Chadha, 2000).

The world's average rural water consumption per capita is only 50lpcd or about 18 cum/year. For the survival of any living beings on earth, water is one of the most important resources as much as food and air. It plays a major role is development of communities, economic and social activities. Unfortunately, not much attention is given for the conservation of this precious resource. India is a land of versatile weather where inconsistency in rain is quite frequently experienced. Due to rapid urbanization, industrialization and infrastructure development the demand of water scarcity arises in ecosystem

Urban Water Needs

Urban water needs can be divided into various sectors on the basis of the diverse kind of uses. The water demand of a city has two aspects a) Domestic water demand, b) Water demand at city level the following tables from 5 to 7 show various standards for water demand and sector wise and population wise breakup. The city level demand varies according to the population size. On an average, the per capita demand for Indian cities may vary as shown in the following table. It must be noted that there are a big gap urban and rural demands. As urban demand is about 150lpcd to 300lpcd, rural demand is 70 to 100lpcd. On an average rural water consumption is only 50lpcdor 18 cum./year. The purpose of this study is to give an overall picture of the different type of water resources and their pattern of distribution. This also includes the consumption of water and its breakup at city level and national level. From the above-mentioned information, it is clear that there is no shortage of water as such but their proper management and utilization is of utmost importance. If we don't pay attention to the natural cycle of water then the natural process of recharging of ground water will not take place and will create the water crisis. In fact, it is the balanced utilization of the various water resources which is necessary. Presently a huge resource of water that is rainwater is not utilized properly and it going waste as runoff causing inundation in one area and brought in other area. One of the preventive measures for this kind

of havoc is rainwater harvesting. The different method of artificial ground water recharge is percolation tank, recharge through open well, pond, ditch and furrow and recharge through different soil conservation structures. But in these methods, the rate of recharge is limited and so the time required for recharge is more. This causes increase in evaporation and other losses with the time passes. To overcome this method, capable to recharge the water fastly without losses, should be adopted. In urban region, the most part of area is covered by concrete building. The rainwater from the roof of concrete building is drained as sewage water, which is useless. This roof water, which will otherwise flow as waste, maybe harvested and recharge to the ground water, using appropriate methods.

Materials and Methods

A study was conducted on rooftop rainwater harvesting and its collection. The storage tank and recharge pits were designed for recharging the rainwater harvested on rooftop of Dayanand commerce College, Latur. The detailed material used and method adopted during the study of rooftop rainwater harvesting are described in this chapter.

General

The Geographical location of Latur is between 18°05′ North to 18°7′ North and 73°25′ East to 77°25′East in the Deccan plateau. The average rainfall of Latur is 801.04mm with the average number of rainy days as 48. In Latur district chief source of monsoon is South-West monsoon. Most of soil in this region is deep black cotton soils.

Study Area

Location

For the present study recharge pits were selected as means of groundwater recharge one is at Dayanand commerce college, Latur and a residential house. The present study was undertaken at two locations viz. Dayanand commerce college Latur and a house. The rainwater falling on rooftops of their buildings were collected and delivered to the recharge pit and storage tank with the help of network of pipes.

Climate

In Latur, the dry season is mostly clear and it is hot year-round. Over the course of the year, the temperature typically varies from 61°F to 102°F and is rarely below 56°F or above 107°F

Metrological data

The Meteorological data i.e., daily data was collected from the Department of Agricultural Metrology, College of Agriculture, Latur. The daily rainfall data was collected from the period June 2021 to September 2021.

Data collection

Determination of catchment area

The rooftop paved surface area was catchment area which receives rainfall. The area has a slope towards the outlet point. Other outlets were blocked and combined together in one discharge pipe. Catchment area of Dayanand commerce college building is 2354m².

The catchment area of residential house was measured and the measured area is10m×14m (140m²). This measurement was done manually with the help of measuring tape. Before using the tape, tape was checked for zero error. The length of tape was also carefully checked for its accuracy.

Alignment of pipe

Pipe from rooftop area was connected to gutters at one end, and the other end was connected to filter unit of the storage tank. PVC pipe of diameter was commonly used for joining the rooftop area to tank. Half inch PVC pipe was connected from bottom of the storage tank and filter unit to bore well. The total length of pipe from filter tank to bore well was 9.5m length.

Design of filter unit

Material used for filter units are 80-100 mm metal, 60-80 mm metal, 60-40 mm metal, 40-20 mm metal or sand pebbles, charcoal and mosquito mesh. It also includes 250-300mm diameter heavy duty PVC pipe with 6kg/sq.cm. Inside filter pipe 150-200mm diameter PVC pipe is inserted.

The simple water filter that could be constructed domestically. The filtration performance depends on the effective size of the particles, thickness of layer and rate of water flow through the filter. Optimum capacity of filtration tank could be designed on the basis of area of catchment, intensity of rainfall and recharge rate.

Type of roof surface

The roof surface from where rainwater is collected may be galvanized iron sheets, asbestos, slopped (tiled) roof or cement concrete. The runoff coefficients of these surfaces are different and are useful for the determination of runoff volume.

Components of rooftop rainwater harvesting system at Dayanand college and Tanmay house

The system mainly consists of following components

1. Roof catchment
2. Gutter
3. First flush
4. Filter unit
5. Recharge well

Roof catchment

The rooftop of Dayanand college and a house was used as the catchment area for collecting the rainwater. The construction material roof was suitability as a catchment roof made of corrugated iron sheet, asbestos sheet, tiles or concrete can be utilized as such for harvesting the rainwater. But thatched roofs are not suitable as it gives some color to water and also water carries pieces of roof material. The study area of catchment 2354m² of Dayanand College and 140 m² of a house. This measurement was done manually by using measuring tape.

Gutters

Gutters are channel fixed to the edges of roof all around to collect and transport the rainwater from the roof to the storage tank. Gutters was prepared in m-circular and rectangular shapes locally available material such la plain galvanized iron sheet was easily folded to require shapes to prepare semicircular and stangular gutters. Semi-circular gutters of PVC material were readily prepared by cutting the PVC pipe into to equal semi-circular channels.

First flush

First flush is a device used to flush off water received in first shower of rain needs to be flush to avoid contaminating rechargeable water by probably contaminants of atmosphere and catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry season. Provision of first rain separator was made at outlet of each drain pipe.

Filter unit

A filter unit is 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 or recharge structure. Charcoal can be added for additional filtration. A simple charcoal filter can be made in a drum or an earthen pot.

Recharge well

Bore well was 100mm diameter with PVC pipes lowered into dry sand with strainer. It was vent on the top portion. During the recharge of well the rainfall on the rooftop area of house was collected in the filter tank.

Results and Discussion

The present study was conducted in Dayanand commerce college, Latur and a house. The rooftop considered for rainwater harvesting were those of Dayanand commerce college, Latur and a house. The rooftop is of cement concrete and have smooth and gentle slope towards one side. The roof area of Dayanand commerce college is 2354m² and house is of 140 m²

Summary and Conclusion

The study was carried out in order to calculate the volume of harvested rainwater. The roof area was selected for rainwater harvesting was 2354 m² of Dayanand Commerce College, Latur and ahouse is of 140 m². The total rainfall of Latur District during June 2021 to September 2021 was collected from the metrology department, College of Agriculture, Latur.

The water available from rooftop rainwater harvesting was 18,82,918 liters from building of Dayanand college. Rooftop of a house was 10,64,154 liters. The quantity of rainwater was calculated by taking runoff coefficient for cement concrete as 0.80. Total amount of water received by rooftop area was collected and diverted into the filtration tank through PVC pipe, after filtration through filtration tank media. According to the study the conclusion is presented as follows:

Table.1 The runoff coefficients for various type of roof tops

Sr. No.	Type of roof	Runoff coefficient
1	Galvanized iron sheet	0.90
2	Asbestos	0.80
3	Slopped (tiled) roof	0.75
4	Cement concrete	0.80

[Source: Rai, 2000]

Table.2 Rainwater harvested in month of June at Dayanand college

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff coefficient	Total volume of harvested rainwater (Lit)
1	1-06-21	3.2	2354	0.80	**6026.24**
2	2-06-21	5.7	2354	0.80	**10734.24**
3	4-06-21	13.4	2354	0.80	**25234.88**
4	5-06-21	4.5	2354	0.80	**8474.4**
5	6-06-21	3.1	2354	0.80	**5837.92**
6	8-06-21	1.2	2354	0.80	**2259.84**
7	9-06-21	16.7	2354	0.80	**31449.44**
8	10-06-21	9.8	2354	0.80	**18455.36**
9	11-06-21	3.7	2354	0.80	**6967.84**
10	12-06-21	11.6	2354	0.80	**21845.12**
11	13-06-21	20.4	2354	0.80	**38417.28**
12	14-06-21	12.5	2354	0.80	**23540**
13	15-06-21	3.0	2354	0.80	**5649.6**
14	16-06-21	1.6	2354	0.80	**3013.12**
15	17-06-21	6.1	2354	0.80	**11487.52**
16	18-06-21	2.2	2354	0.80	**4143.04**
17	19-06-21	3.5	2354	0.80	**6591.2**
18	23-06-21	2.6	2354	0.80	**4896.32**
19	24-06-21	1.5	2354	0.80	**2824.8**
20	26-06-21	4.7	2354	0.80	**8851.04**
21	27-06-21	14.8	2354	0.80	**27871.36**
22	28-06-21	4.4	2354	0.80	**8286.08**
Total		**150.2**	**2354**	**0.80**	**282856.6**

Table.3 Rainwater harvested in month of June at a house

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff coefficient	Total volume of harvested rainwater (Lit)
1	1-06-21	3.2	140	0.80	**358.4**
2	2-06-21	5.7	140	0.80	**638.4**
3	4-06-21	13.4	140	0.80	**1500.8**
4	5-06-21	4.5	140	0.80	**506**
5	6-06-21	3.1	140	0.80	**347.2**
6	8-06-21	1.2	140	0.80	**134.4**
7	9-06-21	16.7	140	0.80	**1870.4**
8	10-06-21	9.8	140	0.80	**1097.6**
9	11-06-21	3.7	140	0.80	**414.4**
10	12-06-21	11.6	140	0.80	**1299.2**
11	13-06-21	20.4	140	0.80	**2284.8**
12	14-06-21	12.5	140	0.80	**1400**
13	15-06-21	3.0	140	0.80	**336**
14	16-06-21	1.6	140	0.80	**179.2**
15	17-06-21	6.1	140	0.80	**683.2**
16	18-06-21	2.2	140	0.80	**246.4**
17	19-06-21	3.5	140	0.80	**392**
18	23-06-21	2.6	140	0.80	**291.2**
19	24-06-21	1.5	140	0.80	**168**
20	26-06-21	4.7	140	0.80	**526.4**
21	27-06-21	14.8	140	0.80	**1657.6**
22	28-06-21	4.4	140	0.80	**492.8**
Total		**150.2**	**140**	**0.80**	**16824.4**

Figure.1 Rainwater harvested in month of June at Dayanand college

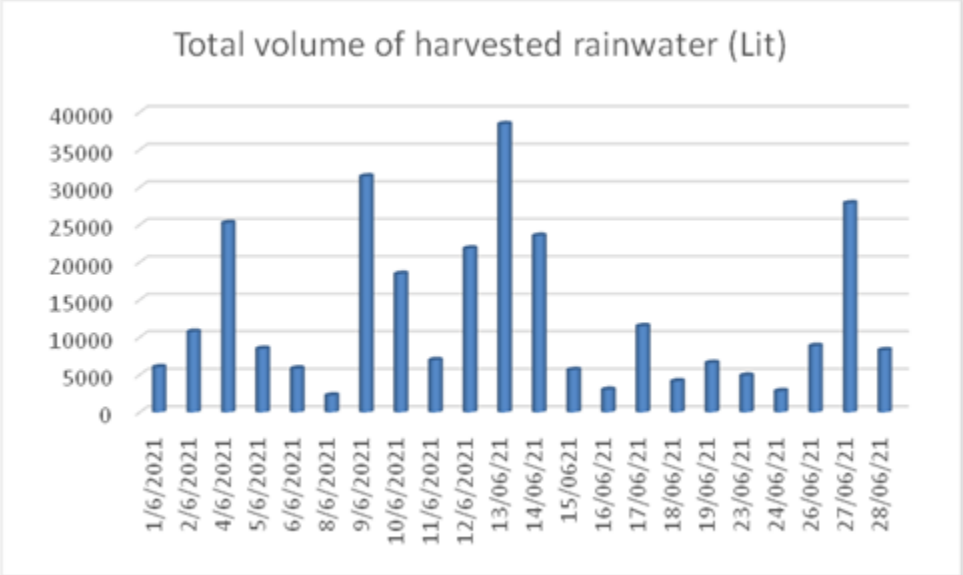


Table.4 Rainwater harvested in month of July at Dayanand college

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff Coefficient	Total volume of harvested rainwater (Lit)
1	1-07-21	12.6	2354	0.80	**23728.32**
2	5-07-21	4.5	2354	0.80	**8474.4**
3	6-07-21	18.9	2354	0.80	**35592.48**
4	7-07-21	19.3	2354	0.80	**36345.76**
5	8-07-21	9.3	2354	0.80	**17513.76**
6	9-07-21	17.5	2354	0.80	**32956**
7	10-07-21	15.8	2354	0.80	**29754.56**
8	11-07-21	28.3	2354	0.80	**53294.56**
9	12-07-21	14.6	2354	0.80	**27494.72**
10	13-07-21	12.5	2354	0.80	**23540**
11	14-07-21	19.2	2354	0.80	**36157.44**
12	15-07-21	8.3	2354	0.80	**15630.56**
13	16-07-21	1.8	2354	0.80	**3389.76**
14	17-07-21	6.7	2354	0.80	**12617.44**
15	18-07-21	8.6	2354	0.80	**16195.52**
16	19-07-21	6.6	2354	0.80	**12429.12**
17	20-07-21	6.4	2354	0.80	**12052.48**
18	21-07-21	24.1	2354	0.80	**45385.12**
19	22-07-21	36.5	2354	0.80	**68736.8**
20	23-07-21	12.0	2354	0.80	**22598.4**
21	24-07-21	3.0	2354	0.80	**5649.6**
22	31-07-21	5.8	2354	0.80	**10922.56**
Total		**292.3**	**2354**	**0.80**	**550459.4**

Figure.2 Rainwater harvested in month of June at a house

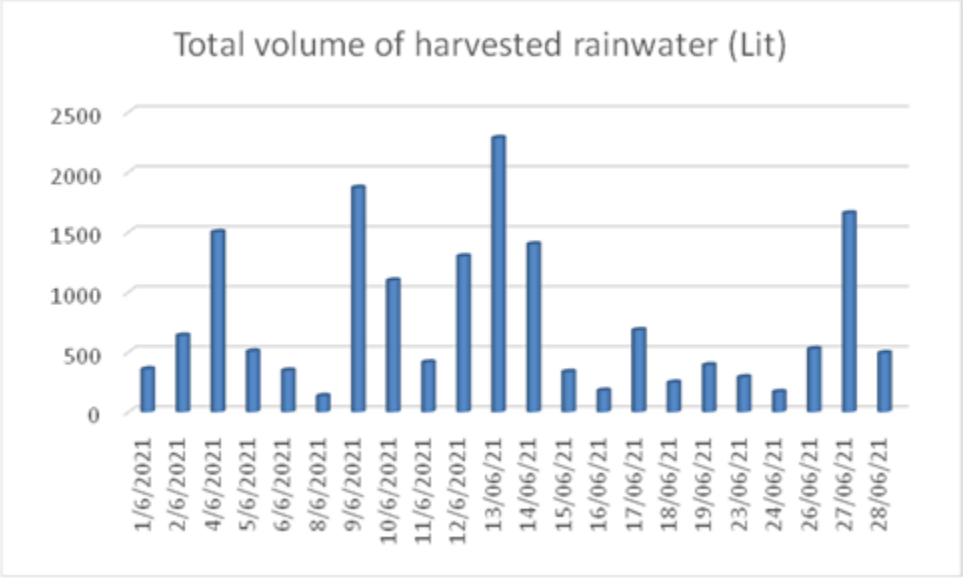


Table.5 Rainwater harvested in month of July at a house

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff Coefficient	Total volume of harvested rainwater (Lit)
1	1-07-21	12.6	140	0.80	**1411.2**
2	5-07-21	4.5	140	0.80	**504**
3	6-07-21	18.9	140	0.80	**2083.2**
4	7-07-21	19.3	140	0.80	**2161.6**
5	8-07-21	9.3	140	0.80	**1041.6**
6	9-07-21	17.5	140	0.80	**1960**
7	10-07-21	15.8	140	0.80	**1769.6**
8	11-07-21	28.3	140	0.80	**3169.6**
9	12-07-21	14.6	140	0.80	**1635.2**
10	13-07-21	12.5	140	0.80	**1400**
11	14-07-21	19.2	140	0.80	**2150.4**
12	15-07-21	8.3	140	0.80	**929.6**
13	16-07-21	1.8	140	0.80	**201.6**
14	17-07-21	6.7	140	0.80	**750.4**
15	18-07-21	8.6	140	0.80	**963.2**
16	19-07-21	6.6	140	0.80	**739.2**
17	20-07-21	6.4	140	0.80	**716.8**
18	21-07-21	24.1	140	0.80	**2699.2**
19	22-07-21	36.5	140	0.80	**4088**
20	23-07-21	12.0	140	0.80	**1344**
21	24-07-21	3.0	140	0.80	**336**
22	31-07-21	5.8	140	0.80	**649.6**
Total		**292.3**	**140**	**0.80**	**32704**

Figure.3 Rainwater harvested in month of July at Dayanand college

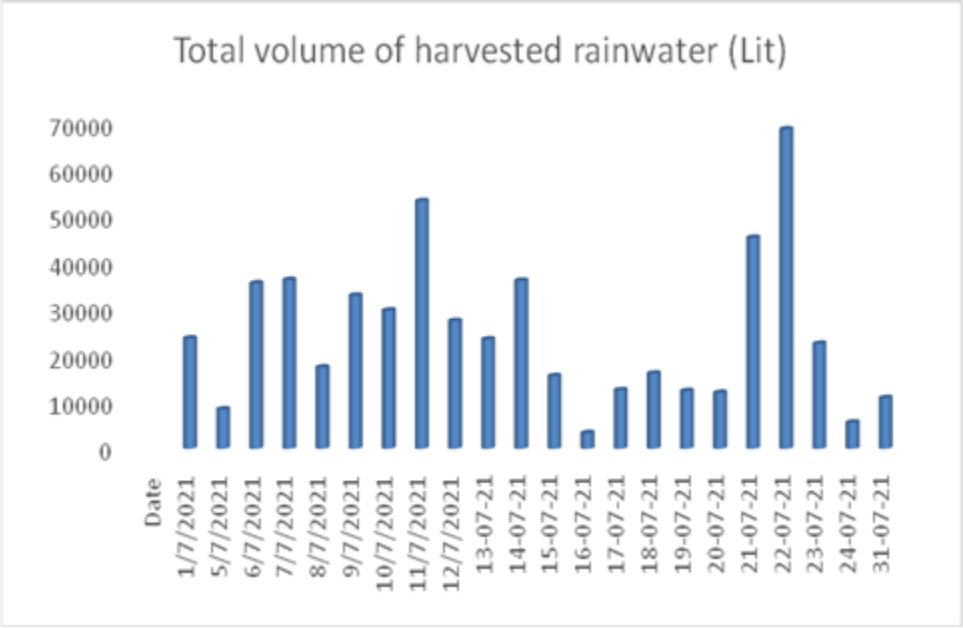


Table.6 Rainwater harvested in month of August at Dayanand college

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff Coefficient	Total volume of harvested rainwater (Lit)
1	1-08-21	2.9	2354	0.80	**5461.28**
2	2-08-21	4.2	2354	0.80	**7909.44**
3	3-08-21	3.5	2354	0.80	**6591.2**
4	4-08-21	3.8	2354	0.80	**7156.16**
5	5-08-21	4.1	2354	0.80	**7721.12**
6	6-08-21	2.0	2354	0.80	**3766.4**
7	8-08-21	6.4	2354	0.80	**12052.48**
8	9-08-21	34.4	2354	0.80	**64782.08**
9	10-08-21	1.1	2354	0.80	**2071.52**
10	11-08-21	31.4	2354	0.80	**59132.48**
11	12-08-21	26.9	2354	0.80	**50658.08**
12	13-08-21	14.8	2354	0.80	**27871.36**
13	14-08-21	13.9	2354	0.80	**26176.48**
14`	15-08-21	13.9	2354	0.80	**26176.48**
15	16-08-21	33.6	2354	0.80	**63275.52**
16	17-08-21	31.7	2354	0.80	**59697.44**
17	18-08-21	64.2	2354	0.80	**120901.44**
18	19-08-21	103.6	2354	0.80	**195099.52**
19	20-08-21	11.7	2354	0.80	**22033.44**
20	21-08-21	6.2	2354	0.80	**11675.84**
21	22-08-21	2.9	2354	0.80	**5461.28**
22	23-08-21	2.3	2354	0.80	**4331.36**
23	23-08-21	2.3	2354	0.80	**4331.36**
24	25-08-21	3.8	2354	0.80	**7156.16**
25	26-08-21	4.1	2354	0.80	**7721.12**
26	27-08-21	1.2	2354	0.80	**2259.84**
27	28-08-21	38.5	2354	0.80	**72503.2**
28	29-08-21	16.8	2354	0.80	**31637.76**
29	30-08-21	13.2	2354	0.80	**24858.24**
30	31-08-21	20.3	2354	0.80	**38228.96**
Total		**519.7**	**2354**	**0.80**	**978699**

Table.7 Rainwater harvested in month of August at a house

Sr.no.	Date	Rainfall (mm)	Roof Area (m^2)	Runoff Coefficient	Total volume of harvested rainwater (Lit)
1	1-08-21	2.9	140	0.80	**324.8**
2	2-08-21	4.2	140	0.80	**470.4**
3	3-08-21	3.5	140	0.80	**392**
4	4-08-21	3.8	140	0.80	**425.6**
5	5-08-21	4.1	140	0.80	**459.2**
6	6-08-21	2.0	140	0.80	**224**
7	8-08-21	6.4	140	0.80	**716.8**
8	9-08-21	34.4	140	0.80	**3852.8**
9	10-08-21	1.1	140	0.80	**123.2**
10	11-08-21	31.4	140	0.80	**3516.8**
11	12-08-21	26.9	140	0.80	**3012.8**
12	13-08-21	14.8	140	0.80	**1657.6**
13	14-08-21	13.9	140	0.80	**1556.8**
14`	15-08-21	13.9	140	0.80	**1556.8**
15	16-08-21	33.6	140	0.80	**3763.2**
16	17-08-21	31.7	140	0.80	**3550.4**
17	18-08-21	64.2	140	0.80	**7190.4**
18	19-08-21	103.6	140	0.80	**11603.2**
19	20-08-21	11.7	140	0.80	**1310.4**
20	21-08-21	6.2	140	0.80	**694.4**
21	22-08-21	2.9	140	0.80	**324.8**
22	23-08-21	2.3	140	0.80	**257.6**
23	23-08-21	2.3	140	0.80	**257.6**
24	25-08-21	3.8	140	0.80	**425.6**
25	26-08-21	4.1	140	0.80	**459.2**
26	27-08-21	1.2	140	0.80	**134.4**
27	28-08-21	38.5	140	0.80	**4312**
28	29-08-21	16.8	140	0.80	**1881.6**
29	30-08-21	13.2	140	0.80	**1478.4**
30	31-08-21	20.3	140	0.80	**2273.6**
Total		**519.7**	**140**	**0.80**	**58206.4**

Table.8 Rainwater harvested in month of September at Dayanand college

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff Coefficient	Total volume of harvested rainwater (Lit)
1	1-09-21	14.81	2354	0.80	**27890.19**
2	2-09-21	85.95	2354	0.80	**161861.0**
3	3-09-21	6.34	2354	0.80	**11939.4**
4	4-09-21	23.89	2354	0.80	**44989.6**
5	5-09-21	5.74	2354	0.80	**10809.5**
6	6-09-21	22.41	2354	0.80	**42202.5**
7	8-09-21	65.33	2354	0.80	**123029.4**
8	9-09-21	18.27	2354	0.80	**34406.0**
9	10-09-21	2.88	2354	0.80	**5423.6**
10	11-09-21	3.02	2354	0.80	**5687.2**
11	12-09-21	5.72	2354	0.80	**10771.9**
12	13-09-21	9.73	2354	0.80	**18323.5**
13	14-09-21	18.69	2354	0.80	**35197.0**
14`	15-09-21	6.51	2354	0.80	**12259.6**
15	16-09-21	1.3	2354	0.80	**2448.1**
16	18-09-21	1.65	2354	0.80	**3107.2**
17	20-09-21	2.3	2354	0.80	**4331.3**
18	21-09-21	23.47	2354	0.80	**44066.8**
19	22-09-21	13.82	2354	0.80	**26025.8**
20	23-09-21	15.91	2354	0.80	**29208.4**
21	23-09-21	40.89	2354	0.80	**77004.0**
22	25-09-21	46.27	2354	0.80	**87135.6**
23	26-09-21	46.67	2354	0.80	**87888.9**
24	27-09-21	3.15	2354	0.80	**5932.0**
25	28-09-21	13.28	2354	0.80	**25008.8**
26	29-09-21	9.08	2354	0.80	**17099.4**
27	31-09-21	1.26	2354	0.80	**2372.8**
Total		**510.07**	**2354**	**0.80**	**956419.5**

Table.9 Rainwater harvested in month of September at Tanmay house

Sr.no	Date	Rainfall (mm)	Roof Area (m^2)	Runoff Coefficient	Total volume of harvesting rainwater (Lit)
1	1-09-21	14.81	140	0.80	**1658.72**
2	2-09-21	85.95	140	0.80	**9626.4**
3	3-09-21	6.34	140	0.80	**710.08**
4	4-09-21	23.89	140	0.80	**2675.68**
5	5-09-21	5.74	140	0.80	**642.88**
6	6-09-21	22.41	140	0.80	**2509.92**
7	8-09-21	65.33	140	0.80	**7316.96**
8	9-09-21	18.27	140	0.80	**2046.24**
9	10-09-21	2.88	140	0.80	**322.56**
10	11-09-21	3.02	140	0.80	**338.24**
11	12-09-21	5.72	140	0.80	**640.64**
12	13-09-21	9.73	140	0.80	**1089.76**
13	14-09-21	18.69	140	0.80	**2093.28**
14`	15-09-21	6.51	140	0.80	**729.12**
15	16-09-21	1.3	140	0.80	**145.6**
16	18-09-21	1.65	140	0.80	**184.8**
17	20-09-21	2.3	140	0.80	**257.6**
18	21-09-21	23.47	140	0.80	**2628.64**
19	22-09-21	13.82	140	0.80	**1547.84**
20	23-09-21	15.91	140	0.80	**1781.92**
21	23-09-21	40.89	140	0.80	**4579.68**
22	25-09-21	46.27	140	0.80	**5182.24**
23	26-09-21	46.67	140	0.80	**5227.04**
24	27-09-21	3.15	140	0.80	**352.8**
25	28-09-21	13.28	140	0.80	**1487.36**
26	29-09-21	9.08	140	0.80	**1016.96**
27	31-09-21	1.26	140	0.80	**141.12**
Total		**510.07**	**140**	**0.80**	**70904.9**

Table.10 Total rainwater harvested at Dayanand college

Sr. No.	Month	Rainfall (mm)	Total volume of harvested rainwater (Lit)
1	June	150.2	**282856.6**
2	July	292.3	**550459.4**
3	August	519.7	**978699**
4	September	510.07	**956419.5**
Total		**1472.4**	**2768434.5**

Table.11 Total rainwater harvested at Tanmay house

Sr. No.	Month	Rainfall (mm)	Total volume of harvested rainwater (Lit)
1	June	150.2	**16824.4**
2	July	292.3	**32704**
3	August	519.7	**58206.4**
4	September	510.07	**70904.9**
Total		**1472.4**	**178639.7**

Figure.4 Rainwater harvested in month of June at Tanmay house

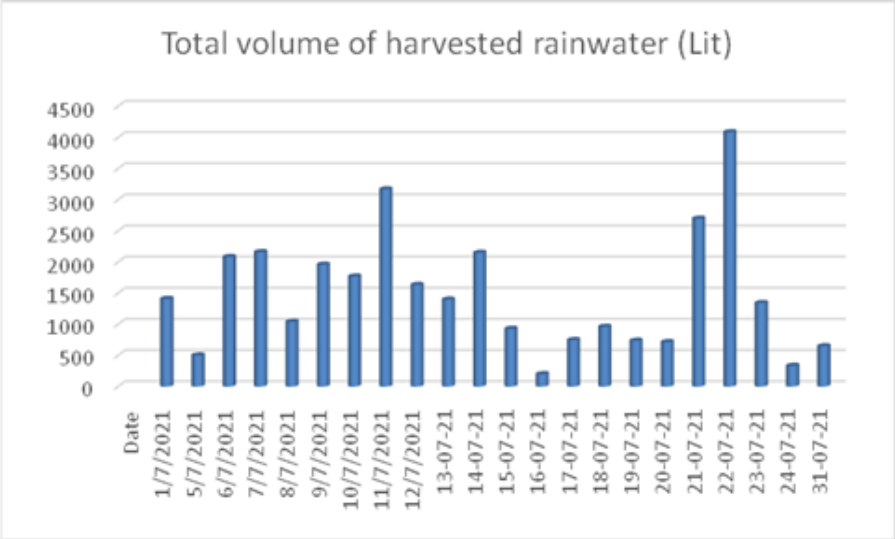


Figure.5 Rainwater harvested in month of August at Dayanand college

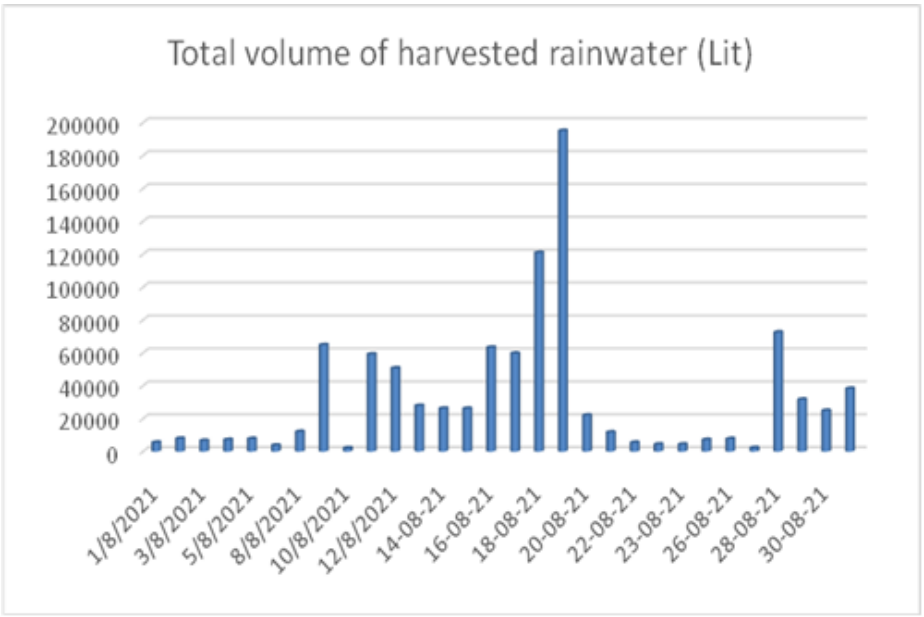


Figure.6 Rainwater harvested in month of August at Tanmay house

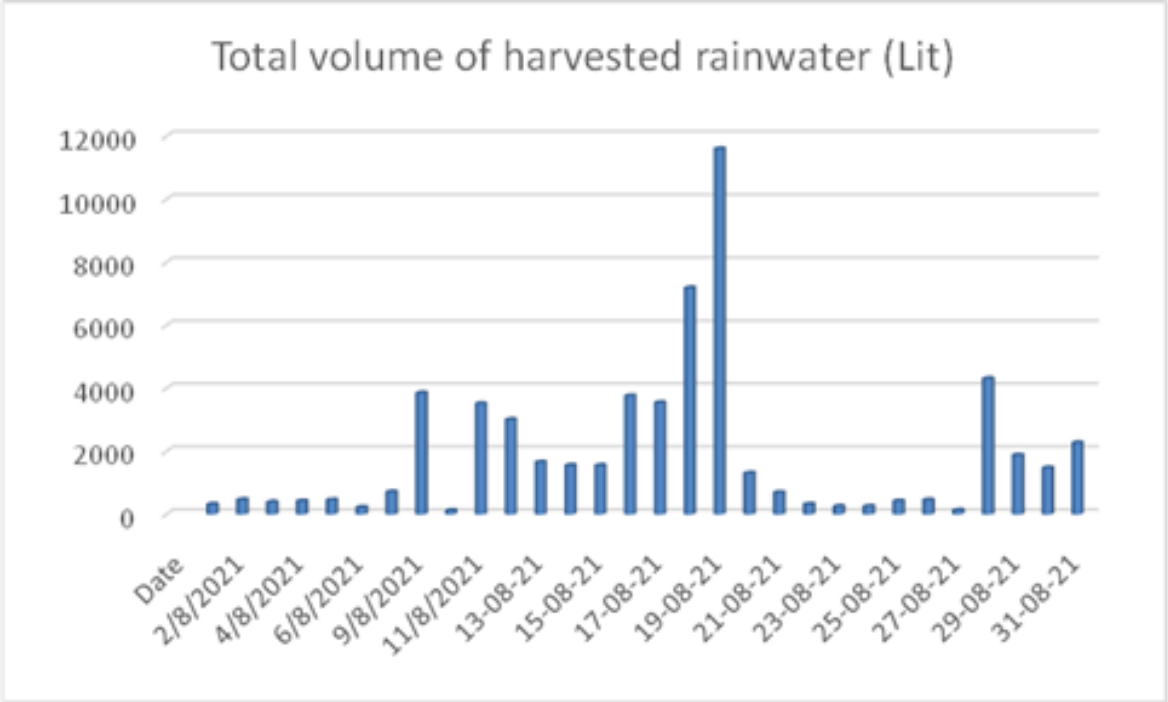


Figure.7 Rainwater harvested in month of September at Dayanand college

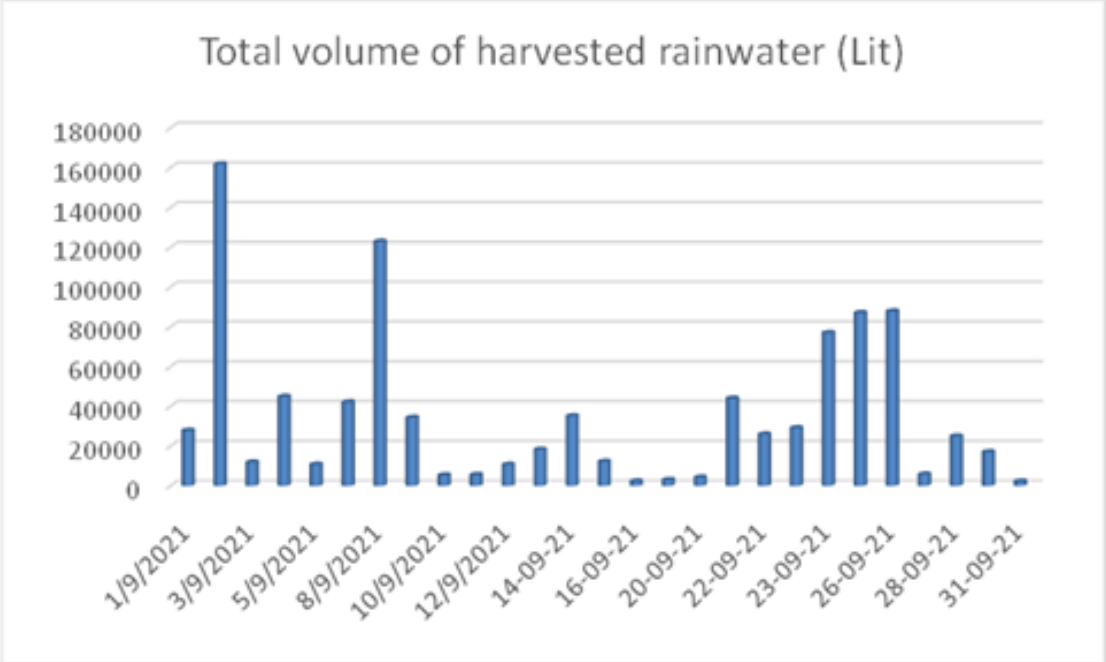


Figure.8 Rainwater harvested in month of September at ahouse

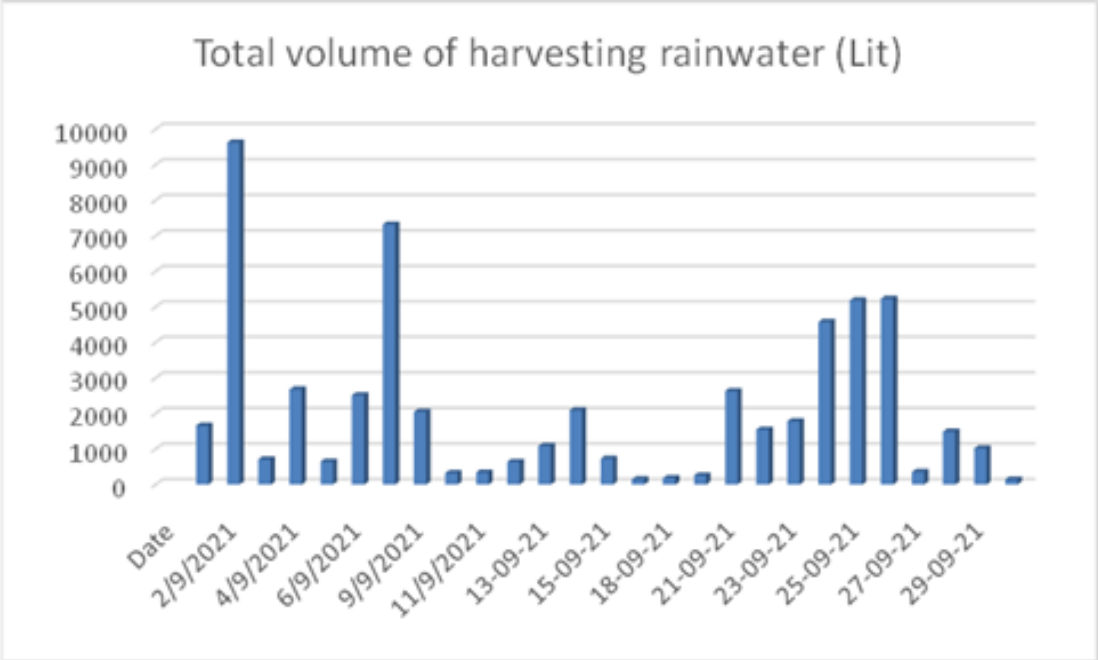


Figure.9 Total rainwater harvested at Dayanand college

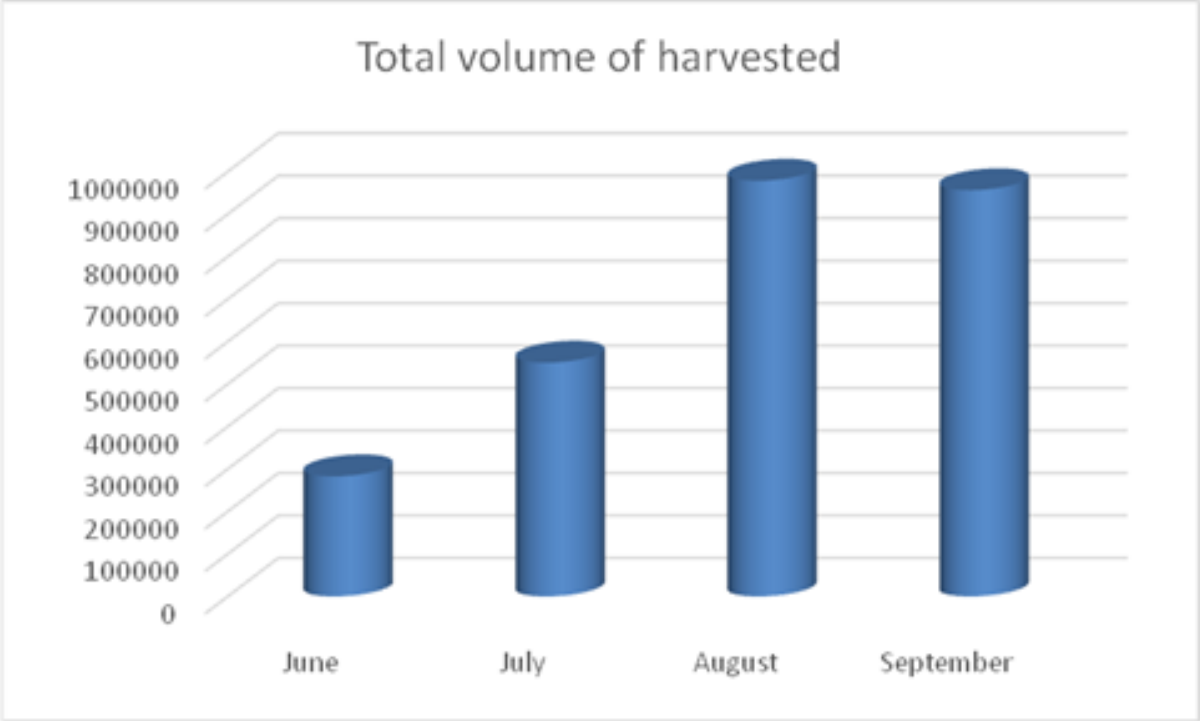
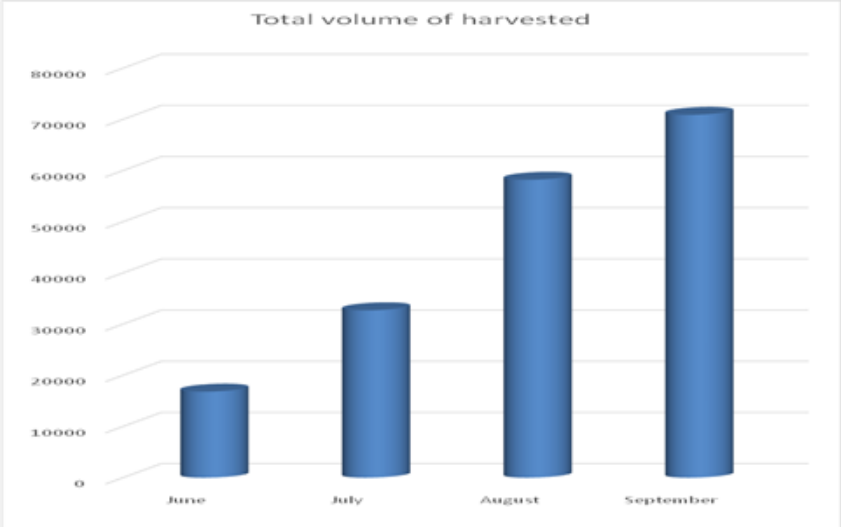


Figure.10 Total rainwater harvested ata house



1. Total rainwater harvested in month of June at Dayanand college is 282856.64 liter.
2. Total rainwater harvested in month of June at a residential house is 16824.4 liter.
3. Total rainwater harvested in month of July at Dayanand college is 550459.4 liter.
4. Total rainwater harvested in month of July at a residential house is 32704 liter.
5. Total rainwater harvested in month of August at Dayanand college is 978699.04 liter.
6. Total rainwater harvested in month of August at a residential house is 978099.04 liter.
7. Total rainwater harvested in month of September at Dayanand college is 956419.5 liter.
8. Total rainwater harvested in month of September at a residential house is 70904.9 liter.
9. Total volume of harvested rainwater of 4 months at Dayanand college is 2768434.5 liter.
10. Total volume of harvested rainwater of 4 months at a residential house is 178639.7 liter.

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