Rain Water Harvesting Technique Implementation for the Chhadvel Korde Village, Maharashtra

Shobha Rani Nadupuru[1], *Manisha* Shewale[1]

[1] Dr.D.Y.Patil Institute of Technology, Pimpri, Pune -18

Abstract. Water is one of the most important resources on Earth. In every way, water is crucial to our daily existence. The amount of water that is available in cities is never enough to meet the entire demand. We must rely on water from underground sources because surface water is not readily available. The amount of rainwater that soaks into the subsurface and replenishes ground water has significantly decreased as a result of rapid urbanisation. In this instance, there must be additional supply to satisfy the demand. When it rains, pure rainwater can be gathered "wherever it falls" to instantly replace the water supply. The act of gathering and organising rainwater in a systematic way for later use is referred to as "rainwater harvesting". Two types of rainwater harvesting that could be used in the research region are rooftop and surface runoff harvesting. By adopting a rainwater harvesting system and constructing natural percolation pits, the groundwater level, soil moisture, and soil fertility can all be increased for plantations. Therefore, using this simple strategy typically leads to more vegetation, which raises the aesthetic value. This article examines every rainwater harvesting system established in the Maharashtra district of Sakri in Chhadvel Korde.

Keywords: Rain water harvesting, natural percolation pit, roof top, fertility factor, ground water discharge

1. Introduction

There is a rising need for safe drinking water as the global population rises. The rate at which surface and groundwater are being extracted exceeds the rate at which they can be replaced. In order to prevent the water from running off the property, rainwater harvesting involves collecting and storing it for later use. Simple systems are used in rain water harvesting in order to collect, transport, and store rainwater. The majority of collected rainwater comes from roofs and other surfaces through runoff. The goal of the percolation pit is to channel rainwater down into an underground water source. In order to maintain or enhance the quality of the ground water, a pit can be dug to collect rainwater and then be used to recharge the aquifer.

1.1. Problem Statement

1. Due to more utilization of bore well water, the underground water table is depleted, and surrounding moisture content of soil is reduced.
2. There is no availability of water sources near the village hence water scarcity is more in that village.

1.2. Literature from previous studies:

Abhijeet Keskar, Satish et al. [1] investigated the rain water harvesting (RWH) system as an alternative source of water at the Government College of Engineering, Aurangabad (GECA) campus in the Indian state of Maharashtra. The study's expected outcome is the development of a rainwater harvesting system for the campus catchment area, which includes the parking lot, workshop area, and some of the electronics department area up to Hostel 'A.' According to the analysis, the current RWH system has a storage capacity of 53,96,816 litres per year and a construction cost of Rs.5 lakhs, and it performs reasonably well in comparison to conventional water sources. By taking almost all technical aspects into account, the developed system meets social requirements and can be implemented in rural areas.

J.R.Julius et al.[2] reviewed the methods, design, and impacts of rainwater harvesting systems used throughout the world. As the world's population grows, so does the demand for safe drinking water. Surface and groundwater resources are depleting faster than they can be replenished. Rainwater harvesting is an ancient practise that many nations are adopting as a viable decentralised water source.

Aditya Morey et al.[3] concentrated on a tank for storing rain water from the building's roof, which was required for the VNIET fair fashion need for water.Rainwater harvesting is a method of collecting rainwater during a downpour and storing it above ground or downloading underground water for later use. Because groundwater resources are depleting, rainwater harvesting is the only way to solve the water problem. Rainwater will not only help to meet the demand for water supply, but it will also help to improve the quantity and quality of water. Miguel Angel Lopez et al [4] investigated the dependability of using rainwater harvesting to meet the water needs of a transportation logistics company in Mexico City. Water consumption in the company's facilities and buildings was calculated. Rainwater harvestable from the company's roofs and manoeuvring yard was estimated using a statistical analysis of the rainfall. Potential water savings were calculated using these data. Rainwater was characterised in order to determine the treatment requirements for each water source. In addition, the capacity of water storage tanks was calculated. An economic assessment was performed on the selected treatment systems to determine the viability of the proposed alternative. The results showed that rainwater can completely cover the company's current water demand. The scenario in which roof and manoeuvring yard rainwater were collected and treated together was more cost effective than the scenarios in which they were collected and treated separately. The installation of a rainwater harvesting system will provide significant financial benefits to the company.

At Sir Padamapat Singhania University (SPSU), Udaipur, Avinash Ojha and Lokesh Gupta [5] worked on the design of a rainwater harvesting system. This also includesthe design of dug wells or abandoned bore wells for recharging. This facility will collect water from the roof and transport it all the way up to a dug well or an abandoned bore well to recharge it. The facility's operating costs are almost non- existent. Rooftop water harvesting Catchments are usually of adequate quality for household needs. Depending on the household's needs Within the available catchment area, water collection capacity can be increased as needed.

According to Sadia Rahman et al [6], the overall quality of water is quite satisfactory. According to Bangladeshi standards. RWH systems provide adequate water and energy savings due to lower consumption. Furthermore, when installation and maintenance costs are factored in, the system is both effective and cost-effective.

Arun Kumar Dwivedi et al [7] conducted research to estimate the rooftop rain water harvesting potential of all buildings, as well as plan and design the rooftop rain water harvesting system, conveyance system, and groundwater recharge system. The cost estimation of various components of the roof top rain water harvesting project for each zone has been completed. The annual equivalent capital cost is calculated both with and without the cost of the ground water recharge structure. When compared to the market price of water, the unit cost of water is high. However, the environmental benefits of recharging ground water with high-quality water justify such projects**.**

Dinesh Kumar et al. [8] Water harvesting has a long history in India. Many traditional water harvesting systems have either become obsolete due to a variety of physical, social, economic, cultural, and political factors that have caused their deterioration, as well as the decline of institutions that have nurtured them (Agarwal and Narain 1997), or have lost their relevance in the modern context due to their inability to meet the desires of communities. While the first dimension of the decline in water harvesting tradition has been extensively researched and documented, the second dimension is far less understood and valued. The unwillingness to recognise that different periods in history are marked by the emergence, rise, and fall of new water harvesting traditionsis also evident.

Bablu Hira Mandal and Biplob Kumar Biswas [9] Water scarcity during the dry season(November-March) is a major issue in Bangladesh that must be addressed. This crisis has been exacerbated by rising populations. Rainwater can provide some of the cleanest naturally occurring water and has great potential in dealing with Bangladesh's current challenges of acute arsenic poisoning as well as physical water scarcity in many parts of the country. In this regard, a rainwater harvesting (RWH) system for a four-person household has been built in a remote and rural village in Khulna, Bangladesh. It consists of a 40 m^2 concrete catchment, a PVC pipe supporting and collection system, and two locally available plastic storage tanks with capacities of 2000 each. The study also looks into the quality of the stored rainwater, which includes standard methods for measuring PH, alkalinity, hardness, total dissolved solids (TDS), iron, chloride, nitrate, and turbidity. The findings revealed that not only is the quality of harvested rainwater good, but there is also enough water for a four- person household to meet its domestic needs throughout the year.

Dr. William F. Hunt and Kathy DeBusk PE, [10] Rainwater harvesting (RWH) is nota new practise; it was used in ancient Greek and Roman civilizations (Phoca and Valavanis 1999; Crasta et al. 1982). RWH, which was traditionally used in areas with limited access to water resources, was common in India, Jordan, and other parts of Asia, Italy, South America, and parts of Africa from the Middle Ages until the late 1900s (Radhakrishna 2003; Abdulla and Al-Shareef 2009; Gianighian 1996; Lee et al. 2000). Many areas, including Australia, Germany, China, and the United States, have experienced population growth, climate change, and increasing water supply shortages in the twentieth and twenty-first centuries (Coombes and Barry 2007; Hermann and Hasse 1997; Zhang et al. 2009a; Mendez et al. 2011); as a result, RWH systems have grown in popularity and quantity in recent years as an alternative water supply in theseregions.

Amit Vashisth et al. [11] With the rate at which India's population is growing, it is predicted that India will supplant China as the world's most densely populated country within the next 20-30 years. These will prompt a high rate of utilisation of the most profitable regular asset; Keeping in mind the end goal to save and take care of our day by day water requirement, we must consider elective savvy and generally less demanding mechanical techniques for water monitoring. Rainwater harvesting is superior to other techniques for meeting those needs. Water collection from housetops is thought to be catchment territories from all lodgings and Institutes departmental working at Lingaya's Institute of Management and Technology, Faridabad Campus. First and foremost, necessary information is gathered, such as catchment zones and hydrological precipitation data. The volume of the tank has been determined using the best estimation strategy. Based on hydrological research, the ideal tank area has been determined.

1.3 Objective statement:

1. To study the layout of the selected area & collection of rainfall data.
2. To determine the quantity of runoff of the area.
3. To design, pipe lines for carrying estimated discharge

1.4 Scope of the Work

The village is located 25 kilometres from Sakri and covers an area of 20.29 hectares (46.698 acres). The village is 6 kilometres from the Kan River and adjacent to the National Highway (NH6). According to the 2011 census, the village has a total population of 3728 people. And because the village is still expanding, the population will grow in the future.
As a result of the current population and the expansion programmes, the village's facilities and maintenance requirements should be increased. Thus, water is the most natural resource that is constantly in high demand by humans and is an essential part of life. If this demand is not met, water scarcity will result.
As a result, this simple technique tends to increase the greenery surrounding the village, increasing its aesthetic factor. Thus, a rainwater harvesting system has numerous advantages with no negative consequences.

1.5 Methodology flow chart:

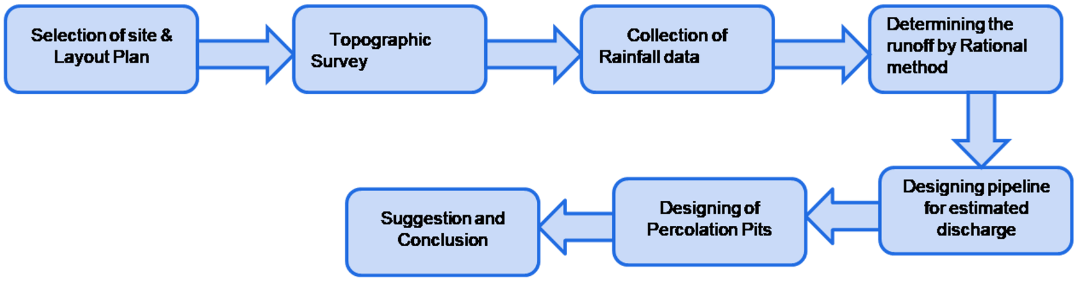

Fig. 1. flowchart of the work

2. Rainwater harvesting Technique:

Rooftop rainwater harvesting (RTRWH) is the most commonly used RWH technique for domestic consumption. Rainwater is collected on the roof and channeled through gutters to a storage reservoir, where it can be used to provide water at the point of consumption or recharge a well or aquifer.

2.1 Methods of Rainwater Harvesting

1 Roof top rain water through
  a) Recharge Pit
  b) Recharge Trench
  c) Tube Well
  d) Recharge Well
2 Catchment
3 gutter and pipe
4 storage of direct use
5 surface runoff harvesting

There are various methods of rainwater harvesting, and only a few of them will be studied. A brief review of the complete analysis and design of the various components of this system is also included. A discussion on the purpose of rainwater harvesting, which is storing harvested water in a tank after various available filtration methods, has been included in the design of a constructed Percolation pit for natural treatment ofrough water.

2.2 Study of selected area and rainfall data collection

The Chhadvel korde village, it is located at 25kms away from, sakri and it has the population according to 2011 census is 3728 and the total number of houses in village is 710.

As discussed earlier in the section of introduction- importance of rain water harvesting and percolation pits at Chhadvel korde village, sakri and its implementation in the village has potential benefits and draw maximum advantages from it.

 https://doi.org/10.1051/e3sconf/202340504033

Fig. 2. Google map of village

2.3 Topographic Study

Chhadvel korde village is located in sakri Tehsil of sakri district in Maharashtra, India. It is situated 25km away from sakri having Latitude 18.675187 and Longitude 73.779306, which is both district & sub-district headquarters of Chhadvel korde village.

The total geographical area of village is 591.93 hectares. Located 5 km away from Kan River. Chhadvel korde has a total population of 3728 and 710 houses.

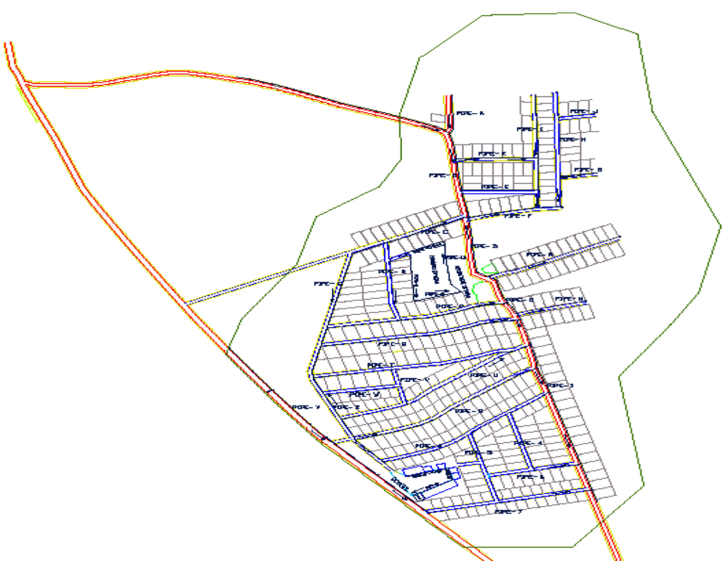

Fig. 3. AUTO-CAD Map of Chhadvel korde village.

2.4 Data Collection Rainfall Data Collection

The average monthly rainfall data are being taken from, **The District Informatics Centre (DIC),** sakri. Chhadvel korde is a small village and thus has a uniform average rainfall throughout the village. The average rainfall data for 4 years in given in the table no 1 and the yearly rainfall data of the Sakri rain gauge station is given below in the table number 2 which is assumed to be same for the Chhadvel korde village.

Table 1. The average rainfall in recent four years

YEARS	**RAINFALL(mm)**
2016	793.6
2017	756.3
2018	653.9
2019	982.4

Table 2. The monthly average rainfall in 2019

MONTHS	**RAINFALL(mm)**
JANUARY	0
FEBRUARY	0
MARCH	5.5
APRIL	33.7
MAY	108.2
JUNE	84.1
JULY	276.9
AUGUST	136.8
SEPTEMBER	48.2
OCTOBER	189.8
NOVEMBER	81.3
DECEMBER	17.9
TOTAL	**982.4**

The fig no 3 represents the average rainfall per annum in the Chhadvel korde village for the year 2019.

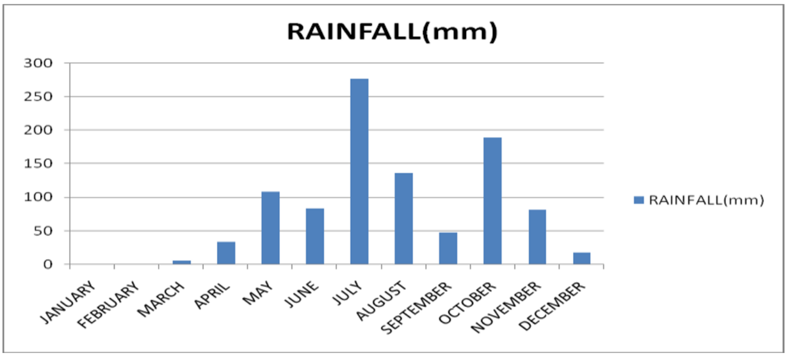

Fig. 4. Graphical monthly average rainfall in 2019

3. Analysis, Discharge Calculation and Design of Pipes Discharge Calculation

Rational method: The rational formula is most commonly used for design of stormdrains. It takes into account the following three factors

- Catchment Area (A)
- Impermeability factor (I) of the catchment area
- Intensity of rainfall (Ri)

Rational formula, can be expressed as follows in its generalized form

Q= (A.I.Ri) / 360

Where,

Q = Runoff or storm water flow m3/sec
A = Catchment area in hectares
I = Impermeability factor
Ri = Rainfall intensity in mm/hr

The correction factor for the discharge is given in the Table No.3

 https://doi.org/10.1051/e3sconf/202340504033

Table 3. Kuichlings Impermeability Factor for the Discharge

Sr.No	**Type of Surface**	**Factor**
1	Water tight roof surface	0.7 to 0.95
2	Asphaltic pavement in good order	0.85 to 0.90
3	Stone, brick and wood block pavements with tightly cemented joints	0.75 to 0.85
4	Stone, brick and wood block pavements with open cemented joints	0.50 to 0.70
5	Interior block pavements with open joints	0.40 to 0.50
6	Macadamized road ways	0.25 to 0.60
7	Gravel road ways and walks	0.15 to 0.30
8	Unpaved surfaces, rail road yards, and vacant lots	0.10 to 0.30

By using Rational method formula the complete discharge is calculated for the pipes in the roof area and in the paved area.

As per calculation for each pipe after applying the discharge correction factor is shown in following Table No.4.

Table 4. Discharge calculation for Roof Area

Pipes	**Area of Roof Top(M^2)**	**Impermeability Factor(I)**	**Rainfal Intensity (Ri) (mm/Hr)**	**Discharge (m^3/sec)**
PIPE-A	115.32	0.8	0.385	0.00098662
PIPE-B	3740.65	0.8	0.385	0.00032003
PIPE-C	3320.36	0.8	0.385	0.00028407
PIPE-D	5404.83	0.8	0.385	0.00046241
PIPE-E	1210.86	0.8	0.385	0.00010359
PIPE-F	28979.9	0.8	0.385	0.00247939
PIPE-G	520.83	0.8	0.385	0.00044559
PIPE-H	2261.85	0.8	0.385	0.00019351
PIPE-J	26718.1	0.8	0.385	0.00228588
PIPE-K	1041.66	0.8	0.385	0.00089119
PIPE-L	2544.66	0.8	0.385	0.00021771
PIPE-M	5705.07	0.8	0.385	0.0004881
PIPE-N	2421.72	0.8	0.385	0.00020719
PIPE-O	21227.1	0.8	0.385	0.00181609
PIPE-P	8080.58	0.8	0.385	0.00069133
PIPE-Q	3027.15	0.8	0.385	0.00025899
PIPE-R	2217.86	0.8	0.385	0.00018975
PIPE-S	1425.88	0.8	0.385	0.00012199
PIPE-T	5448.87	0.8	0.385	0.00046618

PIPE-U	10119.3	0.8	0.385	0.00086576
PIPE-V	807.24	0.8	0.385	0.00069063
PIPE-W	807.24	0.8	0.385	0.00069063
PIPE-X	576.6	0.8	0.385	0.00049331
PIPE-1	24707	0.8	0.385	0.00211381
PIPE-2	5767.23	0.8	0.385	0.00049341
PIPE-3	4196.16	0.8	0.385	0.00035900
PIPE-4	2325.13	0.8	0.385	0.00019892
PIPE-5	1942.24	0.8	0.385	0.00016616
PIPE-6	1639.54	0.8	0.385	0.00014027
PIPE-7	3640.97	0.8	0.385	0.00031150
PIPE-8	1037.88	0.8	0.385	0.00088796
PIPE-9	1902.78	0.8	0.385	0.00016279
PIPE-10	3454.8	0.8	0.385	0.00029557
PIPE-11	1037.88	0.8	0.385	0.00088796
PIPE-12	263.09	0.8	0.385	0.00022508
PIPE-13	375.7	0.8	0.385	0.00032143
PIPE-14	680.2	0.8	0.385	0.00058194
TOTAL	190694			

As per calculation for each pipe after applying the discharge correction factor is shown in following Table No.5.

Table 5. Discharge calculation for Paved Area

Pipes	**Area of Roof Top(M^2)**	**Impermeability Factor(I)**	**Rainfal Intensity (Ri) (mm/Hr)**	**Discharge (m^3/sec)**
PIPE-A	367.83	0.5	0.385	0.000196687
PIPE-B	2067.77	0.5	0.385	0.000110568
PIPE-C	513.15	0.5	0.385	0.000274393
PIPE-D	1073.49	0.5	0.385	0.000574019
PIPE-E	329.22	0.5	0.385	0.000176041
PIPE-F	2947.97	0.5	0.385	0.000157635
PIPE-G	168.2	0.5	0.385	0.000899403
PIPE-H	1086.1	0.5	0.385	0.000580762
PIPE-I	1439.8	0.5	0.385	0.00076989
PIPE-J	168.2	0.5	0.385	0.00089940
PIPE-K	360.87	0.5	0.385	0.00019296
PIPE-M	656.8	0.5	0.385	0.000351206
PIPE-N	320.69	0.5	0.385	0.000171624
PIPE-O	5822.35	0.5	0.385	0.000311334
PIPE-P	1818.86	0.5	0.385	0.000972585

PIPE-Q	901.88	0.5	0.385	0.000482255
PIPE-R	503.6	0.5	0.385	0.000269286
PIPE-S	856.76	0.5	0.385	0.000458129
PIPE-T	1540.08	0.5	0.385	0.000823515
PIPE-U	857.95	0.5	0.385	0.000458765
PIPE-V	551.18	0.5	0.385	0.000294728
PIPE-W	337.68	0.5	0.385	0.000180565
PIPE-X	430.15	0.5	0.385	0.000230011
PIPE-Y	2286.97	0.5	0.385	0.000122289
PIPE-1	5011.5	0.5	0.385	0.000267976
PIPE-2	986.37	0.5	0.385	0.000527434
PIPE-3	876	0.5	0.385	0.000468417
PIPE-4	380.15	0.5	0.385	0.000203275
PIPE-5	556.4	0.5	0.385	0.000297519
PIPE-6	773.65	0.5	0.385	0.000413688
PIPE-7	1285.65	0.5	0.385	0.000687466
TOTAL	**37277.5**			

Discharge calculation from each area i.e. from the roof area and paved area is calculated and the total area along with the total discharge for each pipe is mentioned in the below Table No.6.

Table 6. Total Discharge for each pipe

Pipes	**Discharge from Roof Top (m^3/sec)**	**Discharge from paved Road(m^3/sec)**	**Total Discharge (m^3/sec)**
PIPE-A	0.000987	0.000197	0.000295350
PIPE-B	0.000320033	0.000110568	0.000430601
PIPE-C	0.000284075	0.000274	0.000311514
PIPE-D	0.000462413	0.000574	0.000519815
PIPE-E	0.000103596	0.000176	0.000121200
PIPE-F	0.002479394	0.000157635	0.002637029
PIPE-G	0.000446	0.000899	0.00053553
PIPE-H	0.000193514	0.000581	0.000251590
PIPE-I	0.00228588	0.000770	0.002362869
PIPE-J	0.000891	0.000899	0.000981138
PIPE-K	0.00021771	0.000193	0.000237007

 https://doi.org/10.1051/e3sconf/202340504033

PIPE-M	0.0004881	0.000351	0.000523221
PIPE-N	0.000207192	0.000172	0.000224354
PIPE-O	0.001816093	0.000311334	0.002127427
PIPE-P	0.000691339	0.000973	0.000788598
PIPE-Q	0.00025899	0.000482	0.000307216
PIPE-S	0.000121992	0.000458	0.000167805
PIPE-T	0.000466181	0.000824	0.000548533
PIPE-U	0.000865765	0.000459	0.000911642
PIPE-V	0.000691	0.000295	0.000985367
PIPE-W	0.000691	0.000181	0.000871204
PIPE-X	0.000493	0.000230	0.000723324
PIPE-1	0.002113818	0.000267976	0.002381794
PIPE-2	0.000493419	0.000527	0.000546162
PIPE-3	0.000359005	0.000468	0.000405847
PIPE-4	0.000198928	0.000203	0.000219256
PIPE-5	0.000166169	0.000298	0.000195921
PIPE-6	0.000140272	0.000414	0.000181641
PIPE-7	0.000311505	0.000687	0.000380252
PIPE-8	0.000888	-	0.000887964
PIPE-9	0.000162793	-	0.000162793
PIPE-10	0.000295577	-	0.000295577
PIPE-11	0.000888	-	0.000887964
PIPE-12	0.000225	-	0.000225088
PIPE-13	0.000321	-	0.000321432
PIPE-14	0.000582	-	0.000581949
PIPE-Y	-	0.000122289	0.000122289
PIPE-R	0.00018975	0.000269286	0.000216679

4. Design of Diameter and Slope of Pipe:

After finding the area of provision of pipe for the village for the discharge calculation from each pipe from different areas the diameter of the pipe to be fixed and the slope to be provided for the pipe for carrying discharge is to be designed. For lying of pipes, PVC pipes of different standard sizes are used and that are laid inunderground system in a proper gradient. The size and slope of each pipes are calculated and shown in table no.7.

Table 7. Determination of diameter and slope of pipes

Pipes	**Discharge (m^3/sec)**	**Self-Cleansing Velocity (m/sec)**	**Diameter (m)**	**Area(m^2)**	**Hydraulic Mean Depth (m)**	**Slope (m)**
PIPE-A	0.000295350	0.75	0.015	0.0001767	0.00375	107.207
PIPE-B	0.000430601	0.75	0.040	0.0012566	0.01	94.1919
PIPE-C	0.000311514	0.75	0.040	0.0012566	0.01	179.973
PIPE-D	0.000519815	0.75	0.040	0.0012566	0.01	64.6347
PIPE-E	0.000121200	0.75	0.020	0.0003142	0.005	29.5166
PIPE-F	0.002637029	0.75	0.100	0.007854	0.025	332.468
PIPE-G	0.000536	0.75	0.015	0.0001767	0.00375	32.6074
PIPE-H	0.000251590	0.75	0.040	0.0012566	0.01	275.916
PIPE-I	0.002362869	0.75	0.100	0.007854	0.025	414.095
PIPE-J	0.000981	0.75	0.020	0.0003142	0.005	45.0414
PIPE-K	0.000237007	0.75	0.04	0.0012566	0.01	310.915
PIPE-M	0.000523221	0.75	0.04	0.0012566	0.01	63.796
PIPE-N	0.000224354	0.75	0.04	0.0012566	0.01	346.973
PIPE-O	0.002127427	0.75	0.08	0.0050265	0.02	155.434
PIPE-P	0.000788598	0.75	0.05	0.0019635	0.0125	92.2946
PIPE-Q	0.000307216	0.75	0.04	0.0012566	0.01	185.044
PIPE-S	0.000167805	0.75	0.02	0.0003142	0.005	15.3979
PIPE-T	0.000548533	0.75	0.04	0.0012566	0.01	58.0441
PIPE-U	0.000911642	0.75	0.08	0.0050265	0.02	846.461

PIPE-V	0.000985	0.75	0.02	0.0003142	0.005	44.6556
PIPE-W	0.000871	0.75	0.02	0.0003142	0.005	57.1258
PIPE-X	0.000723	0.75	0.02	0.0003142	0.005	82.8716
PIPE-1	0.002381794	0.75	0.1	0.007854	0.025	407.541
PIPE-2	0.000546162	0.75	0.04	0.0012566	0.01	58.5492
PIPE-3	0.000405847	0.75	0.04	0.0012566	0.01	106.032
PIPE-4	0.000219256	0.75	0.04	0.0012566	0.01	363.296
PIPE-5	0.000195921	0.75	0.04	0.0012566	0.01	454.99
PIPE-6	0.000181641	0.75	0.02	0.0003142	0.005	13.1415
PIPE-7	0.000380252	0.75	0.04	0.0012566	0.01	120.787
PIPE-8	0.000887964	0.75	0.02	0.0003142	0.005	54.9897
PIPE-9	0.000162793	0.75	0.02	0.0003142	0.005	16.3606
PIPE-10	0.000295577	0.75	0.04	0.0012566	0.01	199.904
PIPE-11	0.000887964	0.75	0.02	0.0003142	0.005	54.9897
PIPE-12	0.000225088	0.75	0.015	0.0001767	0.00375	184.584
PIPE-13	0.000321432	0.75	0.015	0.0001767	0.00375	90.5149
PIPE-14	0.000581949	0.75	0.015	0.0001767	0.00375	27.6139
PIPE-Y	0.000122289	0.75	0.02	0.0003142	0.005	28.9933
PIPE-R	0.000216679	0.75	0.04	0.0012566	0.01	371.989

The diameter and slope of the pipes for all the 38 pipes proposed for the Sakri, Chhadvel korde village is calculated as per below given formulas and the sample calculations for the Pipe U is given below.

Diameter of pipe-U

Discharge Q = A x V

Area (A) = Q / V

= (0.000911642) / 0.75

A = 1.2155×10^{-3}

We know that;

Area , A $=\pi d^2/4$

Therefore, d = $\sqrt{A \times 4/\pi}$

D $=\sqrt{1.2155 \times 10^{-3} \times 4 / \pi}$ D =

0.061m

Check -Economical diameter φ of pipe d $=0.97 \times (Q)^{1/2}$

d = 0.97 x $(0.000911642)^{1/2}$d = 0.0298
<0.061m
Hence provide diameter of 8cm i.e. (3 inches). Economical diameter of pipe is 6cm &available diameter in the market is of 8cm.

Slope of pipe-U

Discharge Q
= A x VA=
Area of pipe
V=Mean velocity, By Manning's
formulaV= $\times(R)^{2/3}\times(S)^{1/2}$
N=Manning's coefficient, 0.014
R=Hydraulic mean depth, D/4
Considering the canal is running half-
fullDischarge Q = A x 1/N x $(R)^{2/3}$ x
$(S)^{1/2}$
0.0009116 =$1/8\times0.082\times1/0.0014\times(0.02)^{2/3}\times(S)^{1/2}$
Slope, S=1 in 846.461m
Check -Required Slope of pipe =difference in RL / length of pipe
= 98.549 – 95.262/206.554
=1 in 63.75m

Hence provided slope is 1 in 846.461m; slope of pipe is 1in 63.75m, Hence thecutting & filling work can be done.

As per the discharges given in the above table for the roof and paved areas the final diameter of the pipes for the particular pipe and the discharge is calculated and given the table no 8. For that the available pipes with the mentioned diameters and the type of pipes are given in the fig no 4.

Fig. 4. Figure showing various pipe fittings

5. Conclusion

Water shortage is one of the critical problem in chhadvel korde village. This problem is not new one, and it cannot be solved overnight. As relies on groundwater abstraction through deep tube wells to overcome the excessive demand, the water table is lowering day by day, and the recharge of groundwater table is facing difficulties. Rainwater harvesting is an effective option not only to recharge the groundwater aquifer but also to provide adequate storage of water for future use. In this project tried to focus on the sustainability and effectiveness of a rainwater harvesting system in terms of quality.

After studying the suitability of rain water harvesting scheme in chhadvel korde village the following conclusion were arrived.

- The catchment area of the Chhadvel Korde village divided into two areas and it is estimated to be:

Roof top area = 190694m^2 = 19.069 ha.
Other than roof top area = 37277.5m^2 = 3.727 ha.

- The discharge obtained are:

Total runoff = 882.64m^3/day

- The diameter and length of PVC pipes used for transporting the rain water are:

Diameter	Length
15mm ø	177.13m
20mm ø	1011.95m
40mm ø	1819.2m
80mm ø	296.24m
50mm ø	170.22m
100mm ø	450.52m

- The total estimation of the present work including all the expenses is found to be Rs 307000

Due to adoption of Rain water harvesting system and natural percolation pit construction helps in increase in the ground water table and the soil moisture condition, fertility factor of soil for plantation. Hence this simple technique tends to increase the greenery in surrounding area of the village, increasing aesthetic factor for the village. Thus Rain water harvesting system has endless advantages without any harmful disadvantages.

References

1. Abhijeet Keskar, Satish Taji, Rushikesh Ambhore & Sonali Potdar, July [(2016) "Rain water harvesting – A campus study" genera, volume 3, pg.no.1-3
2. J.R.Julius, R.Angeline Prabhavathy, G.Ravikumar, August (2013), "Rainwater Harvesting (Rwh) – A Review", IJSER vol.no.4 pg.no.276-278

3. Aditya Morey, Bhushan Dhurve, Vishal Haste, Bhupesh Wasnik, August 2013“Rain Water Harvesting System”.
4. Miguel Ángel López, Mónica José Cruz Prieto and Cristina Alejandra Rojas Rojas, October (2017) “Rainwater harvesting as an alternative for water supply in regions with high water stress”,
5. Arun Kumar Dwivedi, Virendra B. Patil & Amol B. Karankal, (2013) “Rooftop Rain Water Harvesting for Groundwater Recharge in an Educational Complex” Global journal of research in engineering civil, vol.no.13, pg.no.13.
6. M. Dinesh Kumar Ankit Patel and O.P.Singh, May (1997) “Rainwater Harvesting In The Water-Scarce Regions Of India: Potential And Pitfalls”
7. Sadia Rahman, M. T. R. Khan, Shatirah Akib, Nazli Bin Che Din, S. K. Biswas, And S. M. Shirazi, (2014) “Sustainability of Rainwater Harvesting System In Terms Of Water Quality” the scientific world journal volume 2014, page no.10.
8. Avinash ojha, lokesh gupta, June (2016) “Design of rain water harvesting system at spsu –udaipur”, IJESRT Journal vol.no.5
9. Biplob Kumar Biswas and Bablu Hira Mandal, (2014) “Construction and Evaluation of Rainwater Harvesting System for Domestic Use in a Remote and Rural Area of Khulna”International scholarly research notice, vol.2014, pg.no.6
10. Kathy debusk, PE and Dr. William F. Hunt, III, PE Biological & Agricultural Engineering North Carolina State University, 15 Sept (2017) “Rainwater Harvesting: A Comprehensive Review of Literature”, Journal water research 115, vol.no.121, pg.no.386.
11. Amit Vashisth, Ashish, Manender Kumar, Amit Kumar and Dushyant Sehgal (2013) Thesis on a Project Report on Design of Rainwater Harvesting System for Lingaya's University Campus.