Utilization of Rainwater Harvesting and Runoff Water to different Aspect in Niyol Village

Yogesh R Lenka
UG Student
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology, Surat

Sahdev C Patel
UG Student
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology, Surat

Mr. Kuldeepsinh Y Jadeja
Assistant Professor
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology, Surat

Abstract

Urbanization has become a common feature of Indian society. Growth of industries as a result of industrialization, people have started moving towards the industrial areas in search of employment. These have resulted in the growth of towns and cities. A country can never prosper if the villages are not developed as this is an important part of country's economy. Our project is about development of appropriate facility and suggestion for up gradation of Niyol village.Niyol is one of the villages in Palsana district. So it is essential to develop the village under the district for the growth of state and also for the country. Slow pace of development in villages and pursuit of better life style has led to huge migration from villages to cities. For most villages on one hand some essential infrastructural facilities like children playground, public garden etc. have been not available and on the other hand provided infrastructural facilities like drinking water, drainage etc. have become insufficient. As per the present scenario, the village has larger area but lack of infrastructures and facilities. They all have separate toilets at home by participating in Swachchh Bharat Abhiyan. The coordination between the villagers is good. But there is lack of employment. There is no proper facilities of transportation and other basic needs. There is mostly health issues are exerting in village. On the basis of collected data from Techno-economic survey & smart village survey, we found GAP between existing facilities and required facilities as per norms.
Keywords- Rainwater Harvesting, RWHS, Rural uses, Simulator, Viability

I. INTRODUCTION

The technique of RWH in Gujarat is very important to reduce the problem of drought and other water related needs such as water for drinking, cooking, industrial and irrigational purposes. The rainfall is decreasing gradually year by year which has resulted in severe drought condition. Moreover, due to increasing population, urbanization, industrialization etc. All sources of water in state mainly depend upon rainfall in spite of uncertain, erratic and uneven monsoon. Water is becoming scare in coming years. This has compelled farmers as well as administrative authorities to extract more and more surface water especially for irrigation and drinking purposes. As the state has 19.50 million hectares of land, in which 12.8 million hectare (mh) are cultivable and only 9.5 million hectares are actually cultivated. The irrigated land is only 2.8 mh (i.e. 30 per cent). The average yield in state is low as compared to other states like U.P, Haryana etc. Due to lack of water, there is a need to conserve soil and moisture in rain-fed areas as to obtain a sustainable agricultural production. The implementation of programmes is governed by the Department of Agriculture (GOI, 2011). The average rainfall in Gujarat varies from 340 to 1900 mm as compared to the southern region which has more quantity of average rainfall ranging from 750 to 1500 mm. Moreover, Dangs district has the highest average rainfall of about 1900 mm in comparison to the northern districts that carry 500 to 1000 mm of average rainfall (Kathiria, 2009). On the other side, the desert area of Kutch has very low amount of rainfall. Due to above reasons; the water harvesting is much more important in Gujarat than other states. Impact of water harvesting especially in rain-fed areas has resulted in achieving state gross domestic product to 10.4 per cent during 10th five year plan as against the targeted GDP to 10.2 per cent. The intensive water harvesting in last 10 years has ultimately resulted an increase in ground water table and irrigated area has increased from 19,30,100 to 27,36,400 hectares(CSRP, 2008). In below table, the Gujarat State Land Development Corporation (GSLDC) under Department of Agriculture has tried their best to show the water management in state in last ten years i.e. from 2002-03 to 2011-12.

II. NEED OF STUDY

By the, government wants technical solution of the problem of villages at the engineering point of view. In this project, the common problem of village are solved by the engineering students. The basic need of rural development program have been alleviation of

poverty and unemployment through creation of basic social and economic infrastructure, provision of training to rural unemployed youth and providing employment to marginal Farmers/Labourers to discourage seasonal and permanent migration to urban areas. Through various government departments are involved in various infrastructural development works, a holistic view and modern solutions (Aesthetic, Vastushastra, etc.) can be provided by new engineers. Study of villages is done by the students with this view. 54% of India's population is below 25 years and most of them live in rural areas with very little employment opportunities. Literacy is the major problem in rural development program. Every one want to go to the cities, so that rural people's remains as ignores part by the policy makers also. Privatization concept is useful for rural development but, government not paying much attention to this aspect. To reduce this migration in this area focus is essential.

III. STUDY AREA PROFILE

Niyol is a Village in Palsana Taluka in Surat District of Gujarat State, India. It is located 9 KM towards East from District headquarters Surat. 10 KM from Palsana. 269 KM from State capital Gandhinagar. Sedhav (1 KM) , Vedchha (2 KM) , Devadh (2 KM) , Oviyan (3 KM) , Haripura (3 KM) are the nearby Villages to Niyol. Niyol is surrounded by Chorasi Taluka towards west Surat Taluka towards west , Kamrej Taluka towards North , Jalalpore Taluka towards South . The nerest town of village is Kadodara (5 to 7 km).The geographical coordinates are latitude 21.1722436˚ & longitude 72.9187415˚. Niyol Pin code is 394325 and postal head office is Umbhel.

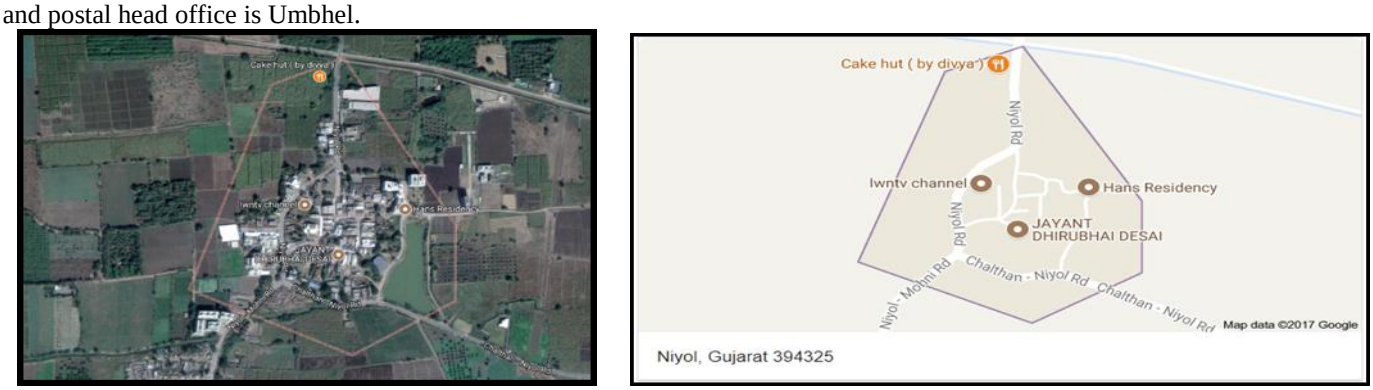


Fig. 1: Niyol Village

IV. SCOPE OF STUDY

- Design, develop and provide more efficient and sustainable Planning in rural area.
- Providing better recreational centres in rural areas.
- Utilizing each resources maximum.
- Developing and Using Sustainable and Economical Planning and Designing.
- Earn money for villagers by receiving Tax and giving facilities.
- Create good environment between villagers.

V. METHODOLOGY

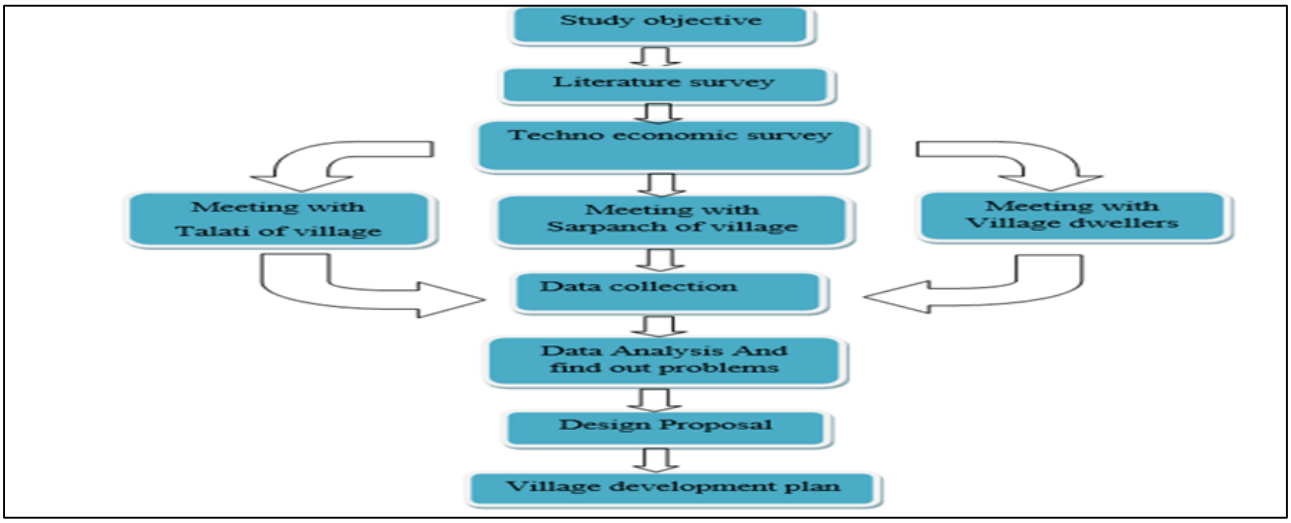


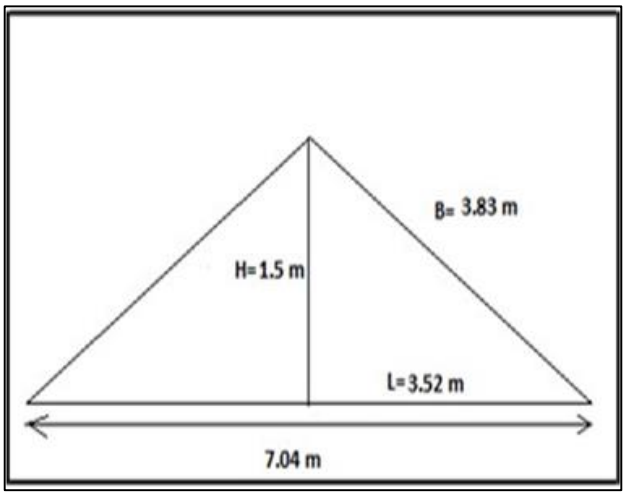
Fig. 2: Methodology of Village development plan

VI. SWOT ANALYSIS

Strengths	*Weaknesses*
– *Reduces the consumption of main water and the associated cost.* – *Reduces the exploitation costs of water supply systems.* – *Reduces the rainwater volume launched in wastewater and rainwater system, contributing to control the floods, the efficiency of WWTP and the discharge of water potentially polluted in receiving environment;* – *Decreases the groundwater reserves dependence which exhaust when super-exploited.* – *The technologies are simple to install and easy to handle what reduces the installation and maintenance costs.* – *The appropriate components and materials are available in the market.* – *The watering with water without chlorine is beneficial to the plants.*	– *Limitation of harvested rainwater quantity in the tank due to the temporal variability of the precipitation.* – *The system can implicate a significant initial investment.* – *Absence of national legislation that specifically regulates the rainwater harvesting.*
Opportunities	*Threats*
– *Technological innovations have been reducing the investment cost.* – *The market of rainwater harvesting has been increasing and a greater number of solutions are available.* – *In the context of climate change, the water availability decreasing reinforces the need of this type of system.*	– *Existence of national legislation that emerges as an obstacle to enable application of this technique (the DL 23/95 prohibits the use of non-potable water in building networks, especially, in flushing cisterns; some council regulations do not allow the connection of wells or other water sources to the pipe installation inside the buildings).* – *There are devices, systems and equipment's that are not certified so if the solutions do not have a recognized quality, it can lead to loss of interest in the use of rainwater systems.* – *Lack of people information can lead to the no acceptance of this technique.* – *The concentration and the intensification of precipitation phenomena will require a greater transport capacity from catchment surface to the tank and a larger tank volume to face the dry periods which tend to be drier.*

A. Design of Rainwater Harvesting

Rain Water Harvesting Can be Defined as activity of direct collection of Rain Water and storage of Rain Water as well as other activities aimed at harvesting and conserving surface and Ground Water, Prevention of loss through evaporation and seepage and other hydrological studies and engineering inventions aiming at most efficient utilization of the Rain Water towards best use for the humidity. There is no any sustainable facilities in present condition of Niyol village. So we propose the Rooftop Rain water harvesting system in school which beneficiate the school dwellers as curing of lawns & it's also used in a latrine block for providing flushing system. It's also useable in draught situation.



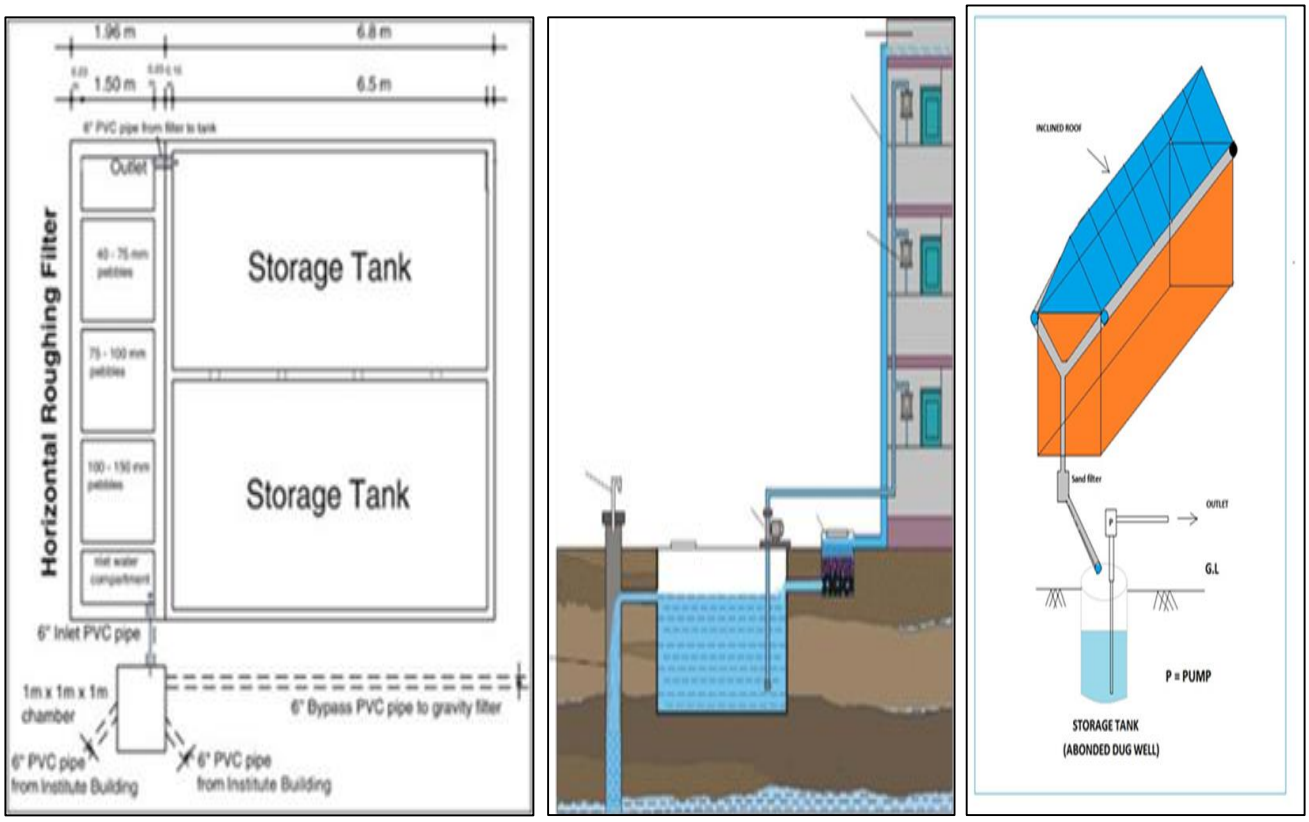


Fig. 2: Rooftop Rainwater Harvesting

B. Procedure

Rainwater which is collected in gutter pipes drained in down pipe and flowing through sand filter where the water is disinfect and storage in tank. Thus the rain water is harvested.

Average annual rainfall of the niyol = 1406.1 mm.

In simple terms, this means if the terrace floor is assumed impermeable, and all the rain that falls on it is retained without evaporation then in one year, there will be rainwater on the terrace floor to a height of 1.4 m.

L = total Plan length= 25.03 m

B = Inclined Width of the roof

H = Height of the pitch of the roof)

We know that, B2 = L2+ H2 (L=length of roof on one side)

= 3.522 + 1.52

So that B = 3.83 m

Area of catchment = L X 2B

= 25.03 X 2(3.83)

= 191.73 m^2

Volume of rainfall over the catchment area = Area of catchment X average annual rainfall

= 191.73m2 X 1.4 m

Total rail water collected = 268.43 m^3

Assuming that 60% water is harvested and 40% of loss is gained due to evaporation loss or conveyance loss therefore total volume of water harvested = 0.6 X 268.43 m^3

= 161.06 m^3

We know that, 1m^3 = 1000 liter

So that total water harvested = 1, 61,060 liter

C. Design of Storage Tank

- Area of rooftop = 191.73 m^2
- Average annual rainfall = 1406.1 mm
- Runoff coefficient for aluminum sheet = 0.85m (Refer DRWS)
- Coefficient for evaporation = 0.8 m
- Total water harvested = 191.73*1.4*0.85*0.8 = 182.53 m^3
- Capacity of storage tank = 182530 liter (Which is 20% larger than required)

Approx. cost of 2.5 lack liter tank is Rs. 40,000 /- (Manual of DRWS)

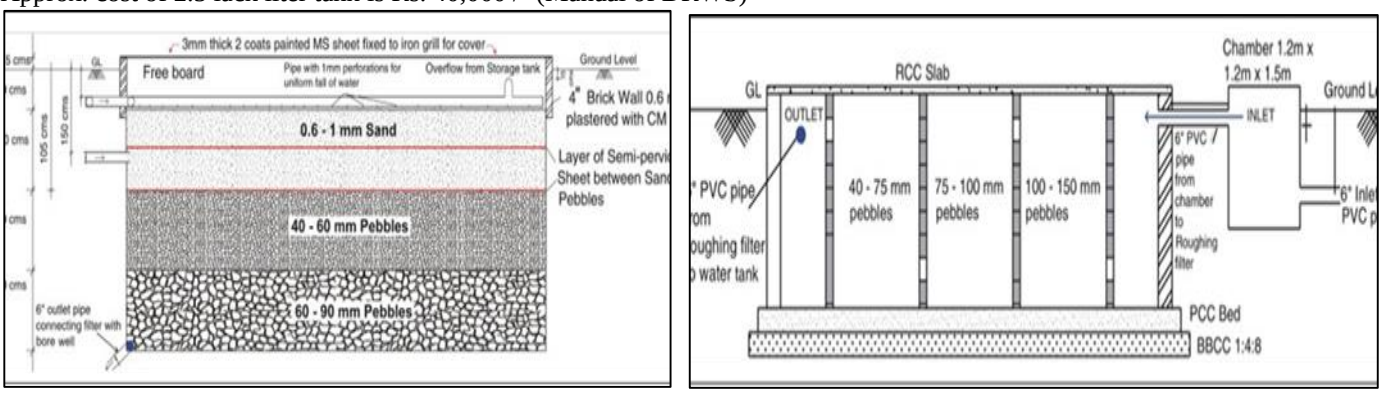


Fig. 4: Storage Tank

So estimate cost of tank that will be = for 182530 liter
= 40000 X 0.73
= 29204.80/-
Estimated cost of storage tank: - 30,000 Rs.

D. Strom Water Management System

1) Unit-Hydrograph Method

The classical theory of unit hydrograph refers to the relationship between net rainfall and direct runoff. The catchment is treated as a black box with the net rainfall as input and the direct runoff as response. If the input is a uniform net rainfall with a duration tdur and a unit depth, the response is the tdur - unit hydrograph. Moreover, the system is considered linear and time-invariant. The direct runoff due to any net rainfall with different depths for successive increments of tdur is obtained by linear superposition of the responses of the various net rainfall depths at each increment of tdur. This process is called convolution. The direct runoff is added to the base-flow to give the total runoff. Application of the Unit Hydrograph Method requires.

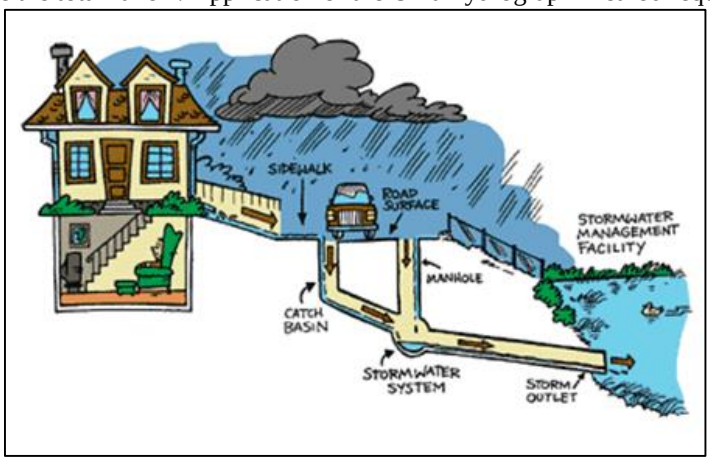


Fig. 5: Strom Water Management

E. Runoff Estimation

Computation of runoff volume used to design of storage tank. Amount of discharge coming from surface runoff can be computed by the following expression.

$$Q=CxIxA$$

Q=surface runoff in m^3/s , I=Intensity of rainfall in m/s , C=runoff co-efficient , A=Catchment area
Runoff volume (m^3) = CxA
From the above formula find the volume of water received to harvest per year, the intensity of the rainfall can be obtained from the formula

$$I = KTx / (D+a) n$$

T=Return period =5 years a=0.5 east India D=75 min duration of rainfall
Where runoff co-efficient for different surfaces in study area are tabulated.

S.NO	*Ground cover*	*Runoff co-efficient*
1	*Built up area*	*0.85*
2	*Bitumen road*	*0.825*

3	*Concrete road*	*0.825*
4	*Open area*	*0.2*
5	*Tiled road*	*0.825*

VII. OBJECTIVES

- To meet increasing water demand.
- To avoid flooding of roads.
- To increase the level of ground water table.
- To reduce the cost of consuming water.
- Utilization of rainwater effectively.

RAIN FALL DATA :: Wednesday, October 4, 2017

Sr No	Taluka Name	Avg Rain Fall Last 10 Year	Rain fall data for Wednesday, October 4, 2017		
			Previous Day	Till 6 AM	Total
1	Bardoli	1652.20 MM	926	0	926
2	Chroyasi	1435.20 MM	1440	0	1440
3	Kamrej	1802.50 MM	1087	0	1087
4	Mahuva	1864.50 MM	1087	0	1087
5	Mandvi	1551.50 MM	1173	0	1173
6	Mangrol	1386.60 MM	1839	0	1839
7	Olpad	1207.80 MM	859	0	859
8	Palsana	1553.20 MM	1114	0	1114
9	Surat City	1377.62 MM	1302	0	1302
10	UmarPada	2022.00 MM	1867	0	1867

Fig. 6: Last Year Rain Fall Data

VIII. CONCLUSIONS

There are various techniques used to harvest rainwater such as pond, check dam, percolation tanks etc. Among them rooftop rainwater harvesting is the most common technique which is especially used for domestic consumption. It is a simple and cheap technique that requires minimum knowledge and offer many benefits. On the other hand, harvested water can supplement water sources when they become scarce or are of low quality like brackish groundwater or polluted surface water in the rainy season. Similarly, the quality of rainwater may be affected by air pollution, bird's dropping, dirt and organic material etc. Therefore, the regular maintenance like cleaning and repairing of storage structures is required. As well as the treatment before the consumption of water (like filtration, chlorination) is also important. On the other hand, aquifer and subsurface barriers are the two important types of groundwater harvesting which provides water for drinking and irrigation. Recently the Central Ground Water Authority of India has announced the rules regarding rainwater harvesting. As per the new rule, the rooftop water shall only be used for recharging the groundwater. Rainwater harvesting is an ideal solution to solve the water crises. Rainwater is free from impurities but when it come in contact with the roof then it wash many types of bacteria, molds, algae, protozoa and other contamination in cistern/storage tank, rivers, lakes and wells. But these risks can be minimized by good design and practice of rainwater harvesting. In rainwater collection the artificial recharge also plays a very important role through augmentation of groundwater. It is relevant in areas where the rainfall is seasonal and not uniform throughout the year as well as the quantum of natural recharge is inadequate to meet the increasing demand of water. Overall, it can be said that rainwater harvesting is an important technique to conserve and sustains the supply of groundwater by improving its quality. In Gujarat the quality of underground water is saline which depends on the pattern and quality of land as a result it has become mandatory to adopt.

ACKNOWLEDGMENT

An act of gratitude is expressed to our guide Mr. Kuldeepsinh jadeja (AssistantProfessor) of, Bhagwan Mahavir College of engg. & Technology, Surat. For their invaluable guidance, constant inspiration and his actively involvement in our work.

REFERENCES

[1] Technical Release 55: Urban Hydrology for Small Watersheds,
[2] 2nd Edition (TR-55), Soil Conservation Service, USDA, Washington, DC, June 1986. 2. SCS National Engineering Handbook, Section 4, Hydrology, August, 1972
[3] North Carolina Division of Water Quality Storm water Best Management Practices Manual, NC Department of Environment and Natural Resources, (DENR), July 2, 2007 or latest ed.,
[4] Hydraflow Hydrographs Extension for AutoCad Civil 3D, 2008 by Autodesk, Inc. v6.052.
[5] Biological & Agricultural Engineering (BAE), NC State University, Cooperative Extension Department, NC State University, Raleigh, NC, http://www.bae.ncsu.edu/stormwater/downloads.htm
[6] Open Channel Hydraulics, Richard H. French, McGraw-Hill, 1985.
[7] Hydrology & Hydraulic Systems, Ram S. Gupta, Waveland Press, 1995
[8] Chao-Hsien Liaw and Yao-Lung TsaiWater (2004)," Optimum storage volume of roof top rainwater harvesting systems for domestic use, journal of the American water resources association", Paper No.03014.
[9] Nadia Ibraimo Paiva Munguambe (2007)." Rainwater Harvesting Technologies for small scale Rainfied Agriculture in arid and semi-arid areas. Integrated water resource management for improved rural livelihoods CGIR challenge program on livelihoods.
[10] K.ARORA soil mechanics and foundation engineering (Geotechnical engineering), Standard publications.
[11] K.Subramanya, (2008), Engineering hydrology, TATA MCGRAW-HILL Education private limited.
[12] G.S Birdie, (2010) water supply and sanitation engineering, Dhanpat rai publications