Rain Water Bank For Residential Building

A. K. Pimpale[1], P.A. Hangargekar[2]
[1, 2] S.T.B.C.E, Tuljapur (M.S.), India

Abstract- *The Maharashtra region is suffering from the water scarcity problems. Osmanabad is situated in Maharashtra region. This is at high altitude and having average annual rainfall of 784 mm. For the water supply of Osmanabad city the sources used are Terna dam, Ujani Dam and from Naldurg. But in summer season, it is very difficult to supply required water demand of the city. To overcome from this situation rain water bank is the concept can be implementing in the residential building. In such scheme select one colony and collect basic data of that colony such as number of occupants, no of bore well, roof area, by considering roof area, average rainfall and coefficient of runoff total quantity of rainwater obtained. This rain water collectively stored in GWT and stored up to summer season. As the summer season it will be make as disinfectant and supplied to those occupant.*

Keywords- Rainwater harvesting, Quantity of rainwater collection, Bore well recharge, Branch 3.0

I. INTRODUCTION

The scarcity of water has been faced by many regions of Maharashtra. In most urban areas, population is increasing rapidly and the issue of supplying adequate water to meet societal needs and to ensure equity in access to water is one of the most urgent and significant challenges Among the various alternative technologies to augment freshwater resources, rainwater harvesting and utilisation is a decentralised. Rainwater harvesting has been practiced for more than 4, 000 years, and, in most developing countries, is becoming essential owing to the temporal and spatial variability of rainfall. Rainwater harvesting is necessary in areas having significant rainfall but lacking any kind of conventional, centralized government supply system, and also in areas where good quality fresh surface water or groundwater is lacking.

Methods of rainwater harvesting

Broadly there are two ways of harvesting rainwater
1. Surface runoff harvesting
2. Roof top rainwater harvesting

1. Surface runoff harvesting

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

2. Roof Top rainwater harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

Objectives: The main objective of study was to determine the total quantity of rain water collecting from roof top and store in storage reservoir that will be utilize in drought season.

II. STUDY AREA

The Osmanabad city is divided into different zones the proposed colony having Survey No. 104/6 with area of 5490sqm. This is situated opposite to the Dnyneshwar temple, M.I.D.C. road, Osmanabad.

Total area for plotting = 3132sqm
Total area for internal road = 2088sqm
Total area for open space = 270sqm

Dnyneshwar nagar has a total population of 125 people. Average annual rainfall is 768mm.

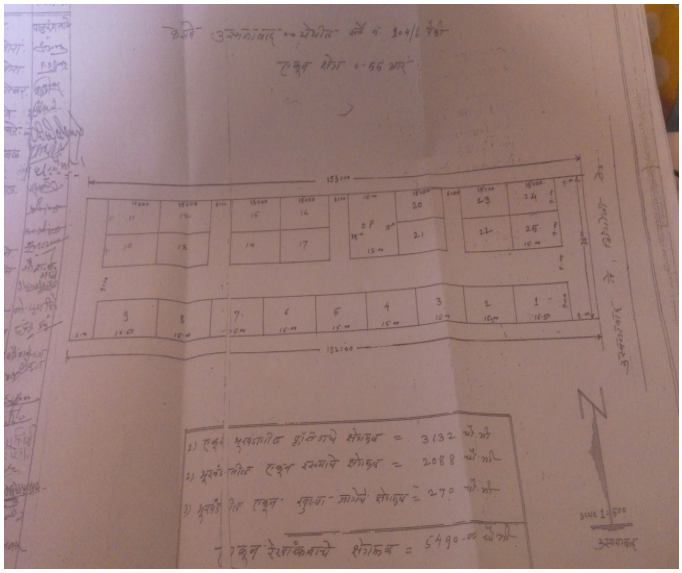

Figure 1. Image of Layout plan of Dnyneshwar Nagar

The basic information of the Dnyneshwarnagar is collected by visiting to the house and these data are shown in Table - 1

Table 1. Details of Occupants Bore well, Storage capacity, Roof area and Demand

Sr. No.	House No	Name of occupant	No. of occupant	Bore well Y/N	Storage Capacity	Roof Area	Demand (135 lpcd)
1	1	Mr. Shintre	3	Y	2000	92.95	405
2	2	Mr. Kale	3	N	300	46.47	405
3	3	Mrs. Avad	2	Y	1000	111.54	270
4	4	Mr. Shaikh	9	N	1500	83.65	1215
5	5	Mr. Gadkar	5	Y	7000	125.48	675
6	6	Mr. Bhutekar	9	Y	11000	79	1215
7	7	Mr. Pimpale	9	N	7500	79	1215
8	8	Mr. Lomte	5	N	2000	79	675
9	9	Mr. Dhone	4	N	3500	50	540
10	10	Mr. Hawaldar	16	N	4000	80.309	2160
11	11	Mr. Kale	11	Y	4000	69.71	1620
12	12	Mr. Mane	12	Y	2000	92.95	1215
13	13	Mr. Rajenimbalakar	9	Y	6000	158.01	540
14	14	Mr. Watne	4	N	500	46.475	540
15	15	Mr. Watne	4	N	1000	52.052	810
16	16	Mr. Lohare	6	Y	1500	117.95	540
17	17	Mr. Mane-Deshmukh	4	N	6000	92.95	675
18	18	Mr. Erode	5	Y	1500	102.24	675
19	19	Mr. Late	5	N	1500	52.05	675
Sum	**125**		**63800**	**1611.8**	**16875**	**Total**	**16875**

III. METHODOLOGY

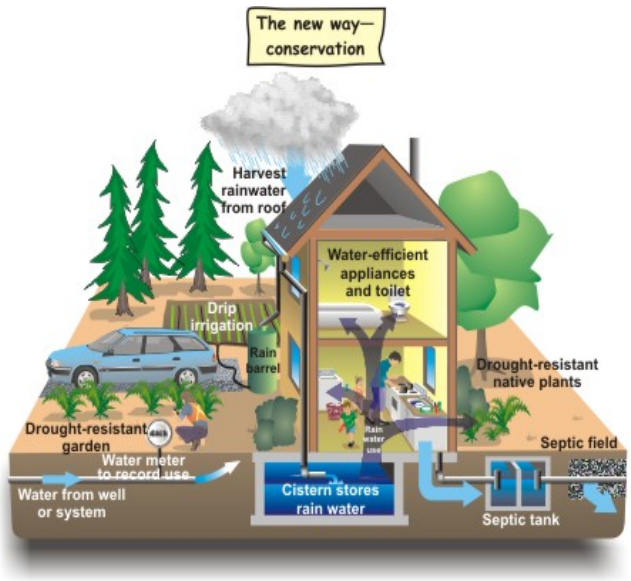

Figure 2. Methodology for rain water bank

overcome from the problems arises due to water scarcity the rain water which is fall over the roof top of the buildings are collected and stored in the underground storage tanks. This stored water is treated and used during the summer season which will reduce the quantity of water tankers and load over the different projects which is run by the government.

Estimation of rainwater collection

The rain water falling over the roof top was estimated as
Sample calculation
Name – Mr. Shintre
No. of members = 03
Bore Well = Yes
Storage capacity = 2000 lit.
Roof Area = 92.95 Sq.m
Availability of water from roof = Roof Area X Avg. Rainfall X Runoff Coefficient
= 92.95 x 0.768 x 0.7
= 49.9699 cum
= 49969.9 lit

50% Water used for bore recharging = 24984.9 lit

Qty of water available for collection =24984.9lit

The total quantity of rain water collected from the colony was shown in table no.2

Table 2. Quantity of rain water collected from roof top

Sr. No.	House No	Name of occupant	Qty of rain water collected in lit (Excluding bore well recharge)
1	1	Mr. Shintre	24984.9
2	2	Mr. Kale	24985
3	3	Mrs. Avad	29982
4	4	Mr. Shaikh	44970
5	5	Mr. Gadkar	33729
6	6	Mr. Bhutekar	21237
7	7	Mr. Pimpale	42475
8	8	Mr. Lomte	42475
9	9	Mr. Dhone	26880
10	10	Mr. Hawaldar	43174
11	11	Mr. Kale	18738.8
12	12	Mr. Mane	24985
13	13	Mr. Rajenimbalakar	42473
14	14	Mr. Watne	24983
15	15	Mr. Watne	27983
16	16	Mr. Lohare	31706
17	17	Mr. Mane-Deshmukh	24985
18	18	Mr. Erode	27483.5
19	19	Mr. Late	27983
Total			**586212.2 lit.**

Design of collection system

The conveyance system of PVC pipes conduct has been adopted for the rain water bank of the proposed colony. The maximum rainfall intensity of 1096mm. the maximum rainfall for that intensity for total roof area 1611.789 sqm is 1766.52074lit/day.
d^2 = 1766520.744/(24 x 15 x0.785)
d = 79.06 mm say 90 mm.

Design of underground storage tank

Area available for open space (size) = (15x18) m
The required storage capacity of water tank = 586.214 cum. Say 600.000 cum.
Assume the height of water tank = 4m
Area of base = 600/4 =150 sqm
Provide the size of proposed storage tank as (14 x 11 x 4) m.

Design of top slab

Given data; M 20; Fe 415
Span ratio = r = ly/lx = 14/11 =1.27 < 2……..i.e. two way slab
Provide an overall depth of 200mm
Effective cover = 15+5 =20mm
Effective depth for short span = 200-20 =180mm
Effective depth for long span = 200-10 =190mm
Live load = 3000N/m^2
Self weight = 0.2 x 1 x 1 x 25 = 5 KN/M^2
Total weight = 3 + 5 = 8 KN/M^2
Mx =αx.W.lx^2= 0.056 x 8 x 11^2 = 54.208 KN-M
My =αy.W.ly^2= 0.0424 x 8 x 14^2 = 66.48 KN-M

Steel reinforcement along x direction (11 m side)
Mu/(bd^2) = 54208000/(1000 x 180^2) = 1.67
Percentage of steel required = 50{[1-√(((1)-4.6 x 1.67)/20)]/(415/20)} = 0.52%
(Ast)x =(0.52 x 1000 x 180)/100 = 936 sqm
Spacing of 16 mm dia bar = (201.06 x 1000)/936 = 214.8mm say 200mm

Steel reinforcement along y direction (14 m side)
Mu/(bd^2) = 66480000/(1000 x 190^2) = 1.84
Percentage of steel required = 50{[1-√(((1)-4.6 x 1.84)/20)]/(415/20)} = 0.58%
(Ast)y =(0.58 x 1000 x 190)/100 = 1102 sqm
Spacing of 18 mm dia bar = (254.46 x 1000)/936 = 230.9 mm say 230mm.
Provide,
(Ast)x = 16mm dia bar @ 200mm c/c.
(Ast)y= 18 mm dia bar @ 230 mm c/c.

Design of pump-

Capacity of tank = 600000 liters
Rate of pumping = 25833.33 Lit/hrs
=7.17lps
Static head = 29
Frictional loss of head 6kh/cm2
Pipe dia mm = 90mm
C value for PVC pipe = 140
Total length = 28m
Pump discharge = 0.5 MLD
Rate of frictional loss:
Q= 7.43x10-9 x C x D2.63 x (Hf) 0.54
Hf= 14.29 m/km
Add 10 % more for valves and fitting = 0.028x14.29
= 0.40m
Margin over residual head = 1.5
Total = 1.9m
Head on pump = 29+1.9
= 30.90 m

BHP of motors (Considering 60 % efficiency)
= (Q x H x1.3)/(75x0.6)
= 7.17x29x1.3/ (75x0.6) Say = 6.00 HP
Hence the pump used for lifting the water from
Proposed storage tank is 6 HP.

Disinfection-

The rain water collected in the underground storage tank is stored up to summer season. There may be chances of upgrading of bacteria. For such condition we have to make provision of disinfectant. To overcome from such situation there are different disinfectant such as

Chlorine
Potassium paramagnet
Ozone
U. V. rays
Boiler

The chlorine is commonly used in various regions. The chlorine is economical as well as available in powder form, in liquid state as well as in gaseous also.

Design of distribution system by using Branch software

The Branch software was used to design the distribution system for Dnyneshwar Nagar. For that we have to provide certain input data which is given as number of pipes, number of node, minimum head loss, maximum head loss, pipe data, node data and commercial diameter data. On this basis the output will be got in cost summary.

IV. RESULTS AND DISCUSSIONS

Results obtained during the research work are presented by the graphs and tables as given below:

Recharge of ground water-

A provision is made for those occupants belonging with bore well at house to recharge it. For the recharge of their bore 50% of the rain water collected from the roof top is used and remaining 50% is transfer to the storage tank. The details of bore well recharge clearly shown in table no. 3.

Table 3. Details of bore well recharge

Sr. No.	House No.	Name of occupant	Qty of rain water used for Bore-well recharge in lit
1	1	Mr. Shintre	24984.9
2	3	Mrs. Avad	29982
3	5	Mr. Gadkar	33729
4	6	Mr. Bhutekar	21237
5	11	Mr. Kale	18738.8
6	12	Mr. Mane	24985
7	13	Mr. Rajenimbalakar	42473
8	16	Mr. Lohare	31706
9	17	Mr. Mane Deshmukh	24985
9	18	Mr. Erode	27483.5
		Total	**280304.2**

Collection of rain water-

The table no. 4 gives the total quantity of rain water collection from the each house and demand of the respective house for per day by considering the number of occupant.

- Water supply to the colony per day,
  Then number of days = 586212.2/16875
  = 34.74 say 40 days
- Water supply to the colony one after day,
  Then number of days = 40 x 2
  = 80 days

Discussion:

In every year rain water wasted due to improper or no such methodology adopted. To minimise the impact of water scarcity we have to implement such scheme to store the rain water and its utilization. The fig. 5.1 shows the graphical representation of ground water recharge and stored water or commonly called as Rain water bank.

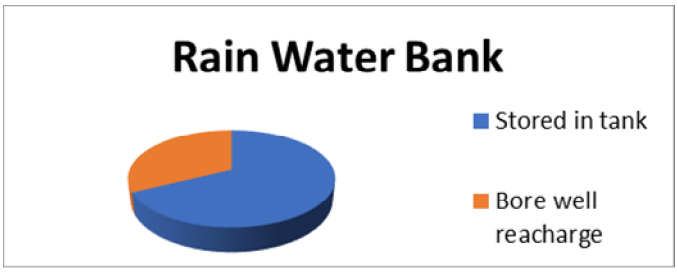

Figure 3. Graphical representation of Utilization of rain water (Rain water bank)

Table 4. Water collection from roof top

Sr. No.	House No	Name of occupant	No. of occupant (A)	Qty of rain water collected in lit	Demand = (A X 135) lpcd
1	1	Mr. Shintre	3	24984.9	405
2	2	Mr. Kale	3	24985	405
3	3	Mrs. Avad	2	29982	270
4	4	Mr. Shaikh	9	44970	1215
5	5	Mr. Gadkar	5	33729	675
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15	15	Mr. Watne	4	27983	540
16	16	Mr. Lohare	6	31706	810
17	17	Mr. Mane-Deshmukh	4	24985	540
18	18	Mr. Erode	5	27483.5	540
19	19	Mr. Late	5	27983	540
Total			**125**	**586214.2**	**16875 l/d**

V. CONCLUSION

On the basis of result it can be concluded that Rain water bank is one of the best method for water conservation. So this water can be used for various purposes during the drought season. This method could be profitably practiced for reducing the impact of drought.Following are the conclusion

1. The average annual rainfall in this reagion is 768 mm by this rainfall amount water collected in the study area was 866518.4 lit.

2. The amount of water required by considering standard demand of occupant is 16875lit/day for study area.

3. After analysis stored water fulfill the demand of occupant in study area upto 80 daysby supplying water on alternate day, so this will reduces the intensity of drought during drought season.
4. Due to this study it is conclude that ultimately reduction in load over the water supply system.
5. Due to this study it is conclude that increase in water table level in considerable amount.
6. Due to the construction of underground water tank top surface can be utilized as playground and open space.

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