An Implementation of Rain Water Harvesting As A Sustainable Development Factor In Julewadi Village Dist.-Satara, Maharashtra, India

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I. INTRODUCTION

The required data for study has been collected from primary and secondary sources. The household survey, village survey, discussion and observations are primary sources. The secondary sources are published and unpublished materials like maps, census data, gram panchayat documents etc.

An open ended questionnaire survey was conducted in village. The mother tongue of villagers is Marathi hence, questionnaire was prepared in Marathi. The survey was carried out in two stages. In the first stage, household survey was carried out to know details about demographic features like population, number of households, and availability of facilities like water supply, electricity and in house latrines etc. In second stage, village survey was carried out to know details about infrastructure and civic facilities like educational details, water supply system, road system, occupation etc.

India has a large rural area which has been mostly undeveloped. And huge population lives in the rural area. The number of villages in India as per 2011 censuses is 597,608. And 70% population lives in the rural area. Those people have to lack of basic and advance facilities. The physical condition of internal roads is the poor and connecting road is narrow and damaged. Most of the village has opened drainage system, so debris and garbage falling in the sewer are blocking the flow and creating critical condition. These villages have not been proper cropping pattern and irrigation for balancing or fulfill the need of the village. Furthermore, insufficient power supplies affecting on the Agriculture Production and small scaled industries. The drinking water is of inferior quality, which is the major reason for health problems of village people. Those villages are suffering from many problems like inferior quality of drinking water supply, poor road conditions, insufficient power supply and Waste water system. So there are needed to provide solutions to above problems.The problems are identified chapter. This chapter includes identified problems.

II. LITERATURE REVIEW

2.1.5 Approaches to Sustainable Livelihoods for the Rural Poor: *(Diana Carney)*

This paper gives idea about sustainable development. It enlists use renewable non-fossil sources of energy. The resources of rural territories should be used to increase welfare. Development will be considered as sustainable if it meets the needs of present generation without compromising the ability of future generations to meet their needs. Rural development leads to reverse the depopulation process, quicken employment and equality of livelihood opportunities, respond to increasing request for better quality, health, safety, personal development and finally improve the quality of life of population.

2.1.6 Roof Top Rainwater Harvesting: (Central Ground Water Board, Ministry of Water Resource, Govt. of India.)

This publication gives the detailed information about Roof Top Harvesting such as what is rooftop harvesting? Needs for roof top Harvesting, Advantages of the roof top Harvesting. Safety consideration such as – 1) Storage in a ground water reservoir, 2) Storage in tanks 3) Collection efficiency, rainfall reliability and formula for calculation of rainwater quantity for roofs this study one of the alternative Roof Top rainwater harvesting for the villages those are facing savior draught conditions due to less rainfall. I have studied advantages, and needs collection efficiency and formula for rainwater collection have been considered.

2.1.7 Catch Rain, house to store- RWH for Andhra University Engg. College Hostels, Visakhapatnam- A Case Study-*(V Chandraiah and V. Mahamood.IJCE 3(2) 2011. Page 133-148.)*

In this paper, they have taken the case study of Engg. College Hostel for roof top Harvesting. In this they have to explain the need for rainwater, advantages in RWH in urban

areas, influencing factors for the design of RWH, components of rainwater Harvesting i.e. collection system, filters, storage tank, etc. In this case study, they calculated water requirement for different hostel building in the Engg. College (Per-capita capita requirement) as well as cumulative inflow and draw from the tank (from June to May). Design of underground storage tank, estimation and cost of storage tank and pipeline, conduit design, How to recharge ground water. Design of rainwater harvesting system during rainy session maintains the quality of rainwater, as well as quality and health. They have given maintenance and monitoring of rainwater harvesting. From this, the author has taken the support of calculation for roof top collection system, operation, monitoring and maintenance tips. It shows the how to design the pipe system and ground storage tank, ground water recharging system. Etc.

2.2Concluding remarks:-

From the above literature, the most of the work is done on Sustainable Development of village; they collect detailed information with help of questionnaires and sample survey. That information does not have any legal approval from local authority. Information collects by random sample with help of probability which makes uncertainty. The sustainable development was generally used for village development. Most of the researcher has been worked on the self-relevant energy and integrated villages. But, none of the researcher worked on the sustainable village development plan for improving life style and reduces the local problem. Also, data collection method and analysis method are helpful for my dissertation from that literature study

III. METHODOLOGY

3.1 Decades wisepopulation for Julewadi village

Table No 1-Forecasted Population

Year	population
1971	1790
1981	2070
1991	2160
2001	3395
2011	3447
2021	3861.25
2031	4275.5
2041	4689.75
2043	4772.6
2051	5214

Domestic Water Requirements as per Head per day as IS 1172-1971

Current Elevated water storage tank available in that village 1.67 lack lit capacity which is constructed 6 years ago .But population after 25 years (year 2043) of that village till will be 4772. As per is code1172-1971 water requirement per capita is 135 lit/day. Existing water going to release in varius zone by two stages such as morning and evening in that village. By considering future 25 year population existing water storage tank is not sufficient. But for future 25 year there will be water deficiency 45lit. per capita per day. Suppose water will be release 3 stages in that village morning, afternoon, evening.

Actual water storage tank required upto year 2043=4772x135lit. =644220 lit.

Water deficiency per day will be 644220lit-167000x3stages =143220 lit.

So, there is also 143220lit total water requirement per day. So that extra water requirement per capita is 30 lit/day/capita. So prefer Roof top rain water harvesting & ground water recharging techniques for fulfill 30 lit deficiency per capita per day & increase ground water table level.

3.2 Case study for Julewadi Village: one family

Current Population = 3347
Total Families = 323
For Calculation purpose we select one -family – Prakash Mohan Raskar.
Roof Area-66.17m^2

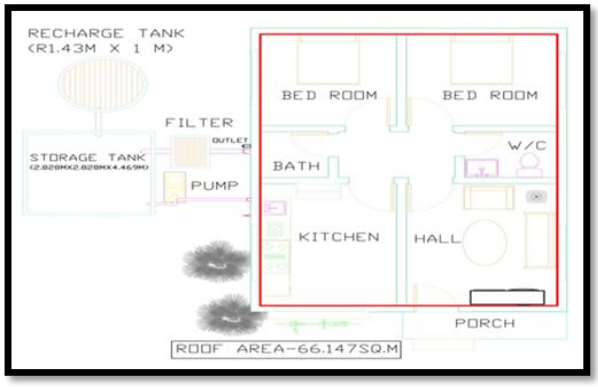

Figure No. 17-Top view of one house

Number of family member-6
Avg. Annual Rainfall-=659 mm
Rainwater Collected= 66m^2 x 0.659 m
= 43.647 m^3

=43647 lit/year
Losses -20%
Actual Collected Rainwater =43647 X 0.80
=34918lit/ year
Current family member =6
Forecasted family member =9
Consider dry season=4 month
Family Water Requirements =9.075 x30 x 120
= 32673 lit/year

Adding freeboard 10% of Water Requirements= $\frac{10}{100}$ x32,673+32673 =35940 lit.
Construct storage tank of 35940 lit. Capacity.
Water for Ground water Recharge = 34918- 32673= 2245lit/year

3.3 Last Fifteen years Rainfall data

Table No 2 - Rainfall Data

Sr. no	Karad (Tahsil)	Average rainfall (mm)
1	2001	632.1
2	2002	441
3	2003	404.8
4	2004	704.3
5	2005	1184.5
6	2006	997.3
7	2007	1007.4
8	2008	807.9
9	2009	131.0
10	2010	872.8
11	2011	593.6
12	2012	550.6
13	2013	569.5
14	2014	663.1
15	2015	317.4

Average of last 15 years rainfall data=658.5 mm
Runoff coefficient (c) =0.95
Quantity cum/hr =13.74
Quantity cum/sec =0.004
Quantity cum/day =329.70
Ground water table depth =30.2m

3.4 Material for rooftop and its cost:

1) Half-round P.V.C. pipe specially made for RTH =3" Ø = 75 mm
Roof water to ground = 3.5m
Wall face to filter tank = 2.5m
Filter Tank to Storage Tank = 1.5m
Total Length = 7.5m
Each piece = 6 m length
Total No. of the piece = 1.25 No.
Cost -Rs. 100 /meter, For our plant required expense is Rs.750/-.

2) P.V.C. pipe specially made for RTH =2" Ø = 50 mm
Roof (top of tank) to base level = 4.9m
Down to Storage Tank = 4.3m
Wall Face to Pump or To storage = 2.25m
Total Length = 11.45m
Cost -Rs. 62.5 /meter, For our plant required expense is Rs.715/-.

3) P.V.C. pipe specially made for RTH =1.5" Ø = 37.5 mm
Roof Tank to Kitchen and other one tab outside = 3.5m
Cost -Rs. 25 /meter, For our plant required expense is Rs.87.5/-.

4) a) L joints: 3"-three nos. Cost - Rs.25/Joint, Required expense = Rs.75/-
2"-5nos. Cost - Rs.20/Joint, Required expense = Rs.100/-
1.5"-6nos. Cost - Rs.15/Joint, Required expense = Rs.90/-

5) T Joints: 1.5"-one no. Cost - Rs. 20/Joint, Required expense = Rs. 20/-

6) HP motor - one no. Rs. 8000/- is required.

7) Bracket 3"- 3 nos.Cost - Rs. 5/Bracket, Required expense = Rs. 15/-
2"-4 nos. Cost - Rs. 4/Bracket, Required expense = Rs. 16/-
1.5"-3 nos. Cost - Rs. 3/Bracket, Required expense = Rs. 9/-

8) End Cap - 1 No., Rs. 25/- is required.

9) One Filter - Rectangular block- 100 lit. Capacity
Sand + aggregate + pebble
Filter size- 40cm x25cm x100cm

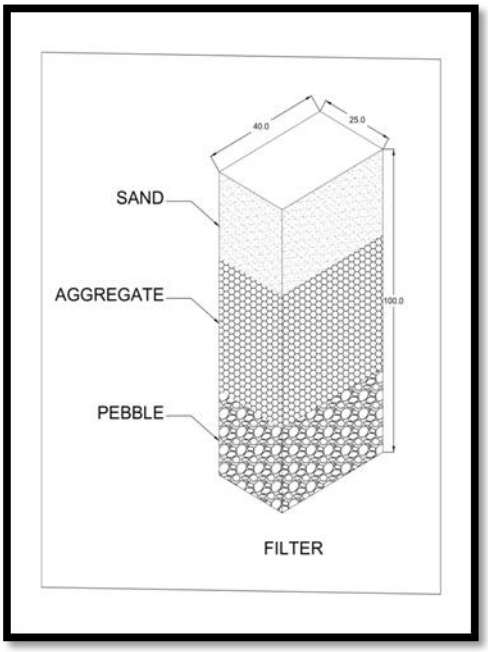

Figure No. 18- Filter

Rs. 1000/- is required.
Cost for Plumbing Accessories = 10002/-
Take extra 10 %=1002/-
Cost for Plumbing Accessories = 11002.2/-

3.5 Underground storage tank estimation

3.5.1 Dimensions Rectangular underground water tank

Tank shall be of R.C.C in 1:2:4 cement mortar foundations and floor P.C.C shall be provided M 10 of 1:2:4 cement concrete. Inside of tank shall be finished with 12mm cement plaster and floor shall be finished with 20mm cement plaster with 1:3 mortar single coated mixed with standard water proofing compound. R.C.C Wall thickness is about 125mm. Roof covering slabs shall be precast R.C.C 150mm thickness. The detailed cost estimation of constructing an underground tank of dimensions 2.828m x 2.828m x 4.67m is given below

Rectangular water tank =32.67 cum.

Extra Freeboard 10% adding =32.6 x $\frac{10}{100}$ =3.26cum
Actual total capacity= 32.67+3.26=35.75 cum.
Consider Height= 4.469m
Area will be =35.75÷4.469=8m^2
Width =$\sqrt{8}$=2.828m
Tank size= 2.828mx2.828mx4.469m.
Side wall will be provided thickness =125mm
P.C.C thickness=150mm
Deductions of manholes =area x thickness

=Π x R^2x thickness
=Π x 0.25^2 x0.125
=0.02453m^3
Total net R.C.C=8.1099m^3-0.02453m^3
=8.08537m^3

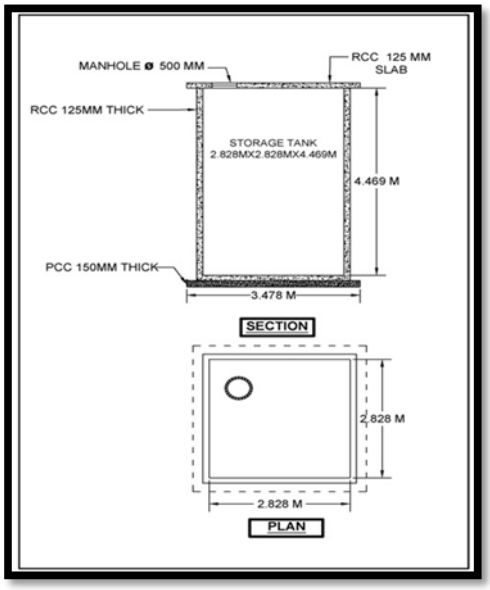

Figure No. 19- Storage tank

3.5.2Steel calculation-

1) Four side Wall -12mm dia.-6 inch c/c
10.09 x 14.65 x 2 x 2 x 4=2366.46feet
=660.77 m

=660.77mx0.88
=581.47kg.

2) Slab-12mm Dia.-6 inch c/c
11.40x11.40x2x2=520 feet
=158.59m
=158.59mx0.88
= 139.56kg

3) Base -12mm dia.-6 inch c/c
10.095x10.095x2x2=407.7023 feet
=124.299m
=109.38 kg

4) P.C.C- 6mm dia.-6 inch c/c
11.4078 x 11.4078 x 2 x 2=520.5534feet
=158.70m
=34.9151 kg
Hence, Total steel quantity = 865.3251kg

3.5.3Plastering

1) Four side wall =2.828 x 4.47 x 4=50.5616m^2
2) Top and bottom slab=2.828 x 2.828 x 2=15.995m^2

Total plastering Quantity (two coated) =66.5566m^2

3.5.4 Abstract of Quantities

Table No 3 - Material Quntities

Sr.No.	Description	No	L(m)	B(m)	H(m)	Quantity
1	Site cleaning	1	2.828	2.828	-	7.997m^2
1	Excavation	1	3.478	3.478	4.869	58.89m^3
2	P.C.C(1:2:4)	1	3.478	3.478	0.15	1.814m^3
3	R.C.C(1:2:4)					
	1) In floor	1	3.078	3.078	0.125	1.1842m^3
	2) In walls					
	Long wall	2	3.078	0.125	4.469	3.4389m^3
	Short wall	2	2.828	0.125	4.469	3.159m^3
	3)slab	1	3.478	3.478	0.125	1.512m^3
	Total R.C.C					8.1099m^3
	Total R.C.C after MH Deductions					8.08537m^3
4	Steel quantity					865.3251kg
5	Plastering					66.5566m^2

3.5.5 Cost of storage tank

Table No 4 –Abstract Sheet

Sr. no	Item	Quantity	Rate (DSR)	Cost
1	Site cleaning	7.997m^2	Lumsump	300/-
2	excavation	58.89m^3	139/m^3	8186.79/-
3	P.C.C(1:2:4)	1.814m^3	3700/m^3	6711.8/-
4	R.C.C	8.08537m^3	6175/m^3	49927.15/-
5	Steel	865.3251kg	48.5/kg	41968.26/-
6	Plastering (1:3)	66.5566m^2	130/m^2	8652.358/-
Total cost				1,13,971.5/-
Contingency + work charges establishment		5 %		5698.6/-
Engineering profit		10%		11397.2/-
Grand cost				**1,31,067.3/-**

3.6 Ground Water Recharge Estimation

Ground water recharge tank capacity =2245lit
Void Ratio = 0.5
Actual water available for Recharging purpose is 2245 lit. But void ratio is 0.5. So we can take size of recharge pit for 4490 lit water.
Consider,Ground water recharge tank capacity =4490 lit

3.6.1 Circular Recharge pit

Consider Recharge tank pit is circular
Then, volume = πx R^{2}x Height
Assume Radius 1m then,
4.49= πx 1^{1}x H
H=1.43m
= 4.69 feet
Radius kept constant =1m & depth=1.43m which will be change according its Recharge tank capacity

1) Excavation cost for Circular Recharge Pit =4.49m3
   =139/m^3 (DSR)
   =624.11/-
2) Circular Recharge pit divided in three layers

A) Sand placed in that Recharge tank pit upto top one Third Portion

Height of each layer=1.43m/ 3=0.48m
Volume of sand =π x R^2 x height
=πx 1^{1}x 0.48
= 1.51 m^3
Rates of sand (DSR) =8000/brass
Rates of sand =2826.8/m^3
Cost of sand =2826.8x1.51
=4268.5/-

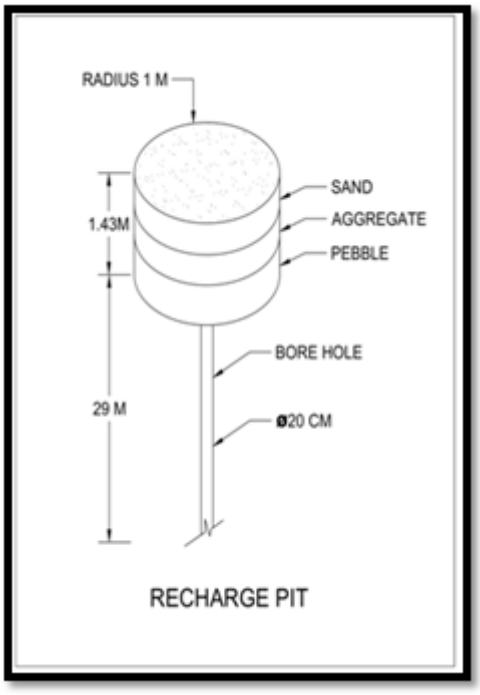

Figure No. 20- Recharge pit

B) Aggregate placed in that Recharge tank pit in its middle Portion

Volume of Aggregate =1.51 m^3
Rates of Aggregate (DSR) =2500/brass
Rates of Aggregate =883.4/ m^3

Cost of Aggregate =883.4 x1.51
=1333.9/-

C) Pebble placed in that Recharge tank pit in its bottom one third Portion.

Volume of Pebble =1.51 m^3
Rates of Pebble (DSR) =2000/brass.
Rates of Pebble =706.7/ m^3
Cost of Pebble =706.7 x 1.51.
=1067.1/-
Total cost of Circular Recharge pit= 624.11+4268.5+1333.9+1067.1
=7293.61/-

3.6.2 Bore Hole

Bore hole of 20cm diameter drilled upto 30.2 m inside from center of Recharge pit

Then bore drilling cost will be 60/ feet
Total bore drilling length =100feet -height of recharge pit
=100feets - 4.69 feet.
=95.31 feet.
Bore hole Cost = 95.31 x60
=5718.6/-
Total ground water recharge cost =7293.61+5718.6 =13012.21/-

3.7Total cost for rain water harvesting system:

A) Total cost required for Rain water Harvesting system for domestic use = Cost required for plumbing Accessories + Cost of R. C. C. Storage Tank

= Rs.11, 002.2 + Rs.1, 31,067.3
=1, 42,069.5/-

Therefore, Rs.1,42,069.5/- required to installation rain water harvesting system for roof area 66.17 Sq.m. This storage tank capacity is 35940 liter.
So for 1 liter capacity storage tank, required expense is Rs. 3.953/-

B) Total cost required for Ground Water recharge system = Cost of Circular Recharge Pit
= 13,012.21/-

Therefore Rs.13,012.21/-required to install Ground Water recharge system.This recharge tank capacity is 2245 liter.
So for 1 liter recharge tank capacity, required expense is Rs. 5.796/-

C) Total cost required for Rain water Harvesting system = Cost required for plumbing Accessories + Cost of R. C. C. Storage Tank + Cost of Recharge Pit
= Rs.11,002.2 + Rs.1, 31,067.3+ Rs, 13, 012.21
=1, 55,081.5/-

Therefore, Rs.1, 55,081.71 /- required to install total rain water harvesting system for roof area 66.17 Sq.m. So average 1 liter capacity construction cost required expense is Rs. 4.061 /-

For total village, required expense to reduce water deficiency parameter for rain water harvesting is Rs. 3,46,77,010/- and grond water recharging purpose is 2,42,99,310/- and for this total RWHS plan implemenration required expense is 5,89,76,320/-

5.9 Model layout plan

A suitable model layout plan regarding water deficiency parameter for sustainable development of village Julewadi, Tal–Karad, Dist-Satara, Maharashtra (India). Shown in

5.10 Suggestions /implementation

I have told awareness of water and decresing water table depth, conservation of water for future needs and importance of rain water harvesting system to villegers. I have given rain water harvesting system devopment plan of every family to head of Julewadi grampanchayat. I have given letter to head Julewadi of grampanchayat for implementation of rain water harvesting system in selected village and they agree with this

IV. CONCLUSION

From above dissertation work, following points are concluded:

1) Primary and secondary data collection included village survey, household survey, educational details, land owner details and house owner details are helpful to Mapping available resource and finding the major problem of village and possible area of sustainability.
2) I have given rain water harvesting system and ground water recharging devopment plan to every family upto 25 years. It is shown in sheet No 1-4.
3) Total village cost required for Rain water Harvesting system for domestic use = 3,46,77,010/- So for 1 liter capacity storage tank, required expense is Rs. 3.953/-

4) Total village cost required for Ground Water recharge system = 2,42,99,310/-/- So for 1 liter recharge tank capacity, required expense is Rs. 5.796/-
5) Total cost required for Rain water Harvesting system for this one family =1, 55,081.5/- So, average cost for total rainwater harvesting system is 4.061/lit.
6) For total village, required expense to reduce water deficiency parameter is Rs. 5,89,76,320/-
7) I have provided suitable model layout plan regarding water deficiency parameter for sustainable development of village Julewadi, Tal–Karad, Dist-Satara, Maharashtra (India).
8) I have given letter to head Julewadi of grampanchayat for implementation of rain water harvesting system in selected village and they agree with this.
9) I have suggested for implementation of rain water harvesting system in selected village through samaj kalyan nidhi ,Dalit vastisudhar yojana ,14th vittaa aayog yojana, Aamdar fund nidhi, Khasdar fund nidhi , Zilhaparishad shesh fund, Rastiya peyjal yojana.etc.

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