ESTIMATION OF WATER DEMAND AND RAINWATER HARVESTING POTENTIAL IN THE CAMPUS OF SHRI SIDDARAMESHWAR EDUCATION TRUST BELAGAVI

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ABSTRACT

The study was aimed at designing a rooftop rainwater harvesting structure for the SSET's Campus Belagavi, located in Karnataka state of India. Out of the possible catchment areas, the main building of all Institutes in the campus was selected as the required catchment area for rainwater harvesting considering the water demand in campus and the supply. It was observed from the analysis that implementation of RWH system in campus can resolve the water scarcity problems during non-monsoon season by storing a huge quantity. This initiative can increase the water supply for construction work, gardening and also will help in artificial recharge of ground water thus enriching both the surface and the ground water resources.

Due to indiscriminate pumping of ground water, the project focuses on designing a tank to store rainwater from rooftop of the various building to cater the need of water requirement for Shri Siddarameshwar education trust Belagavi, Karnataka. The estimation of the appropriate size of the water tanks and their costs required to fulfil the annual drinking water demands through Domestic Rooftop Water Harvesting (DRWH) from rooftop of different areas are done. In this project an attempt has been made to calculate the quantity of water collected annually and provision also made for ground water recharge.

Keyword : - *Direct roof top water harvesting system, unit cost, Rain, water, harvesting, rooftop.*

1. GENERAL

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.[1] 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. 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.

1.1 Components of Rainwater Harvesting

A Rainwater harvesting system comprises of components for pipes or drains, filtration, and tanks for storage of harvested water. The details of the components of rainwater harvesting system

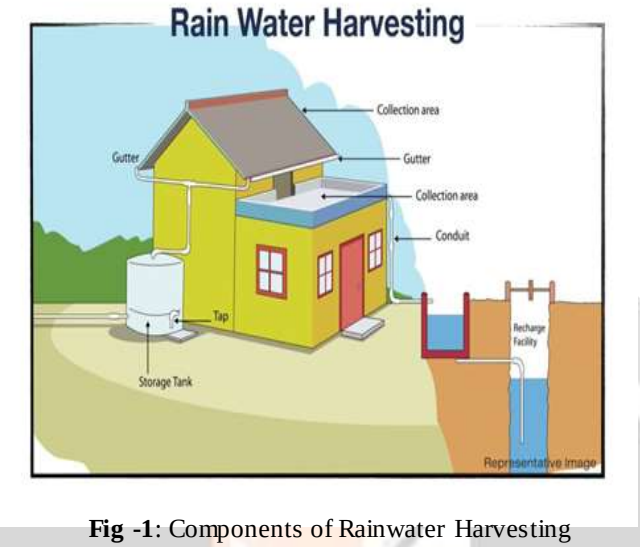

Fig -1: Components of Rainwater Harvesting

1. Catchments
2. Coarse Mesh
3. Gutters
4. First Flushing
5. Filter
6. Storage Tank

1.2 Importance of Rainwater Harvesting

1. Rainwater Harvesting plays an important role in agriculture.
2. Use for urban areas.
3. It is important to save the water for the future.
4. Does it is important to improve the rainwater harvesting through technical and financial prospects.

1.3 Problem Statement

1. Water is one of the basic necessities of life that are required daily. Without it life would not be the same. Some daily activities would come to halt. The resources, water should therefore be available at all times. In arid and semi arid areas, this is just a mirage.
2. This study seeks to solve the situation by determining potential/suitable rainwater harvesting sites using GIS.
3. The purpose of this project is therefore to map out these harvesting sites and provide the information, which can then be used by the responsible authorities to put these water harvesting into place. For this purpose the combined effort GIS analysis and field survey can be used. This report describes the mapping by GIS (Geographical Information System) of the rain water harvesting potential in seem.

1.4 Objectives

1. To collect the rainfall, rainfall intensity, Google map, etc. for SSET's Campus.
2. To collect the data of students and staff member residing in the institute campus.
3. To compute the total runoff volume form rational formula.
4. To compute the roof top area of various buildings in the SSET'S Campus.
5. To carry the contour surveying by total station to know the slope of the ground of SSET'S campus.

6. To design the capacity of a underground water tanks and surface water tanks to store the rain water

2. METHODOLOGY

2.1 Study Area

2.1.1 Location

SSET'S college campus is located in the Belagavi, state of the Karnataka, in India, has been undertaken for the present investigation. The geographical area of the Belagavi is 94 sq. Km. the city is situated in western ghat in Karnataka between $15^0$51' North to 74^0 30' East Latitude. It has an average elevation of 784 meters (2572 ft). The total population of the city is 7,52,000 as per 2022 Census.

2.1.2 Extent of the study Area

SSET's campus comprised with 17.54 acres of campus with 20341.3568m^2 built up area. Population of campus is about 4477including students, teaching and non-teaching staff.

There is great demand of water in campus mainly for laboratories used in Civil Engineering, Mechanical Engineering, Chemistry, Physics etc., for use in cleaning the building floors, labs as well as classes, for use in horticulture purpose also, for sprinkling the water in dry land of college campus especially in summer season for preventing the soil dust particle in air etc.

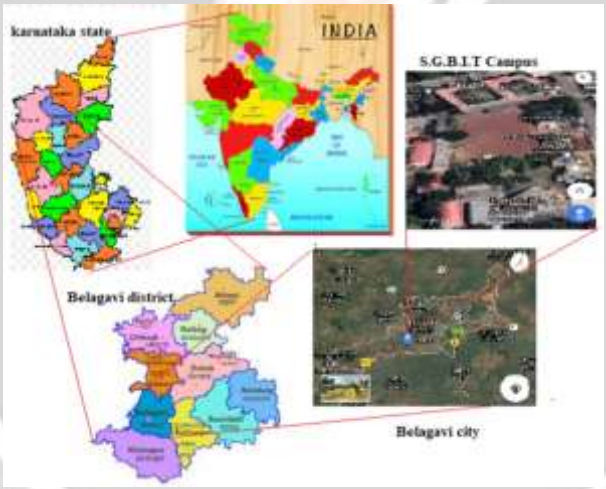

Fig -2: Location Map

2.1.3 Climate of Study Area

Belagavi is known for its pleasant climate all round the year. Summer season is considered as humid as the temperature goes up to 380 Celsius. And is coldest in winter (Temperature is dropping to 120 Celsius). And it experiences almost continuous monsoon rains from June to September. Belagavi sometimes receives hail storms during April. The annual average rainfall is about 1200mm.

2.1.4 Conventional Data:

For this study, rainfall and rainfall intensity data for a period of (2002-2021) of the study area

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Annual
2002	0	0	0	52.3	24	420.4	209.5	426.1	20.2	199.8	0	0	1352.3
2003	0	0	37.8	64.4	1.8	201.1	158.8	133	39.6	116.4	17.2	0	770.1
2004	0	0	0	91.6	113.3	258.1	100.9	411	117.2	41.2	20.4	0	1153.7
2005	0	0	0	127	35	273.7	500.8	538.5	518.7	101	6	0	2100.7
2006	0	0	7.6	0	267.4	374.2	550.8	379.6	211.2	35.2	47.5	0	1873.5
2007	0	0	0	29.5	12.8	277.5	451	381.7	181.2	28	93	0	1454.7
2008	0	6.2	98.7	88	29	245	258	391	129	78	3	0	1325.9
2009	0	0	0	19	40	203.3	730	131	229	233	45	10	1640.3
2010	2.1	0	0	114	3	226	434	204.2	204.9	135	1830	0	3153.2
2011	0	1	0	68	47	230	321.4	315	213.4	125	2	0	1322.8
2012	0	0	0	48.3	15.6	103.3	236.6	199	212	81	31	1	927.8
2013	0	21	0	34	21	201.3	490	199.2	203	46	0	0	1215.5
2014	0	0	34.2	57.4	119.1	109.5	461.9	218.8	91	166.5	49	15.2	1322.6
2015	0	0	18	20	143	176	113	78.3	30	123	0	12	713.3
2016	0	0	23	16.4	67.2	180.5	402.6	306.4	123.9	26.9	21.3	0	1168.2
2017	0	0	0	27	156.1	112	289.5	102	155.7	125.8	1	0.1	969.2
2018	0	0	6.4	8.1	141.2	202.1	412.2	188.1	90.8	18.6	3.1	0	1070.6
2019	0	0	46.6	29.8	6	181	482.2	992.7	208.1	348.3	58.6	3.2	2356.5
2020	0	0	88.6	29.8	20.3	259.7	241.3	593.7	157	202.2	0	0	1592.6
2021	0	13	3	47	144	332	481	81	0	0	0	0	1101
						Total							28584.5

Chart -1: Rainfall Data

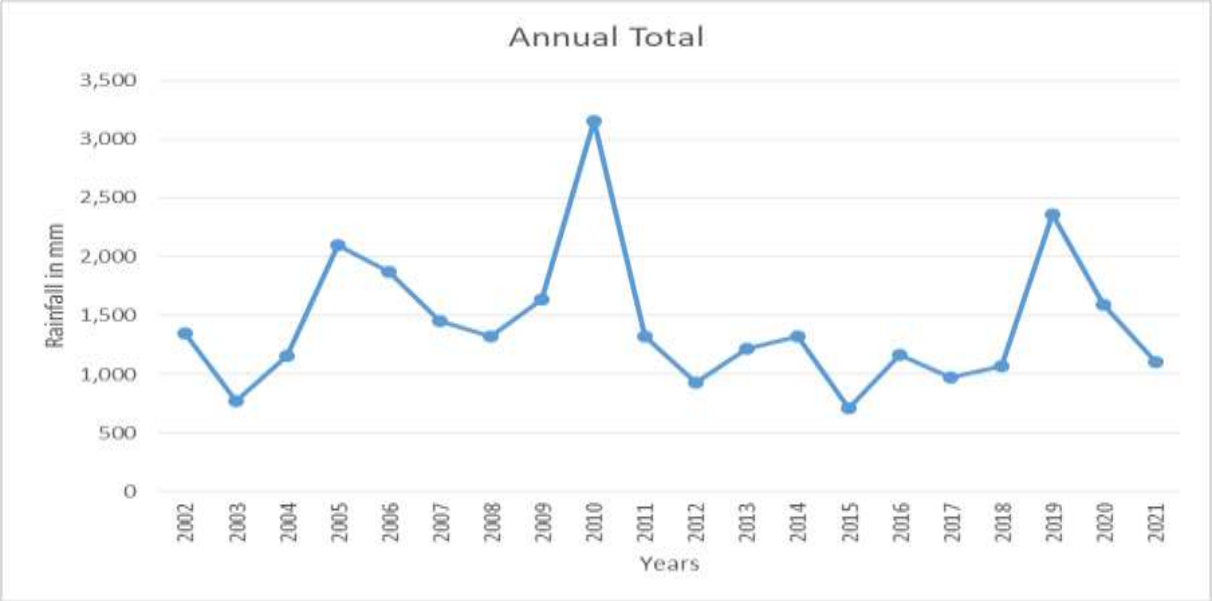

Fig -3: Annual Rainfall Graph

2.1.5 Existing Population of SSET'S Campus

There are many educational institutions like S.G. Balekundri Institution of technology, R.N. Shetty Polytechnic College, High School, English Medium School, Shri Siddarameshwar PU college, Shri Siddarameshwar Industrial Training Institute..

Total Population = 4477

2.2 Design
For Catchment 1: Rooftop area

1. Total Rooftop area=19896.678 m^2
   Assume,
2. Average rainfall intensity= 2cm per hr.
3. Runoff coefficient,

For roof top area = 0.95

4. Storm duration = 2 hr

Now, by using rational formula,

For roof top area,

Q = C.I.A/3.6

Q = 0.95 x 20 x 19896.678x 10^-6/3.6

Q = 0.10501 m3/sec

Total runoff = 0.10501 m3/sec

Now,

Total runoff volume = Peak runoff rate x Storm duration

= 0.10501 x 2 x 3600

=756.072 m3

=756072lit

For Catchment 2: Open area

1. Total Open area = 51085.6484 m^2

Assume,

2. Average rainfall intensity= 2cm per hr.
3. Runoff coefficient,

For open area = 0.8

4. Storm duration = 2 hr

Now, by using rational formula,

For open area,

Q = C.I.A/3.6

Q = 0.8 x 20 x 51085.6484 x 10^-6/3.6

Q = 0.22704 m3/sec

Total runoff = 0.22704 m3/sec

Now,

Total runoff volume = Peak runoff rate x storm duration

= 0.22704 x 2 x 3600

= 1634.688 m3

= 1634688 lit.

Building type	**Roof area(m^2)**	**Volume of water in litres**
Administrative Building	857.796	32544
Academic Block	3480.47	132257
Auditorium	725.683	27504
Chemistry lab	572.80	21744
Civil Department	1569.51	59641
Lingayat Library	40.086	1092
Guest Room	146.67	5573
Temple	137.671	5184
Canteen	111.55	4176
Girls Hostel	1916.516	72720

Proposed Workshop	549.136	20808
Siddarameshwar Industrial Training Institute	1173.91	44568
R.N.Shetty college	8614.88	327312
Open Area	51085.6484	1634688
Total	70982.3264	2389811

Chart -2: Volume Tabulation

2.1.6 Water Demand

Water required for institution – 135 liters per head per day
Water demand = Population x 135
= 4477 x 135
= 604395liters per head per day

3. RESUL AND DISCUSSION

Storage Tank	Building Name	Storage Tank Size
1	R.N.Shetty Building	8x8x6m
2	Civil Department, Girls Hostel, ITI College	5x5x7m
3	Workshop, Temple, Guest Room, Auditorium	4.1x4.1x3.5m
4	Academic Block, Administrative Building, Canteen, Lingayat Library	8x8x4m

Chart -3: Details Of Tank

4. CONCLUSION

Recharge of ground water table is a gradual process, we cannot suddenly increase the ground water table after constructing recharge structures, by constructing any type of recharge structure, and we can give our contribution in aquifer recharge. This will help to rejuvenate the depleting ground water resources. Also help to save the little amount of rain water which used to drain away from many years. Thus it is concluded that implementation of RWH system of SSET's campus would result in the form of the best approach to deal with present scenario of water scarcity and storing huge quantity of 2389811 litres in a year in college campus.

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