Rainwater Harvesting at SDPS Women's College, Indore, Madhya Pradesh

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Abstract - *This article evaluates the potential for water saving by using rainwater in SDPS College in Indore city located in Madhya Pradesh, India. The roof top of the hostel and institutional buildings is the catchment area. Using average rainfall data, calculations for rainwater endowment and water harvesting potential were made. Volume of water that can be collected in one year was calculated. The project cost was calculated making use of prices prevailing currently in India. Annual monetary savings were calculated based on the volume of water collected by rain water harvesting and payback period was arrived at.*

***Key Words*: water conservation; catchment area; rainwater harvesting potential; rainwater endowment, run-off coefficient.**

1. INTRODUCTION

One of the biggest challenges of the 21st century is to overcome the growing water shortage. In present scenario, the gap between water demand and supply has been continuously widening. This has led to increase emphasis on the optimal management of the available water resources.

Rigorous planning and management of water resources is required for long term sustainable resource development. Surface water is inadequate to meet our demands and so we have to depend on the ground water. Due to urbanization, infiltration of rainwater into the subsoil has decreased drastically and recharging of ground water has diminished. Thus, the growing concern about the water scarcity challenges us to think of alternative solutions to avoid the water scarcity.

Rainwater harvesting (RWH) has thus regained its importance as a valuable alternative or supplementary water resource, along with more conventional water supply technologies. Water shortages can be relieved if rainwater harvesting is practiced more widely. People collect and store rainwater in buckets, tanks, ponds and wells. This is commonly referred to as rainwater harvesting and has been practiced for centuries.

1.1 About Rainwater Harvesting Systems

Rainwater, which is the purest form of water, would be an immediate source to augment the existing water supply by "catching water wherever it falls". Rain Water Harvesting technique is the accumulation and storage of rainwater for reuse on-site, rather than allowing it to run off. Rainwater can be collected from rivers or roofs, and in many places, the water collected is redirected to a deep pit.

Its uses include water for gardens, livestock, irrigation, domestic use with proper treatment, indoor heating for houses, etc. The harvested water can also be used as drinking water, longer-term storage, and for other purposes such as groundwater recharge

1.2 Features of Rainwater Harvesting

- Reduces urban flooding.
- Ease in constructing system in less time.
- Economically cheaper in construction compared to other sources, i.e. dams, diversion, etc.
- Rainwater harvesting is the ideal situation for those areas where there is inadequate groundwater supply or surface resources.
- Helps in utilizing the primary source of water and prevent the runoff from going into sewer or storm drains, thereby reducing the load on treatment plants.
- Recharging water into the aquifers which help in improving the quality of existing groundwater through dilution.

Rainwater Harvesting yields a large amount of water. For average rainfall of 1000mm, approx. 4million liters of rainwater can be collected in a year in an acre of land, post evaporation.

1.3 Components of Rainwater Harvesting System

1. Catchments
2. Transportation
3. First flush
4. Filters
5. Recharge pits

2. OBJECTIVES

- To meet increasing water demand.
- To overcome the problem of water scarcity in the campus.
- To increase the level of ground water table.
- Utilization of rainwater effectively.

3. DESCRIPTION OF STUDY AREA

3.1 Water Demand as per Standards:

Water demand is estimated by adopting the standards for various consumption units. Water is being utilized by people for various purposes such as drinking, sanitation, cleaning, gardening, construction, fire accidents, etc..,

Table -1: Water demand as per Standards

S. No	Consumption units	Consumption per capita per day(lit)
1	Students, teaching staff and non-teaching staff	45
2	Hostel	135

FROM THE ABOVE DATA WATER CONSUMPTION PER DAY IS 121,500 LITERS.

3.2 Determination of Catchment Areas:

Table -2: Rooftop Areas

S.No.	Description	Areas (sq. m)
1	College Building 1	991
2	College Building 2	1026
3	School Building	1274
4	Hostel Building	1565
	Total Rooftop areas	4856

Table -3: Other Areas

S.No.	Description	Areas (sq. m)
1	Paved	3774
2	Unpaved	3638

Fig -1: Site Area

Table -4: Monthly Average Rainfall From 2009-2017

MONTHS	AVERAGE RAINFALL(mm)
JANUARY	3.41
FEBRUARY	5.47
MARCH	3.45
APRIL	2.39
MAY	3.72
JUNE	144.62
JULY	393.37
AUGUST	377.10
SEPTEMBER	160.92
OCTOBER	36.93
NOVEMBER	10.73
DECEMBER	3.75
Annual average rainfall	1145.87

4. METHODOLOGY

4.1 Runoff Estimation

The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area. And the amount that can be effectively harvested is called the water harvesting potential. The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:-

Harvesting potential or Volume of water Received (m^3) = Area of Catchment (m^2) X Amount of rainfall (mm) X Runoff coefficient

Runoff coefficient for any catchment is the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface. Runoff coefficient accounts for losses due to spillage, leakage, infiltration, catchment surface wetting and evaporation, which will all contribute to reducing the amount of runoff. Runoff coefficient varies from 0.5 to 1.0.

$$Q = C \times I \times A$$

$$= 0.9 \times 1.145 \times 4856$$

$$= 5004.11\ m^3/year$$

Volume of water Received (m^3) = Area of Catchment (m^2) x Amount of Rainfall (m)

$$= 4856 \times 1.145$$

$$= 5560.12\ m^3/year$$

4.2 Method for storage of harvested rainwater in tank

The volume of tank which stores the harvested water will be directly proportional to the total volume of water harvested.

Technically, there are two types of methods for distributing the harvested rainwater:-

RATIONING METHOD (RM)- The Rationing method (RM) distributes stored rainwater to target public in such a way that the rainwater tank is able to service water requirement to maximum period of time. This can be done by limiting the amount of use of water demand per person.

RAPID DEPLETION METHOD (RDM)- In Rapid Depletion method, there is no restriction on the use of harvested rainwater by consumer. Consumer is allowed to use the preserved rain water up to their maximum requirement, resulting in less number of days of utilization of preserved water. The rainwater tank in this method is considered to be only source of water for the consumer, and alternate source of water has to be used till next rains, if it runs dries.

4.3 Size of tank

In Indore, rainy season extends over four months (June – September). Therefore, dry season is of 245 days. Daily drinking water requirement is 15 liters per person.

Using Rationing Method, the water requirement is limited up to 5 liters per person. Calculating drinking water requirement for dry season-

= No.of days of dry season x water requirement x population of college

= 245 x 5 x 2050

=2.511.250 liters = 2511.25 m^3

Size of tank should be 20% larger than the requirement for safety factor.

Therefore, drinking water requirement is 3013.5 m^3.

Size of tank for-

1. Hostel

Population = 200, Water requirement = 10litres

245x10x 200 = 490 m^3 + 20% = 588 m^3

Size of tank = (10.8x10.8x5) m

2. Similarly size of tanks are calculated for school building, college building and nursing building which are as follows-

School – 955.5 m^3 – (13.8x13.8x5) m

College – 1102.5 m^3 – (14.8x14.8x5) m

Nursing – 514.5 m^3 – (10x10x5) m

5. CONCLUSIONS

This paper dealt with all aspect of improving the water scarcity problem in the SDPS campus by implementing ancient old technique of rainwater Harvesting.

It is concluded that RCC tanks which are to be constructed should be an underground one, so that upper surface of the tank can be utilized economically for any land purpose such as playground or any such small structure.

These tanks should be built for the storage of 3160.5 m^3 of drinking water. Hence this tank has huge capacity of getting rainwater and on proper storage, this tank can supply almost throughout the dry season for about 2000 consumers having a consuming rate of 5 liter per person as calculated by rationing method.

From the above information it is concluded that designing of storage tank as per standard dimensions will reduce the cost of implementation.

There will be the placing of plastic filter which reduces maintenance cost i.e. It prevents mixing of material so that we can re-use it again. The filter materials should be filled in graded form. Boulders at the bottom, gravels in between & coarse sand at the top. Level of ground water also rises so that pumping cost can be minimized.

Hence it was finally concluded that implementation of rainwater harvesting project to the campus of SDPS college will be the best approach to fight with present scenario of water scarcity in all aspects, whether it is from financial point of view or from optimum utilization of land surface. Therefore, water is highly a precious natural resource which is always in high demand in the campus of SDPS campus and thus, rainwater harvesting at SDPS campus is highly recommended.

REFERENCES

[1] C.B. Pawar, S.S Patil and R.P. Pawar, "Case study of Rooftop Rainwater harvesting of Renavi Village in Sangli District of Western Maharashtra," *Academic Journal*, vol. *9,* no. *25,* pp. *1941-1947,* June 2014, Dept. of Environmental Studies Sangola College , Solapur

[2] Dr.S.Chandramouli1 G.N.V.Prasad2, "Design of Rainwater Harvesting System (RWHS)," *IJSRD - International Journal for Scientific Research & Development, Vol. 3, Issue 07, 2015, ISSN: 2321-0613*, 1,2M.V.G.R.College of Engineering, Vizayanagaram, Andhra Pradesh.

[3] M. Dinesh Kumar1, Ankit Patel1 and O.P. Singh2,Rainwater Harvesting in the Water-scarce Regions of India: Potential

[4] Pitfalls, IWMI-TATA Water Policy Program, Hyderabad, India 2 Benaras Hindu University, Varenasi, India

[5] Ranjit Kumar Sharma, Prof. K.C.Patra & Prof. Ramakar Jha, Rainwater Harvesting at N.I.T. Rourkela

[6] MODELLING AND SUSTAINABLE MANAGEMENT OF RAINWATER HARVESTING IN URBAN SYSTEM

[7] CGWB. 2000. Guide on Artificial Recharge to Ground Water prepared by Central Ground Water Board, Ministry of Water Resources, Government of India, New Delhi. May.