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RAINWATER HARVESTING SYSTEM BY SUSTAINABLE MATERIALS

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ABSTRACT: Water is considered as everlasting free source that can be acquired naturally which is essential for environment, food security and sustainable development. Sustainable use of water could maintain a balance between its demand and supply. Sustainability of RWH in meeting the household demands of fresh water is the prime focus of this study. The method of this study comprises of various literature reviews. Availability of drinking water and provision of sanitation facilities are the basic minimum requirements for healthy living. Rainwater harvesting is the most traditional and sustainable method, which could be easily used for potable and non-potable purposes both in residential and commercial building. Rainwater harvesting, in its broadest sense, is a technology used for collecting and storing rainwater for human use from rooftops, land surfaces or rock catchments using simple techniques such as jars and pots as well as engineered techniques. Rainwater harvesting has been practiced for more than 4,000 years, owing to the temporal and spatial variability of rainfall. Rainwater harvesting describes processes in which precipitation that falls on a site is diverted, captured, and stored for use on-site, as opposed to allowing it to run off, evaporate, or infiltrate into the soil. Depending on its intended use, the captured precipitation may require treatment. In a broad sense, rainwater harvesting can also include capture from surface water runoff rapid population growth, combined with industrialization, urbanization, agricultural intensification and water intensive lifestyle is resulting in a global water crisis. Sustainable rainwater harvesting provides the long-term answers to the problem of water scarcity. This paper mainly conveys importance of RWH and factors to be considered for rainwater harvesting system and new technologies used in this system.

INDEX TERMS: Rainwater Harvesting, global perspective, sustainability, dimensions and indicators

INTRODUCTION

A sustainable water supply system is defined with respect to irrespective conditions when the social capital which is a set of shared community norms, expectation of community, pattern of community interaction are fully utilized including the factors. Rainwater harvesting is one of the useful effective processes of water conservation. It is used to indicate the collection and storage for rainwater and also used for human, animals and plants needs. Rainwater harvesting is a simple and primary technique of collecting water from natural rainfall. Rainwater harvesting is a multipurpose way of supplying usable waters to consumers during crises period, reaching the ground water and finally reducing the runoff and water logging during the season of heavy rainfall. Traditional knowledge, skills and materials can be used for this system. During the rainy season, an individual can collect water on his rooftop and manage it on his own. Reserved rainwater on rooftops can be used for self-purification or domestic use and also reduces the several effects of drought or water scarcity problem. Rainwater harvesting system plays, an important role in developing sustainable urban future. Availability of water of serviceable quality from conservative sources is becoming limited day by day due to huge demand. Rainwater provides sufficient quality of water with small cost. In order to understand the variation between demands and supply, the total demand needs to be known. That could be calculated through population data and per capita demand. The extraction of water from sources, the treatment of raw water to the consumers requires high energy. Therefore, the water sector consumes a huge amount of electricity from local and national grid. The associated costs of rainwater harvesting system are for installation, operation and maintenance. Of the costs for installation, the storage tank represents the largest investment, which can vary between 30% and 45% of the total cost of the system dependent on system size. A pump, pressure controller, and fittings in addition to the plumber's labor represent other major costs of the investment. Cost comparison and associated benefits between a rainwater harvesting system and traditional water supply system encountered and revealed a rainwater harvesting system is a cost-effective technology. Now a days there are many new technologies used for rainwater harvesting. This including-

1. Rain saucer- The rain saucer system is a barrel accessory that allow users to harvest rainwater anywhere. It looks like an upside umbrella. It is easy to install anywhere and decrease the potential for contamination. It can be used for sustainable gardening, for small scale farming, and for collecting a fresh water.

2. Check dams- A check dam is a small, sometimes temporary, dam constructed across swale, drainage ditch, or waterway to counteract erosion by reducing water flow velocity. The purposes of check dam are to retain water upstream, so that water percolates into ground and recharge the ground water table.

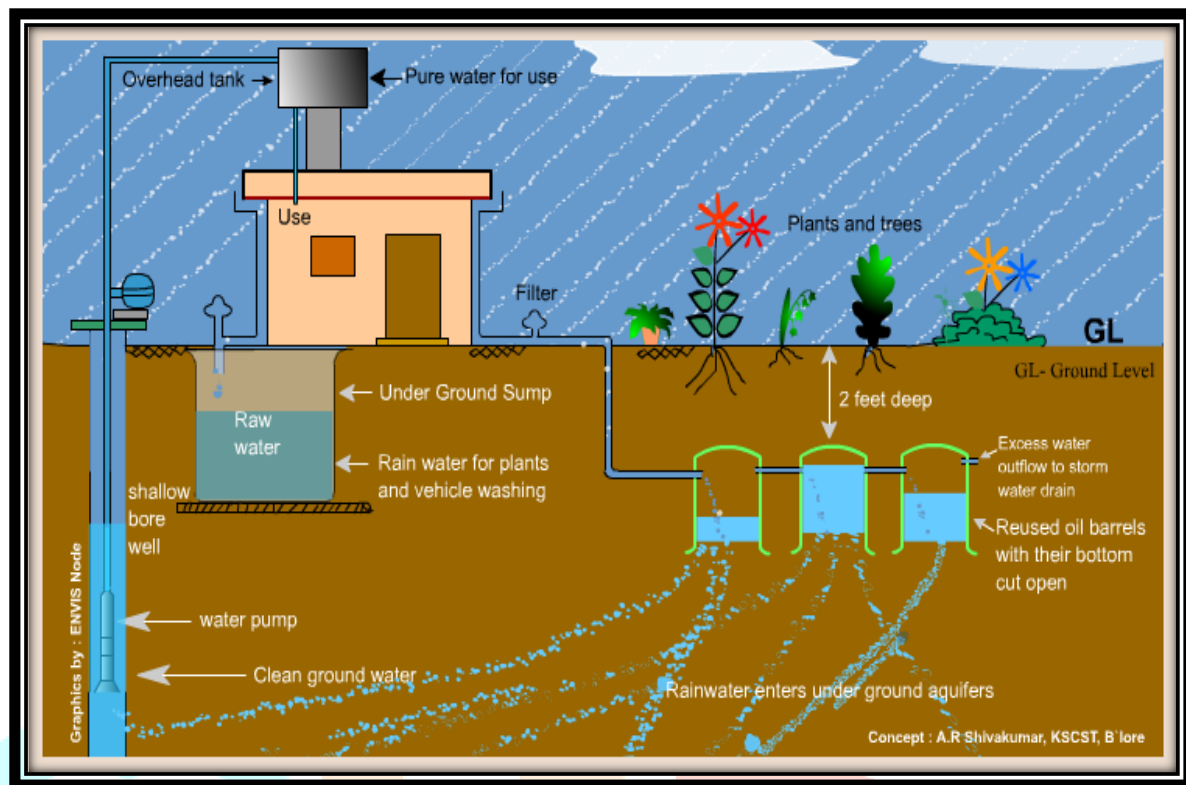


Figure 1. Cycle of Rainwater Harvesting
(Sources: <https://essay.iaspaper.net/>)

Making sustainable rooftop rainwater harvesting system to meet the domestic needs of the community specially in the rural area is prerequisite so that minimum standards of rainwater harvesting could be met. Sustainable rooftop rainwater harvesting system which meets the entire sustainability dimension of rainwater harvesting system; economical, socio-environmental, technical and institutional will support the community to live better improved life. It will contribute to mitigate the water scarcity at some place in the larger context i.e. at national level by keeping its use in top priority by the national level stake holders working in water and sanitation sector. The sustainability of water supply system means delivering the service up to its design period where operation and maintenance, availability of local trained person, active users committee, and availability of evolving and maintenance fund are all met.

ADVANTAGES OF RAINWATER HARVESTING SYSTEMS

Rainwater harvesting system is defined as a science of collection, utilization of runoff collected either from rooftop or ground runoff or from any intermittent water courses. It is the primary ultimate source to fill the entire water needs on the earth like wells, ponds, lakes, rivers, and recharging the ground water table. It is a simple technology used in the world as it helps to satisfy the demand of water with quality due to its natural P^h value and comparatively free from pollutants. It can be a good option for the rural area suffering from the acute water scarcity and also a main source where ground water is unavailable and becomes supplementary water supply where the ground water is limited. It provides water for domestic, commercial, institutional, individual, agriculture, livestock and ground water recharge. It has many advantages that can be classified as economic, environmental, social, hygienic, sanitation and health which has been benefiting human being in the cumulative way. Roof top rain water harvesting can be used in both rural and urban area. It is very much useful for the arid, semi-arid, and high up hillsides, scattered settlements. It is safe compared to surface water like from river and is simple and economical. Construction materials for the constructing roof top rain water harvesting is easily available. It is convenient as it provides water at the point of consumption.

GLOBAL PERSPECTIVE OF RAIN WATER HARVESTING

The world is facing the increasing demand of safe drinking water due to increased population, industries, intense farming, climate change and more consumption of potable water. In India, hundreds of villages and cities are facing the problem of water scarcity and it has a very significant impact on life, culture, tradition. Rainwater harvesting system emerges as the alternative solution to mitigate the water scarcity in these villages and cities which are running out of water. Rainwater harvesting system is mainly used in Asia and Africa which has been a major source of water. In the lower latitude, the Hindu Kush mountainous region stands as the largest volume of fresh water storage. The storage in this hilly region functions as the water tap for almost five hundred million people living along and below Hindu Kush mountainous region. People of this region use different rain water harvesting techniques based on their own traditional systems and culture of rainwater harvesting. They use different kinds of apparatus and methods of rainwater harvesting to meet the domestic demands. Today, it is adopted by many countries and its use is increasing and has been a part of urban management. Knowing its importance many countries like Sri Lanka, Kenya, Bermuda, Brazil, China, Ethiopia, Uganda, and India have enforced laws to construct rainwater harvesting system in new buildings

in the rural area. There is a significant growth in the uptake of rainwater harvesting in these countries. During the past two decade significant development in rainwater harvesting has taken place both in the developed and developing countries like Thailand, Sri Lanka, Kenya, India, Ethiopia, China, Uganda and Brazil and also, rainwater harvesting is very useful in meeting the challenges of water scarcity in urban and per-urban developing areas having huge population and huge settlements. It is cheap and provide the water with desired quality. This has helped the government and the concerned water authorities to find the solution of potable water issue. An example of such type of solution could be the new settlement of Kolkata city which has been developed as new urban area in which rainwater harvesting is installed to meet the water requirements of the household of the settlement. Likewise, it is also in top priority for the most urbanized cities of the world like Chennai, Delhi and Kolkata where the rainwater harvesting has been made mandatory for each household.

Globally, rainwater harvesting is also being used in improving the food security situation, especially in the developing countries. Application of rainwater harvesting to higher crop yield encourage farmers to diversify their enterprises and add value to their crops. It creates additional source of water and support the conventional water supply systems. Rainwater harvesting at household level and community level have enable the farmers to access an additional source of irrigation that supports an improvement in the food security.

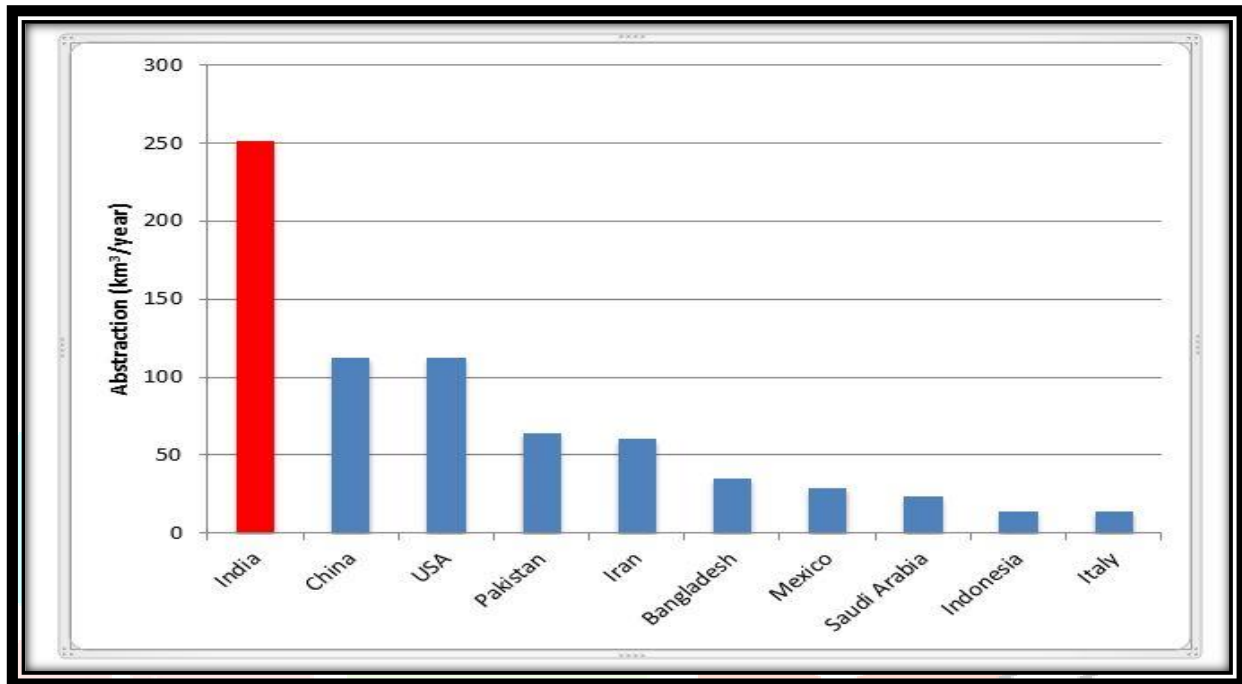


Figure 2. Utilization rate of RWTH of different countries in a year
(Sources: http://nwa.mah.nic.in/sdmc/rwh/01_advantages.htm)

SUSTAINABILITY

Sustainability is ability to be sustained, supported, upheld and is more related with the use of natural resources. World bank defines sustainability as requirement of our generation to manage the resources base such that we ensure ourselves can be shared by all future generations. It is a process of change in which the exploitation of resources, direction of investments, the orientation of technological development and institutional change are in harmony and enhance both current and future potential to meet human need and aspirations.

SUSTAINABILITY OF WATER SUPPLY SYSTEMS

A rural water supply system is said to be sustainable when the social capital which is a set of shared community norms, expectations of community, pattern of community interaction are fully capitalized including other factors. When an infrastructure is built, long term sustainability is expected.

SUSTAINABILITY DIMENSIONS AND INDICATORS

For a community-based drinking water supply, basically there are four dimensions of sustainability; socio-environmental, technical, financial and institutional. This can be explained as follows:

1. SOCIO- ENVIRONMENTAL DIMENSION

There must be equitable access to the safe drinking water in adequate quality with good quality with ensured protection of health and social welfare. The indicators for this dimension can save time, health status, environmental benefits and GESI impact.

2. INSTITUTIONAL DIMENSION

The local community organization must be effective to manage the operation and maintenance, available fund and other required activity. The indicators are operation and maintenance practice, functioning of users committee, existence of revolving fund. Capacity building and use of local trained people.

3. FINANCIAL DIMENSION

Project must run at low cost, financially self-sufficient and fund must be available for maintenance. Indicators are operation and maintenance cost, capital and upgrading cost.

4. TECHNICAL DIMENSION

There must be planning, design, and management of physical infrastructure and the technology involved. Indicators are verification of quantity, accessibility, reliability, quality, physical status of the system.

5. RANKING OF SUSTAINABILITY

The running project can be ranked into three categories, viz., sustained; sustained but at risk; and not sustained project. The ranking helps to take the decision about the investment in future. For sustained project there is no need of investment, some follow up is required for the sustained but at-risk project. Major support is required for not sustained project. Sustained project obtains 70 percent and more in individual dimension and overall scoring. Sustained but at-risk project obtains 70 percent in overall and less than that in individual scoring. Not sustained project obtains less than 70 percent in overall as well as in individual scoring.

CONCLUSION

Water storage is one of the critical problems now a days. This problem is not new one, and it cannot be solved overnight. Rainwater harvesting is an effective option not only to recharge the groundwater aquifer but also to provide adequate storage of water for future use. Cities, where water is a major concern during dry periods, should introduce this system along with its traditional and new approaches used in harvesting rainwater. The system is cost effective as large amount of money can be saved per year. Increased awareness on water crises has led rainwater harvesting to be proposed as community facility. The small and medium residential and commercial construction can adopt this system as sustainable option of providing water. It is almost the only way to upgrade one's use hold water supply without waiting for the development of community system.

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