Domestic Rainwater Harvesting as a Water Supply Option in Sri Lanka

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Abstract: Domestic rainwater harvesting has been revived in Sri Lanka since 1995 with the Community Water Supply and Sanitation Project. Since then, through the efforts of the Lanka Rainwater Harvesting Forum (LRWHF, an NGO set up to promote rainwater harvesting for domestic need), the technology and the concept has been spread to other parts of the country. At present there are over 31,000 domestic rainwater systems in the country. Rainwater harvesting has been successfully legalized in Sri Lanka.

Key words: Rainwater harvesting, water quality, Sri Lanka, technology, policy

Introduction

Rain is the primary source of water in Sri Lanka. Situated in the tropics, Sri Lanka receives an average rainfall of 1800mm with a range of 900mm in the Northwest and Southeast of the country and 5080mm in the Southwest of the country (Figure 1). Based on these average statistics, several research studies have identified Sri Lanka as a country with either little or no water scarcity, or moderate water scarcity

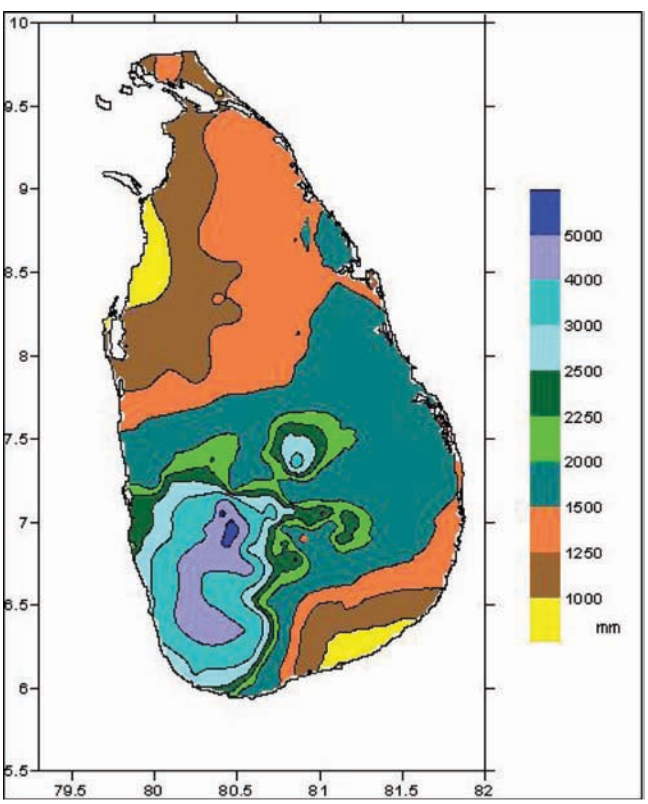

Figure 1. Rain Fall Zones of Sri Lanka (adapted from Chandrapala 1996)

conditions (Amarasinghe et al 1999). These observations are based on aggregated statistics presented at the national level. Aggregated statistics at national level, however, are often misleading for countries with large regional variations in rainfall. These studies have ignored the spatial and temporal variations in water availability and demand.

Sri Lanka experiences high seasonal and spatial variations in rainfall due to the bi-monsoonal climatic pattern. The two main monsoons are the northeast monsoon from October to March and the southwest monsoon from April to September. Though earlier these were the conventionally accepted monsoon periods, presently much of this pattern has changed due to global weather changes, causing more variability and unpredictability.

Depending on the weather pattern, the country has two seasons, basically classified according to cultivation purposes:

(1) The Maha season is the wet season starting from October to March, and

(2) the Yala season is the dry season from April to September.

Accordingly, the rainfall pattern divides the country into two climatic zones—the wet zone and the dry zone. The wet zone receives an average annual rainfall of 2350mm

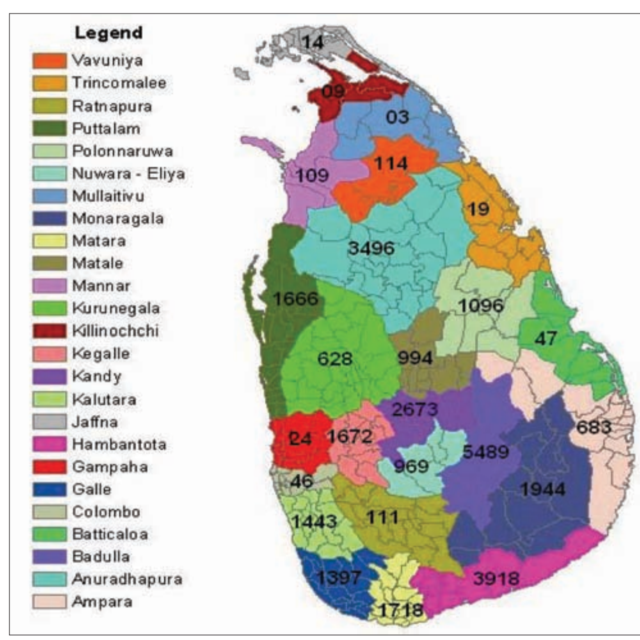

Figure 2: Distribution of Rainwater Harvesting Systems in Sri Lanka

distributed in the two seasons and the dry zone receives 1450mm of annual rainfall (Ibid 1999). In the dry zone more than two thirds of the rainfall is received during the Maha season, and more than 70% of the rain is received from October to December. This indicates the large variations in rainfall which leads to spatial and seasonal variation in water supply.

As a result of this large variation in the dry zone, the dry season experiences water scarcity, the dug wells and tube wells dry up, and some people have to travel a distance exceeding four kilometers to fetch water. In the wet zone, although the precipitation is generally high, unfavorable topography results in water having to be hauled up steep hills. Though the collection distance is less than two kilometers, the time spent on collecting water is high, as they have to climb the hills number of occasions. The coastal areas also experience water shortages due to saline intrusion into wells; this situation is exacerbated after the tsunami of 2004, which contaminated 40,000 wells along the coastal line of Sri Lanka.

Domestic Water Supply Situation in Sri Lanka

The growing population and development activities such as rapid urbanization, industrialization and agricultural activities create tremendous pressure on available water resources. Groundwater is increasingly tapped for agricultural and other commercial purposes and thereby the over exploitation causes saline intrusion. Dumping of industrial and other wastage into water bodies pollutes the water and further limits the supply. Therefore, the current per capita water availability of 2400 m^3 will be end up with 1800m^3/capita in year 2025, which is just above the water scarcity threshold of 1700 m^3/capita (Amarasinghe et al 1999).

According to the 2009 draft Drinking Water Policy for Sri Lanka the current drinking water supply coverage in Sri Lanka is estimated to be 78 percent. Out of this 35% of the population enjoys piped water supply service. The remaining 43% relies on sources such as dug wells, tube wells, springs and rainwater harvesting Therefore, the relevant authorities face serious setbacks in meeting the Millennium Development Goal of *Water for All* by 2025, and supplying adequate quality water becomes a real challenge to policy makers and other stakeholders. Considering alternative and feasible water sources has become an important factor to meet present and as well as the future demand.

Uptake of Rainwater Harvesting

Sri Lanka has used rainwater for both domestic and agricultural use for many centuries. Traditionally, rainwater is collected for domestic use from tree trunks using banana or coconut leafs, and from rooftops into barrels, domestic containers and small brick tanks. In recent years there has been revival of rainwater harvesting and much research has been conducted to improve the technology. In 1995, the Community Water Supply and Sanitation Project (CWSSP), initiated by the government of Sri Lanka with the World Bank funds, introduced rainwater harvesting as a water supply option in two districts: Badulla and Matara (Heijnen and Mansur 1998). This project initiated the emergence of the Lanka Rainwater Harvesting Forum (LRWHF), which is an NGO actively engaged in promoting rainwater harvesting in the country. LRWHF promoted the technology and the concept to other parts of the country through demonstration projects, publication in media, workshops, awareness programs and training. As a result, in 1998, following a request from the President of Sri Lanka, the National Water Supply and Drainage Board constructed 73 rainwater harvesting systems in Yatinuwara in Kandy district (Ranatunga 2000). Today there are more than 23 institutions and organization implementing rainwater projects and there are more than 31,000 systems constructed throughout the country (Figure 2).

Rainwater Harvesting Policy and Legislation

In 2005 the government of Sri Lanka, realizing the importance of rainwater harvesting as a solution to overcome the water scarcity in the country, passed a national policy on rainwater harvesting. The policy objective is aimed at encouraging communities to control water near its source by harvesting rainwater.

The policy was followed by necessary legislation which was gazetted on April 17, 2009, to amend the Urban Development Authority By-Laws on drainage, which makes rainwater harvesting mandatory in certain categories of new buildings in areas under municipal and urban council jurisdiction.

Technology Improvement

The CWSS Project designed five cubic meter volume tanks, taking into account the size of the catchment, frequency and intensity of rain fall in the project area and domestic consumption. On the basis that, a family of five should have a minimum of 20 liters per day for a period of 50 days (maximum dry period in the two project districts). Thus 5 x 20 x 50 = 5000 liters, or five cubic meters (5 m^3). Following some trials, two options were offered: an underground brick tank modeled after the Chinese biogas digester and a free standing Ferro cement tank (Figure 3).

The 5 m^3 capacity was designed mainly for wet zone localities, where the CWSS Project was operating. Later, when the technology was spread to other drier parts of the country, the capacity of the tanks was increased to 7.5 m^3 for households and 10 m^3 and above for institutional usage.

The LRWHF in collaborative research program with Warwick University of UK designed Ferro cement partial underground structures of 10-50 m^3 capacity (Martinson et al 2002)

Rainwater Quality

Rainwater is one of the purest sources of water available, as it does not come into contact with many of the pollutants often discharged into local surface waters. It comes free and can be used to supply both potable (drinkable) water and non-potable water.

Studies of water quality of the collected rainwater from various project sites in several districts reveal following results:

- The pH was high in the new rainwater tanks due to cement dissolving. This improved after the tanks were washed and flushed several times.
- WHO recommended standards on conductivity of drinking water were maintained in all the rainwater harvesting tanks.
- WHO recommended standards on the total hardness of drinking water were maintained for all rainwater tanks.
- All rainwater harvesting tanks passed the WHO recommendation on turbidity for drinking water.
- Over 40% of the tested rainwater tanks recorded no Escherichia coli (E. coli), which is the WHO recommended value for drinking water. In more than 55% of the rainwater tanks, the E. coli levels are less than 10 in 100 ml of water, WHO low risk value (Ariyananda 2003).
- Having a simple charcoal and gravel filter and first flush systems reduces the contamination levels in the tanks markedly (Ariyabandu 1999).
- E. coli levels in the tanks receiving rainwater from G.I. roofs are less than from other roofs due to heating of the G.I. roofs, which results in killing the E.coli on the roof (Vasudevan et al 2001)
- Mosquito breeding is reported in some tanks. If the tank is tightly sealed, however, it serves both in preventing the breeding of mosquito larvae and the growth of algae, and thereby improves the quality of the harvested rainwater.

Earlier studies have shown on an average only 10-15 % of beneficiaries use rainwater for drinking purposes (Ariyabandu 1999). One of the reasons for the non-acceptability of rainwater for drinking purposes was the peoples' perception of quality (Ariyananda 2000). The presence of leafs and other materials including mosquito larvae and other insects, and rodents, as well as water color and taste are the major parameters they use to perceive quality. Improvement in technology and more effective awareness has brought about an increase in use of rainwater for drinking. Recent studies on the third ADB-funded Water Supply and Sanitation Project have shown that up to 80-90% of the beneficiaries use rainwater for drinking.

Ferro cement above ground tank | Brick under ground tank | Partial under ground Ferro cement tank

Figure 3: Different Types of Rainwater Harvesting Tanks

Social Aspects

The most significant impact of the rainwater harvesting system in Sri Lanka is the ensured supply of water in the homestead. Domestic rainwater harvesting system increased the use of water per capita from 28 lpcd (liters per capita per day) in non-beneficiary households to 43 lpcd in beneficiary households (Ariyabandu 1999). The harvested rainwater that is stored in the tanks also acts as a source of water for small-scale home gardens. It also has introduced water conservation practices with use of drip irrigation and water management systems. Mushroom cultivation, poultry and goat rearing and running of boutiques are some of the economic activities that households are able to engage in as a result of having a rainwater harvesting tank. Increased use of water for toilet and washing purposes is seen in beneficiary, and households will indirectly achieve improvement in personal health.

Social aspects too have been improved in the beneficiary households, mainly from saved time on fetching water. Households were found to save 30% of their time on fetching water after establishing a rainwater tank. The time saved is spent with family members especially with the children, to help in their schoolwork. They are also better able to cook and serve meals on time. When a visitor comes home they do not worry about water, even to prepare a cup of tea. It also facilitates them to participate in community activities like attending in village meeting, shramadana (shared labor activities), and other social functions like weddings and religious events. As a result, the strength of the village community is also increased due to their commitments in the above activities. Most of the rainwater beneficiaries try to manage with the available water and thereby household water management skills are also improved. Beneficiaries living in hilly areas have less strain on their back from climbing and carrying water long distances. In certain areas, the incidents of snakebites and harassment have come to an end as the women are no longer forced to fetch water at night. The beneficiaries also try to increase community economics by improving their systems using locally available materials. The strong community contribution makes them more independent and gives more value to the concept of domestic rainwater harvesting. Project planning and implementation through community-based organization has brought about strengthening of local organizations and skill development of these organizations. The skills and livelihoods of local masons have also increased.

Conclusions

Rainwater harvesting has brought much relief to rural people of Sri Lanka during times of drought, water scarcity and recently to those affected by the devastating tsunami of 2004. Rainwater harvesting in urban areas has improved many functions:

- supplementing piped water for non-drinking purposes thus conserving piped water,
- reducing cost of water treatment,
- reducing energy cost of pumping,
- reducing water bills, and
- reducing flooding in certain cities.

Rainwater collection in commercial and public buildings has particular advantages resulting from large roof areas.

As with any new technological intervention, rainwater harvesting also needs changes in the public and community attitudes, perceptions and behaviors if the new technique is to be successful in terms of social, economic, cultural and environmental factors.

One of the major disadvantages of roof rainwater harvesting technology is that it requires a higher capital investment initially for the construction of storage cisterns and other supplementary components. The cost is much higher when the rainfall is low and there is a longer dry period, which results in the need for a larger cistern to ensure water security.

The success of any technological intervention also depends on its cost and affordability by users. Therefore, the use of an appropriate tank size and use of less and cheaper materials, less labor and simple construction aids are important factors to reduce the cost of construction. In this regard, some supportive mechanisms such as loans and subsidies can be effectively used to promote the technology among poor families. In the past, the use of subsides has shown positive results in introducing rainwater harvesting systems among rural poor (Gould and Petersen 1999).

Rainwater harvesting as a domestic water supply has similar potential in other countries within the region. This was recognized during a recent International Workshop on Rainwater Harvesting held in Kandy, Sri Lanka in 2006, where five SAARC (South Asian Association for Regional Cooperation) ministers signed a declaration to promote this concept in their countries. It was further emphasized during the SAARC Summit held in Colombo, in 2008 (SAARC Declaration 2008).

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