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INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Rainwater harvesting for domestic use in Sri Lanka

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SRI LANKA IS striving to achieve the goal of "water for all" by the year 2010. Surface water and water from aquifer is under pressure due to urbanisation, deforestation and pollution. To meet the growing demand on water supplies new types of water sources need to be developed.

Sri Lanka is divided into 3 major zones, wet zone, dry zone and intermediate zone within which eight coherent rainfall zones has been identified by Chandrapala (1996) (Figure 1). All sources of water supply in the country derive from the rainfall received. Rainfall in the country exhibits a regional and a seasonal variation. The dry zone gets rainfall from Northeast monsoon from November-April and wet zone from Southwest monsoon from May to October. Sri Lanka has more than 75 per cent of area with minimum of 1250 mm annual average rainfall. Rainfall in all zones is adequate to initiate rain water harvesting.

Rain water harvesting has been practiced in Sri Lanka for many centuries, a good example is the sophisticated rain water-cum-reservoir systems in 5th century Sigiriya fortress complex. In recent years many of these rain water collection skills have become obsolete due to introduction of pipe supplies, boreholes or protected wells or springs. However the pressures of increasing population and competition for resources has forced people live in areas that have less water resources. In certain parts of the dry zone, the coastal belt with salt water intrusion into the ground water, and some uphill localities in the wet zone, rain water harvesting remains an important, and sometimes the sole, source of water. In the last 10 years there has been revival of rain water harvesting and many researches were conducted to improve the technology. Lanka Rain Water Harvesting Forum formed in 1996, aims to foster, disseminate and research into the potential of utilising rain water as an option for domestic water supply in Sri Lanka.

Rain water harvesting in the CWSSP

Community Water Supply and Sanitation Project (CWSSP) is implemented by the Ministry of Housing and Public Utilities and it is a joint initiative of the Government of Sri Lanka and the World Bank. The objective of the CWSSP are to initiate and construct rural water supply and sanitation infrastructure with community participation and establish institutional structures that enable the community to operate, maintain and manage this infrastructure. CWSSP operate on 3 wet zone districts; Badulla, Matara and Ratnapura. Since January 1994, through the participatory process CWSSP has been able to offer communities 158 schemes of gravity water supply schemes with stand posts and house connections, shallow dug wells, tube wells with hand pumps and motorized pumps schemes. However, at the end of 1994 the project implementers realized that several communities living in hilly areas could not be served with the available technical options. In 1995 a study was conducted to look at the feasibility of rain water harvesting to provide a service to the uphill settlements. The objective of the study was to design and construct low cost rain water harvesting storage tanks and to gather existing information on rain water harvesting in the country.

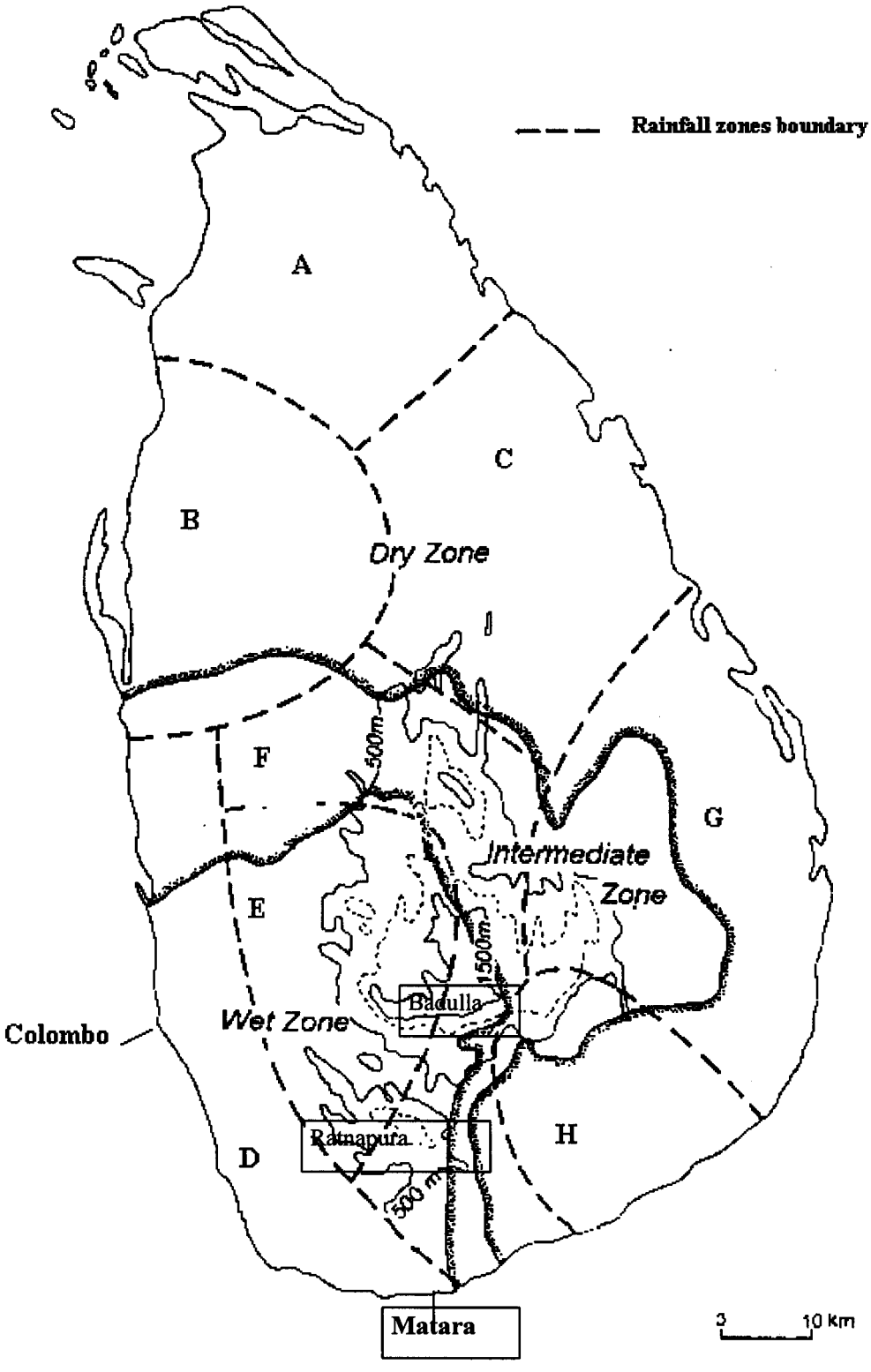
Study revealed that rain water harvesting for domestic purposes was extensively practiced in Sri Lanka (Hapugoda, 1995). However, many of these traditional rain water collecting techniques lack adequate storage capacity and collect water during the rainy season only.

Taking into account the catchment area (size of the roof, average 60 m^2), frequency and intensity of rain fall minimum (50 dry day period), and domestic consumption, a 5m^3 tank was designed by the CWSSP study. On the basis that a family of 5 should have a minimum of 20 l each per day for a period of 50 days (dry period). Thus 5 x 20 x 50 = 5000 l or 5m^3. Following some trials, two options were offered: an underground brick tank modeled after the Chinese biogas digester and a free standing ferrocement tank. Initially rain water option was rejected by the majority due to various social and health reasons. The project implemented demonstration units at a village called Dematawelihinna in the Budullla district. From there the concept was picked up very quickly, specially by the women and today there are over 5000 applications in Badulla alone.

At current prices the brick tank is within the CWSSP subsidy limit with 20 per cent obligatory household contribution in the form of unskilled labour. The ferrocement tank requires an additional Rs. 1,500 from the household. To build the brick dome tank a few pieces of bamboo and some wooden planks are needed and, a metal frame is used to give the ferrocement tank the required rigidity before the plastering can start. The Frame can be constructed for Rs. 5,000 which can be reused to construct 100 tanks.

User pattern and durability

Study of the CWSSP units in 3 villages at Demawelihinna, Dikapitiya in Badulla district and Katiyape in Matara district (Ariyabandau, 1998) revealed that less than 10 per cent of the users drink rain water and the main uses of rain water are for washing (clothes and face)and toilet purposes. The main reason for not using rain water for drinking was



(Adapted from Chandrapala, 1996)

Figure 1. Coherent rainfall zones of Sri Lanka

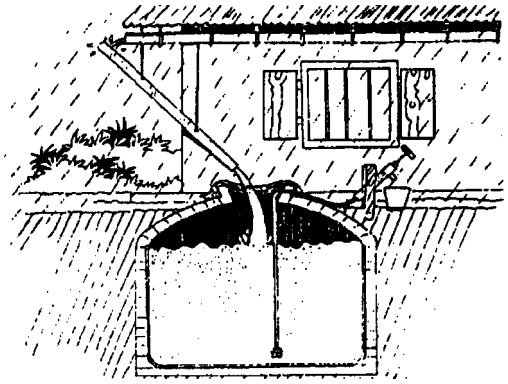


Figure 2. Underground brick dome tank

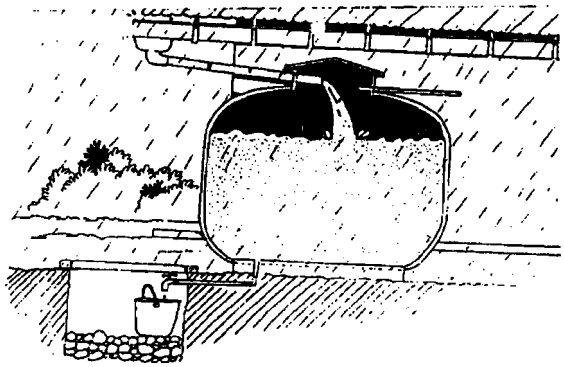


Figure 3. Above ground ferrocement tank

Table 1. Cost estimates for brick and ferrocement Tanks (H. Heijnen and U. Mansur, 1998)

Description	*Unit*	*Rate*	Brick Tank		Ferrocement Tank	
			Quantity	*Total in Rs.***	*Quantity*	*Total in Rs.*
Cement	Bags	310	8.50	2635	8.00	2480
Sand	Cubes	1700	0.40	680	0.60	1020
0.75" Metal	Cubes	4000	0.10	400	0.06	240
Brick	Nos.	2/10	800.00	1680		
Padlo Cement	Kg.	100	0.50	50	0.50	50
Chicken Wire	Sq.m.	40			40.00	2200
Binding Wire	Kg.	85			1.00	85
Skilled Labour	Days	250	4.00	1000	8.00	2000
Total Rs.				6445		8075
Unskilled labour	Days	150	12.00	1800	14.00	2100
Total				8245*		10175*

* Costing are inclusive of transport
** Rs. 69 = US $1

due to attitude that water collected from the roof is not fit for consumption. Also since the earlier built CWSSP tanks lack tank lids and filter units some were found to be contaminated with debris from the roof and breed mosquitoes.

Although there has been few leaks reported in the tanks (both under ground and above ground) these are thought to be due to bad construction rather than a fault of the design of the tank.

Water quality

Initially, only the storage tank was provided by CWSSP and beneficiaries had to include the lid of the tank, gutters, pipes, first flush device and a simple gravel filter in their system. People who included such devices in their systems found improvement in the quality of water. Subsequently, filters and the lids of the tanks were also provided by CWSSP and made it compulsory for all types of tanks to prevent contamination. The tight cover ensure dark storage conditions preventing growth of algae and breeding of mosquito larvae. A simple hand pump was also designed to extract water from the underground tank which was later included in the subsidy.

Comparative study of the water quality of the traditional rain water tanks with CWSSP tanks indicated that chemical and physical quality of rain water collected in both types of

Table 2. Water quality data from the two types of rain water harvesting tank systems

Location / types *of tank*	No. of *samples*	*pH*	*Colour*	Turbidity	*Conductivity*	Total Colioform per 100ml	E. Coli per *100 ml*
Open rectangular tanks (Ahspokuna)*	18	6.0-7.50	5-110	5-15	50-200	04-1000	00-180
CWSSP tanks (Baddulla)**	39	6.5-10.00	10-40, 100	0-16	45-229	0-170	0
Drinking water WHO standard		6.5-8.5	0-30	0-20	5-1500	10	00

* Padmasiri (1998) **Mansur (1999)

tanks are similar (Ariyananda 1999). However, bacterial quality of the rain collected in the CWSSP tank was much superior and meets the required standards.

Advantages and disadvantages of collected rain water

Advantages

- Water is available at household, time and energy is saved on collecting water
- Simple technology and is easy to maintain
- System is independent and can be managed at household level.
- Local material and skills can be used for construction of the system.
- Water collected can be kept in high quality and safe with simple precaution.

Disadvantages

- The high initial cost of building the permanent storage facilities
- Water is mineral-free and has a flat taste and not popular for drinking.
- The quantity of available water depends on the size of the rainfall catchment area and storage capacity.
- The user must learn to ration the use of water during the dry season.
- Inadequate management and maintenance can lead to contamination.

Conclusion

In Sri Lanka, rain water-harvesting remains neglected due to lack of awareness and recognition by the policy makers on the technology. Initial cost of the tank is still high for most householders. Therefore a government subsidiary or a credit facility scheme should be developed to encourage these groups. Success at Badulla and Matara in the wet zone indicates scope for expansion into dry and intermediate zone of the country.

Awareness programs on maintenance and operation of the system should be a mandatory requirement for all rain water harvesting program to ensure collection of good quality water. Simple techniques of improving the quality of stored water to meet the drinking water quality standards should be incorporated into the system.

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