

RUN OFF RAINWATER HARVESTING

THE PATH TO ENHANCED LIVELIHOODS

Introduction

Even though agriculture is an integral part of rural livelihoods of communities all over the world, there are many instances when farmers in water scarce areas are unable to succeed in their agricultural ventures due to the unavailability of water at correct time in required quantities.

The aim of this Technical Brief is to create awareness of a successful method of “run off rain water harvesting” which can be effectively used by resource poor farming households, to overcome the hardships of nature. This method has been developed over a long period of time by various institutions experts and community members, and people working with men and women who live in drought situations.

Rainwater for Agriculture

Rain fed agriculture is not a novel idea to drought affected areas. As a counter measure to the unpredictability of rain, communities developed various agricultural practices to suit ‘low water intensive’ agriculture. Rainwater harvesting is one such method. In Sri Lanka, the first evidences of rainwater harvesting can be traced back at least 2500 years to ancient civilizations. The use of rainwater harvesting for agriculture has become common as a result of the intermittent nature of rains in many Asian counties and is widely practiced in areas where there is a failure of the seasonal rains, or drier climatic conditions persist for most part of the year. Rainwater harvesting is a viable option for areas with two or three scattered rainy seasons. In Sri Lanka, even the driest area would get an average annual rainfall of 1250mm. In Sri Lanka, rain occurs only during four months of the year and during the remaining eight months the rainfall is minimal.

Therefore, rainwater harvesting technology helps to store water in rainy seasons, for usage, during the drought season.

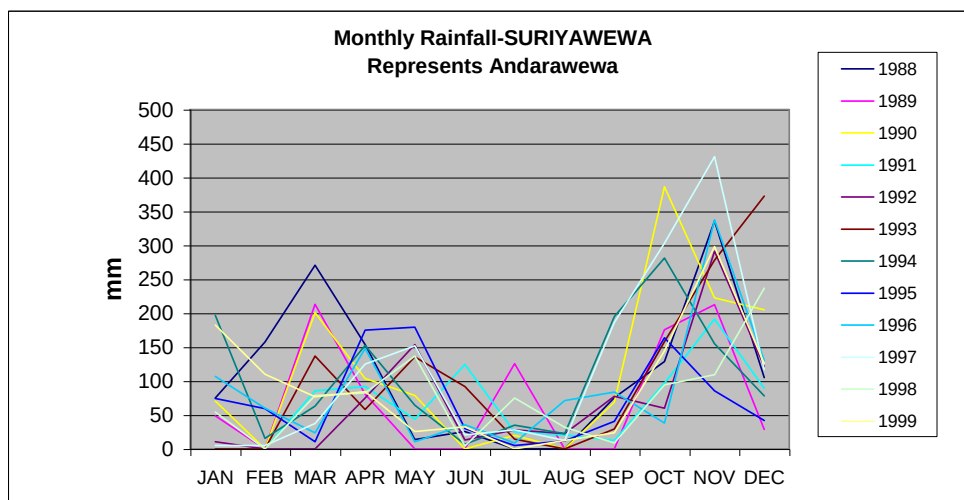


Figure 1: Rainfall pattern in Suriyawewa - Hambantota District

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As an example, the rain fall pattern in Suriyawewa divisional secretariat, in Hambantota district is shown in figure 1, which clearly highlights that rain is mainly received during the four months; March - April and October - November.

“Not even a single raindrop should be allowed to flow into the sea without having made use of it for the benefit of the people” - King Parakramabahu the Great (1153-1186AD), Pollonnaruwa Era

Sri Lankan ancestors were successful in harvesting rainwater through a cascade system of massive tanks. The following data (table 1) indicates the scale of ancient irrigation tanks in which rainwater harvesting was an integral part of their irrigation management.

Name of the Tank	Extent (acres)
Parakrama Samudraya	6614
Kalawewa	6380
Minneriya wewa	4670
Kantale wewa	3263
Nuwara Wewa	2960

Table 1: Major constructed tanks in the Dry Zone Sri Lanka tanks

These tanks were built to irrigate vast areas and support a large population. The rainwater tanks described in this brief are on a domestic scale, that can store about 10,000 litres of rainwater at a time, and sufficient to irrigate a quarter or half an acre of land, to successfully grow 35-40 perennial crops such as – `Jak` (*Artocarpus nobilis*), coconut (*Cocos nucifera*), pomegranate (*Punica granatum*), orange (*Citrus* spp) and mango (*Mangifera indica*).

What is rainwater harvesting?

Managing, controlling and making use of rainwater in-situ or within the vicinity of rainfall is termed as rainwater harvesting.

Run off rainwater harvesting

In this method of collecting rainwater for irrigation, water flowing along the ground during the rains will be collected to a tank below the surface of the ground. The tank is constructed using bricks, which are coated with cement. During storage, it is important to incorporate efficient and effective water conservation methods – by reducing evaporation and also by adopting efficient irrigation techniques. It is a very ‘easy to adopt’ technology proven with many communities in the country that if used properly can be very profitable.

Step-by-step procedure of run off rainwater harvesting

Selecting a location for the construction of a rainwater harvesting tank

- Observe the direction of the surface flow of rainwater in the land.
- Even though some believe that such tanks should be constructed in the lowest lying area of the land, this is not essentially so. Due to the seasonal patterns of rainfall and the high intensity of rains received in Sri Lanka, it is possible to fill a 12,000 litre capacity tank without much difficulty.
- The tank may be subjected to cracks due to the root zone activities (i.e. ramification), therefore, it is advisable not to construct the tank in close proximity to large trees.
- The tank should be close to the area of cultivation to ensure ease of irrigation.

- The tank should not be in close proximity to the house or to paths /roadways as it is possible for children and even negligent adults to fall in. As an additional security measure, construct a fence around the tank.
- The opening of the tank should be to the direction of the flow of rainfall. It is not advisable to obstruct patterns of natural flow of water as there is a possibility of mud and other waste getting into the tank. (The mud filters function only when the water flows directly through them).

Things to be bare in mind

- If a very strong current of water is flowing it could place the tank in jeopardy.
- If by construction of the tank, the natural water flow is obstructed, soil erosion can occur and crops can consequently be destroyed.

Constructing the rainwater harvesting tank

- Clear the selected land thoroughly. Flattening the land is important for ease of taking measurements.
- It is advisable to construct a circular tank as it will withstand greater pressures.
- Determine the quantity of water required for irrigation purposes.

In such instances, the following factors should be considered;

- a.) The rainfall pattern of the area. (If the area experiences regular rainfall throughout the year, a small tank of 4000-5000 litres would suffice, whereas in particularly dry areas which experience dry spells for about 6 months of the year, it would be beneficial to store as much water as possible.)
- b) The extent of land, which is proposed to be cultivated
- c) The amount of investment that can be made.

The tank should not be more than 1.75 m in depth in order to withstand the pressure of the water. Low depth makes cleaning and use of the tank easier.

The chart given below can be used as a guide to determine the radius of the tank.

Capacity of tank (Litres)	Radius of tank (Meters)
5000	0.9
6000	1
7000	1.125
8000	1.2
9000	1.275
10000	1.35
11000	1.425
	1.5

Table 2: Capacity according to the radius of the tank

- Take a length of rope as long as the radius and tie it to a wedge. Plant the wedge at the place you want to be the centre of the tank and draw a circle.



Figure 2: Measurement taken for radius of the tank



Figure 3: Pit for the tank construction

- Now dig-out the soil within this circle.
- The tank should have a slope of about one foot from the periphery to the middle of the tank. Figure 4 will give a side view of the tank.

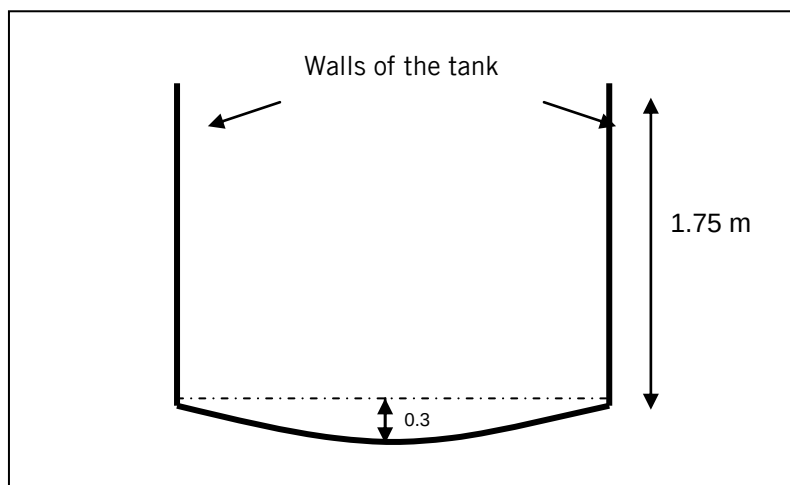


Figure 4: Cross section of a tank

- After the soil has been removed, a 10 cm slab of concrete has to be laid at the bottom of the tank. The ratio of sand, cement and metal stone in the concrete mixture should be 1: 2: 4
- After the slab of concrete is hardened and has completely dried, construct the walls one foot in height from the inlet with a width of one brick. It is important to use bricks with dimensions of: 5cm x 10cm x 23cm for this purpose. The cement mixture should have a ratio of cement to sand of 4:1.



Figure 5: Wall construction of the tank on the concrete base

- As the water inlet is connected to the tank at the ground level, hence, the water inlet wall should not be raised above the surface level.



Figure 6: Measurement taken for the inlet construction

- The mud filters are attached to the water inlet. Hence the door has to be sturdy. As depicted in the picture below, a concrete slab measuring in metres 0.75m X 1m (height and length) should be laid near the door.



Figure 7: Concrete base for the inlet construction

- When constructing the water inlet, it is necessary to face it in the direction of the natural water-flow of the garden. As the mud filters should be placed around this door, a drain should be constructed close to the inlet of 0.5 meters (near the door) and 1 metre width. The total length of this drain should be 1 metre.

Mud filters

- Various waste items are present in flowing water. Mud, sand and gravel deposits in the tank will lessen the quantity of water that can be stored in the tank. Therefore mud-filters are used as a simple method of reducing the flow of waste items into the tank.
- Construct 2 brick bunds in the shape of a 'V' on either side of the drain, which is constructed near the inlet. Two other small bunds of about one brick (10 cm) high should be constructed across the 'V' shaped bunds. They should be placed in 45 cm and 85 cm from the inlet.
- From these 2 small bunds, the one closer to the tank should be a 0.75 cm lower than the inlet bund. The external bund should be constructed 0.75 cm lower than the internal bund.

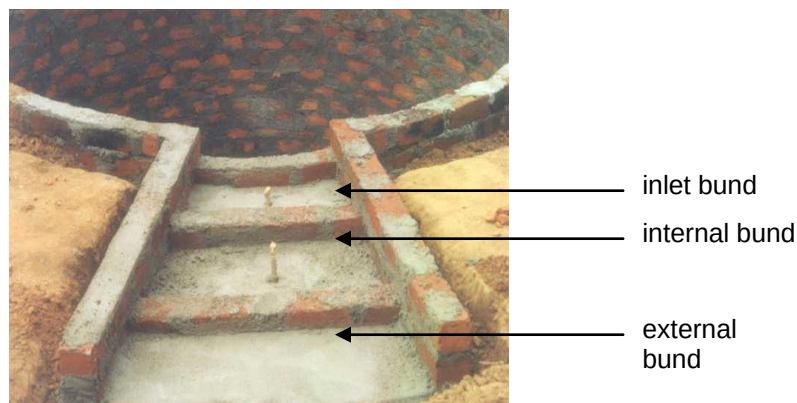


Figure 8: Bunds of the inlet before plastering



Figure 9: Inlet of the run off tank after plastering

By construction of bunds with a gradual rise towards the tank, it is possible to retain waste items, that flow in with the rainwater, in silting chambers located within the bunds

- In the opposite direction of the inlet-door, a 22 cm spill space (outlet) should be constructed in order to facilitate the flow of excess water. It is important to make this a 1.25 cm higher than the inlet-door.



Figure 10: Outlet of the tank



Figure 11: Completed tank before plastering

- Now plaster the tank completely with cement. In this case you should plaster the outside of the tank about 15 cm above the ground level.



Figure 12: Plastering the tank

- You would have observed an empty space of several inches, which has been left around the tank during the construction, to facilitate the process of construction. This empty space should be filled tightly with sand. Sand is used for the filling of this space as it can be packed tightly and is not easily subjected to decomposition. In the instance of repairs being needed for the tank, this sand layer will allow access to the tank.
- If maintained properly, it will be possible to use the rainwater-harvesting tank with ease, for about 15 years.

Best practices of operation and maintenance

- When the water in the tank becomes empty remove all soil deposits and other waste products from the bottom of the tank and clean it well.



Figure 13: Run off rain water collection to the tank

- A small thatched hut and fence should be constructed around the tank to reduce the evaporation of water and for the security of children & domestic pets.
- Do not let water-plants grow in the tank as these will increase water loss through evapotranspiration.
- Still waters are breeding grounds for mosquitoes, therefore fish which prey on mosquito larvae eg. 'Korali'- *Oreochromis mossambicus* should be introduced into the tank.



Figure 14: After the completion of the rainwater-harvesting tank



Figure 15: Thatched hut, fence protecting the rainwater harvesting tank

Estimation of costs for a run off tank with 10000 litre capacity

Item Description	Cost of a unit	No. of units	Total cost in SL Rs.
Cement	6.50 Rs per kg	600 kg	3900/-
Water proof cement	80 Rs per kg	500 g	40/-
Bricks	1.50 Rs	1600	2400/-
Sand	1600 per m3	1 m3	1600/-
Metal Stones	3200 per m3	0.25 m3	800/-
Transport	Varies		1500.00/- generally
Mason fees	350 Rs a day	7 days	2450.00/-
Unskilled labour	275 Rs a day	12 days	3300/-
Total			15990.00/-

1 Sri Lanka Rupee (LKR) = 0.005374 British Pound (GBP)

How to use water efficiently for irrigation

Pitcher irrigation is an efficient method of low cost irrigation. It can be adopted in any location. In the pitcher irrigation, unglazed clay pots are used to distribute water by seepage action through the wall of the pot. This saves over 90% of water over traditional surface irrigation systems and produces higher plants yield than any other traditional or improved irrigation practice. Around 6 - 10 litre pots are sufficient to grow most of the crops. The number of pitchers needed varies with the crop density and the type of crop.

It is important to cover the pots to minimize evaporation losses. Deep percolation losses are also minimized under this method. When planting on a slope place pitchers by the side of the plants, rather than above or below the plants, to minimise wastage.



Figure 16: Plant with pitcher irrigation



Figure 17: Citrus tree in home garden

References and further reading

- [The Underground Brick Dome Tank, Sri Lanka - A Case Study](#) Practical Action Technical Brief
- [Underground Rainwater Harvesting](#) Practical Action Technical Brief
- *Wisdom of traditional collection of rainwater for domestic use* by Ariyabandu R D E S, Lanka Rain Water Harvesting Forum, 1998
- *Water Harvesting: a manual for the design and construction of water harvesting schemes for plant production* by Critchley W, Siegert K, Food and Agriculture Organization of the United Nations (FAO), 1992
- [The Sri Lankan 'Pumpkin' Tank ~ Case Study](#) Practical Action Technical Brief
- [Cement Mortar Jar ~ Case Study](#) Practical Action Technical Brief
- [Rainwater Catchment Systems for Domestic Supply](#), by John Gould and Erik Nissen-Petersen, Practical Action Publishing 1999.
- [Ferrocement Water tanks and their Construction](#), S. B. Watt. Practical Action Publishing 1978
- [Rainwater Harvesting: The Collection of Rainfall and Runoff in Rural Areas](#), Arnold Pacey and Adrian Cullis Practical Action Publishing 1986
- *Water Harvesting – A Guide for Planners and Project Managers*, Lee, Michael D. and Visscher, Jan Teun, [IRC International Water and Sanitation Centre](#), 1992
- *Water Harvesting in five African Countries*, Lee, Michael D. and Visscher, Jan Teun, [IRC / UNICEF](#), 1990. As snapshot of the status of RWH in five African countries.
- Waterlines Journal [Vol. 18, No 3](#), January 2000 and [Vol. 14, No.2](#), October 1995 Both issues are dedicated to rainwater harvesting, available through [Practical Action Publishing](#)
- Photo-manuals by Eric Nissen-Petersen. A range of manuals on how to build a number of tank types including: cylindrical water tanks with dome, an underground

tank, smaller water tanks and jars, installation gutters and splash-guards, available from the author at: P.O. Box 38, Kibwezi, Kenya.

- Rainwater Catchment Systems – Reflections and Prospects, John Gould, Waterlines [Vol.18 No. 3](#), January 2000.
- Domestic Water Supply Using Rainwater Harvesting, by T.H.Thomas, Director of the Development Technology Unit (DTU), University of Warwick. The article is available on [DTU's Website](#)
- [Waterlines back issues](#) containing rainwater harvesting articles: Vols 17(3), 16(4), 15(3), 14(2), 11(4), 8(3), 7(4), 5(4), 5(3), 4(4), 4(3), 3(3), 3(2), 3(1), 2(4), 2(1), 1(1).

Video

- [Mvua ni Maji – Rain is Water, Rainwater Harvesting](#) by Women's Groups in Kenya, FAKT, 1996. 27 min VHS/PAL. A Kenyan film team documented this success story on the occasion of the visit of a delegation of Ugandan women who came to learn the skills of rainwater harvesting from their Kenyan sisters. Available through FAKT
- [A Gift from the Sky – An Overview of Roofwater Harvesting in Sri Lanka](#). Available from the Lanka Rainwater Harvesting Forum
- *Construction of Water Tanks for Rainwater Harvesting* – a video manual prepared by Eric Nissen-Petersen (see above).
- *Rock Catchments*. Several designs of rock catchment system looked at in detail by Erik Niseen-Petersen.

Useful contacts

**Development Technology Unit,
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<http://www2.warwick.ac.uk/fac/sci/eng/research/civil/crg/dtu/>

- a number of case studies from around the world, with good descriptions.

Contact Dr Terry Thomas. Also the co-ordinators of the Rainwater Harvesting Research Group (RHRG) <http://www2.warwick.ac.uk/fac/sci/eng/research/civil/crg/dtu/rwh/links/>

International Rainwater Catchment Systems Association (IRCSA)

Dept. of Natural Resources, Chinese Cultural University, Hwa Kang, Yang Min Shan, Taipei, Taiwan.

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Website: <http://www.ircsa.org/>

IRCSA Fact sheets <http://www.ircsa.org/factsheets.htm>

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Kenya Rainwater Association

P O Box 72387, Nairobi, Kenya

E-mail: kra@net2000ke.com

United Kingdom Rainwater Harvesting Association

Website: <http://www.ukrha.co.uk>

The Pelican Tank Rainwater Collection System - a packaged RWH collection system developed in Australia for use in developing countries

<http://www.trade.altconcepts.net/>

SimTanka

<http://simtanka.sourceforge.net/>

software for sizing reliable rainwater harvesting systems with covered storage tanks – SimTanka, is freely available.

JRCSA (Japan Rainwater Catchment Association)

<http://takeyam.life.shimane-u.ac.jp/jrdsa/homepage.html>

SA WATER (South Australian Water Corporation)

<http://www.sawater.com.au/sawater/>

Centre for Science and the Environment (CSE)

<http://oneworld.org/cse/html/cmp/cmp43.htm> -

Rainwater harvesting page - a very active Indian Group

Sunstove

<http://www.sungravity.com/>

The Sunstove Organization's web site provides free instructions, photos, drawings and specifications to build a roof catchment system, sand filter, cement water tank, and spring capping systems

Global Applied Research Network (GARNET)

<http://info.lut.ac.uk/departments/cv/wedc/garnet/tncrain.html>

Site of the Global Applied Research Network (GARNET) Rainwater Harvesting Page –

<http://www.unep.org/publications/> - link to a recent UNEP publication titled 'Sourcebook of Alternative Technologies for Freshwater Augmentation in Small Island Developing States' that includes some useful information on RWH

<http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-8e/index.html>

Sourcebook of Alternative Technologies for Freshwater Augmentation in Some Countries in Asia - another in this series of **UNEP publications**

World Meteorological Organisation (WMO)

<http://www.wmo.ch/>

Rainwater Harvesting in the Loess Plateau of Gansu, China - a paper presented at the 9th **IRCSA** Conference in Brazil

<http://www.greenbuilder.com/sourcebook/Rainwater.html#CSI> - Sustainable Building Sourcebook Website

Information Centres

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Website: <http://www.ait.ac.th/>

[Center for Library and Information Resources \(CLAIR\)](#)

[International Ferrocement Information Center \(IFIC\)](#)

WELL

<http://www.lboro.ac.uk/well/resources/technical-briefs/36-ferrocement-water-tanks.pdf>
A technical brief on how to make a ferrocement water tank

Roofwater harvesting discussion forum
<http://www.jiscmail.ac.uk/lists/rwh.html>

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