



C2 REVEALING GOOD PRACTICE

Rainwater harvesting

At a glance

Rainwater harvesting (RWH) collects water from rainfall for later use. It is convenient, provides good quality water, and saves time and energy for women and children.

- The most common catchment surface is a roof. Roofs should be made of a hard material that does not absorb water or pollute the run-off. The larger the roof, the bigger the run-off flow, and the more rainwater that can be collected.
- Guttering catches the water falling from the roof and carries it sideways under the edge of the roof to the water store. Sometimes a tube called a downpipe then leads the water from the gutters down into the water store. Gutters need to be kept clean.
- Water is often stored in a tank. A smaller tank is cheaper but holds less water, and may only supply water during the rains. A larger tank is more expensive but will hold more water and will supply into the dry season and possibly throughout the year.
- Decide the size and location of the tank, and what material it will be made from.
- The tank should be covered, but ventilated, with openings sealed with a screen so that mosquitos and insects cannot get it.
- A 'first flush diverter' diverts the 'first flush' of dirty water from the roof (leaves, bird droppings etc) away from the water storage tank.
- Filtering and screening 'holds back' dirt and debris on a surface but lets the water pass through. The waste builds up on the filter and can be removed by cleaning.
- The quality of rainwater harvested in the ways described in this tool is usually high and does not need treating – especially during the rainy season when freshwater is regularly entering the tank. However if it is stored for long periods, bacteria will multiply and it will then need treating before drinking.



Why use this tool?

Rain can provide a source of good quality water that is very easy to access. Rainwater is plentiful during wet seasons, and can be stored to last through at least part of dry seasons as well. The water can be used for cooking and drinking, hygiene, washing, gardens and livestock. RWH is relatively cheap to set up and easy for households to manage. As it is close to the home, it is convenient, and saves time and energy for women and children particularly where the walk to the nearest water source is far, difficult or remote.

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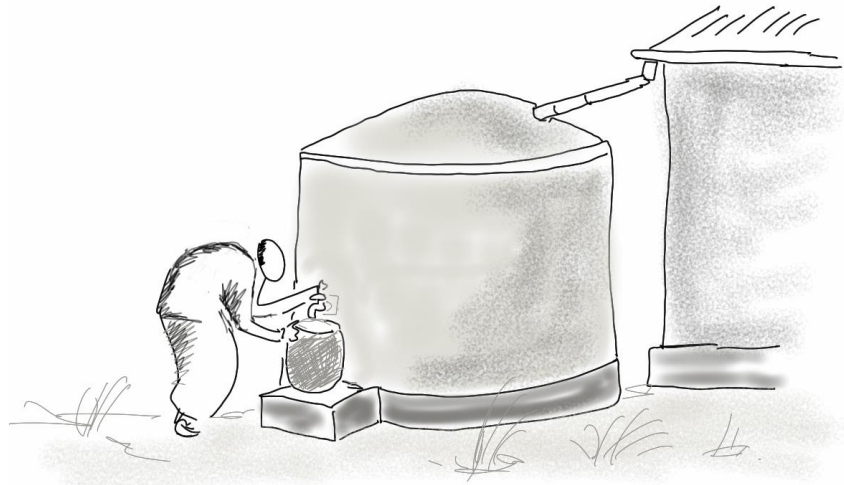
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A brief description

This tool focuses on household- or community- level RWH systems and highlights the important things to think about in designing a system. It describes the different parts of a RWH system and how they can be constructed and maintained.



You will need

The specific tools and materials needed will depend on the type of RWH system being planned. However, there are several components that most RWH systems include:

- a catchment area for the water. In most cases this means a suitable roof
- a water storage tank
- a way to transport the water from the catchment area to the store (guttering and pipes)

Some RWH systems also have other components to make them easier to manage or to improve the quality of the water. These are all discussed in more detail below.



Explaining the words we use

Catchment - the surface on which rain falls and is then collected (usually a roof, an area of ground, or plastic sheeting).

Guttering - an open pipe below a roof which collects and carries away rain.

Rainwater harvesting - the collection, management and use of rainwater.

Roofwater harvesting - a method of rainwater harvesting, using a roof as the water catchment area.

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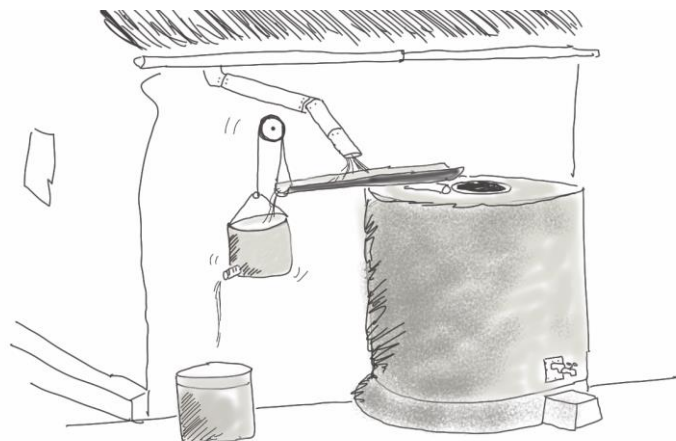
Keys to success

- Ensure all members of a household – especially women – take part in designing, planning and building the RWH system.
- Think carefully about the size of tank needed. A bigger tank is much more expensive, but will store water for longer. A smaller tank is cheaper and easier to build, but will store less water.
- The tank must be kept covered to keep the water clean and safe. Any openings should be covered with a mesh to stop mosquitoes and other insects from entering.
- Ensure that gutters are installed properly with a low gradient (slope) so that water is unable to collect in the gutters and become a breeding ground for mosquitoes.
- Gutters and filters must be kept clean and clear.
- Any screens and covers must be checked regularly.
- Underground tanks (cisterns) must always be covered to prevent people falling in. Build a wall or fence around the tank, in case the cover breaks or goes missing.
- Do not over-clean tanks and avoid scrubbing the walls of a tank. Excessive cleaning destroys a layer of helpful bacteria that forms on the walls.
- Ensure good hygiene in collecting the water from the tank. Do not dip dirty hands or containers into the water tank.



What to do

Here is an example of a roofwater harvesting system. The system has a **catchment** surface (the roof). From the roof, the water travels through **guttering** and a **downpipe** to a **storage tank**. The system includes a simple method of **first-flush diversion**. We will look at each of these aspects below.



Before starting

RWH can either be a main water source for a household, or can add to other sources. In some places, rainwater is much better quality than other sources, and so provides water for drinking and cleaning, while other sources provide water for other uses. In other places, RWH provides *additional* water for handwashing, home gardening, washing clothes etc. Ensure all members of a household take part in designing, planning and building the RWH system, particularly women as they will often be using and maintaining the system, and managing the use of water.

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The catchment

At community and household level, the most common surface for collection of rainwater is a roof. In some areas, roof catchments are built especially for harvesting water. The larger the roof, the bigger the run-off flow and the more rainwater that can be collected.

Many other surfaces can be used for RWH: for example, threshing areas, paved walking areas, plastic sheeting and trees. The principle is simple: catch the rainwater on a clean surface before it hits the ground, and channel into a clean container.

What should roofs be made of?

The roof should be made of a hard material that does not absorb water or pollute the run-off. Options include:

- Galvanised corrugated iron or plastic sheets, or tiles.
- Thatched roofs made from palm leaves (coconut and anahaw palms with tight thatching are best). Other thatching materials and mud discolour and contaminate (through rats) the rainwater.
- Unpainted and uncoated surface areas are best. If paint is used it must be non-toxic (no lead-based paints).
- Asbestos-cement roofing does not pose health risks - no evidence is found in any research. However, the airborne asbestos fibres from cutting, etc. do pose a serious health risk (cancer) if inhaled.

Source: WELL factsheet. See the 'Finding out more' section below.

Groundwater runoff harvesting

Rain water flowing along the ground is collected in a tank below the ground surface. The tank is often constructed using bricks coated with cement. The water is unsafe to drink without proper treatment (filtration and disinfection), but is fine to use for small-scale irrigation and livestock purposes, watering tree nurseries, brick-making etc.

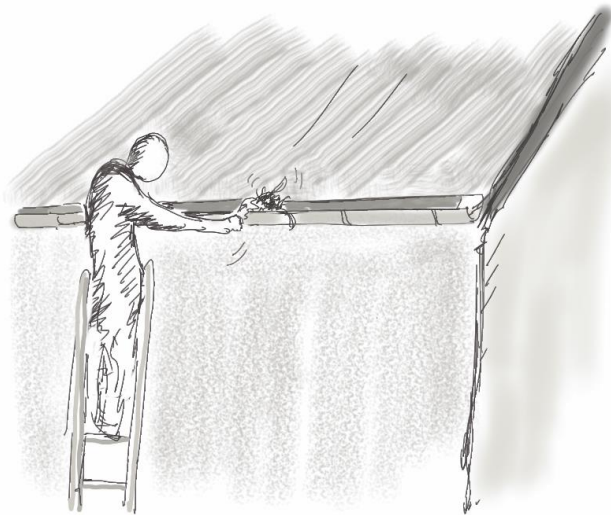
For more information, see **Practical Action's Technical Brief on Runoff Rainwater Harvesting** in the 'Finding out more' section below.

Guttering

Guttering is usually fixed to the building just below the roof. It catches the water falling from the roof and carries it sideways under the edge of the roof to the water store. Sometimes a tube called a downpipe then leads the water from the gutters down into the water store.

Plastic guttering can usually be bought from local trading centres. Guttering can also be made from a folded metal sheet or a plastic pipe cut in half length-wise. Timber or bamboo can also be used, but may need replacing regularly. They should **never** be treated with pesticides if using the water for drinking or cooking.

The most secure way of attaching the gutter to the roof is to use a fascia board. This is a long, straight board that runs across the lower edge of the roof and is attached to the ends of the rafters. Brackets can be mounted to this board to hold up the gutter, or nails can be put through the top of the gutter into the board. An easier and cheaper method is to use wire ties along the length of the guttering. However, this isn't as strong, and the gutter may become loose or change its position during a storm.



Gutters need to be kept clean. They should be swept out with a brush before the rains start and again a few times during the rainy season.

Storage tanks and cisterns

There are many options for small-scale water storage from RWH, including plastic bowls and buckets, jerrycans, jars, empty food containers, etc. However, for storing larger quantities of water, the system will require a tank (above the ground) or a cistern (below the ground).

The water storage tank is usually the most expensive part of a RWH system. The size of tank is important. Tanks vary in size from around a cubic metre (1000 litres) up to 20 or 30 cubic metres. A smaller tank is cheaper but holds less water, and so may only supply water during the wet season (which is still extremely helpful – saving time and potentially difficult journeys to collect water from another source). A larger tank would hold more water and therefore the supply could last well into the dry season and possibly throughout the year.

- **What material will the tank be made from?** Examples include ferro-cement, plastic, concrete, and brick. Are any tanks available to buy locally? If so, are they affordable?

For resources on how to construct a Ferro-cement water tank, see 'Finding out more' below.

- **What size should the tank be?**

What space is available?
How much rainfall is there, and what is the pattern of rainfall (the length of the wet and dry seasons)? How much water will the roof be able to collect? How many people will be using the water, and how much water do they need? Is RWH the main water source, or is additional to another source? In the box below, we include an example of how to calculate the size of the tank using information about how much water a household needs.



Calculating the size of the system

For example,

Consumption per person per day, $C = 20$ litres
Number of people per household, $n = 6$
Longest average dry period = 25 days
Daily consumption = $C \times n = 120$ litres
Storage requirement, $T = 120 \times 25 = 3,000$ litres

This method will only work when there is enough rainfall and a large enough catchment area. In areas of low or unevenly distributed rainfall, more care has to be taken to size the storage properly. **Source: Practical Action Technical Brief**

- **Where should the tank be located?** If the roof has just a single slope (ie no peak in the middle), it is best to locate the tank half way along the roof's lower edge. If the roof has two slopes either side of a central ridge, you could locate the tank at the end of the house where the gutters on both sides can access it. Or, you could consider two tanks, one at either end. Tanks should be sited away from trees if possible. If a cistern is used (under the ground), ensure that tree roots do not damage it, and it is more than 15m uphill from any pit latrine.

The tank will need to include a means for water to be taken from it – rope and bucket or tap. An underground cistern will need a hand or electric pump. The tank should be covered so that light cannot enter. This prevents algae growing. However, it does need to be ventilated. All openings should be sealed with a screen so that mosquitos and insects cannot get it.

While it is important to keep tanks clean, too much cleaning is not good! Scrubbing the walls of the tank gets rid of a layer of good bacteria that helps keep the water clean (it may also be impossible or dangerous to climb inside the tank!). To clean a tank, scoop or wash out any

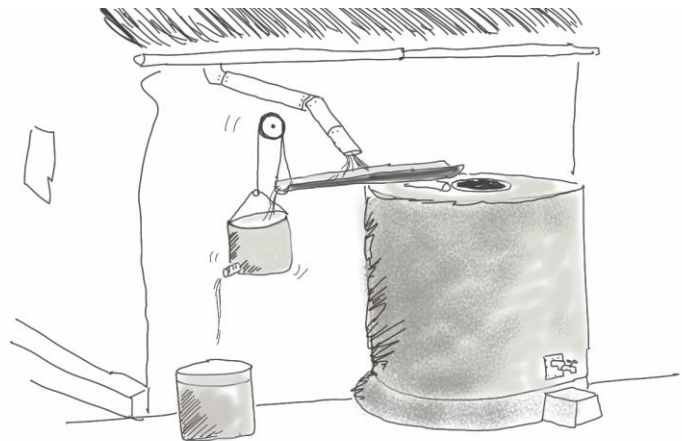
settled matter whenever the sludge level is approaching the level where water exits the tank, or when the water smells.

Extra components

These are found in some, but not all, RWH systems.

First flush diverter systems for rooftop rainwater harvesting

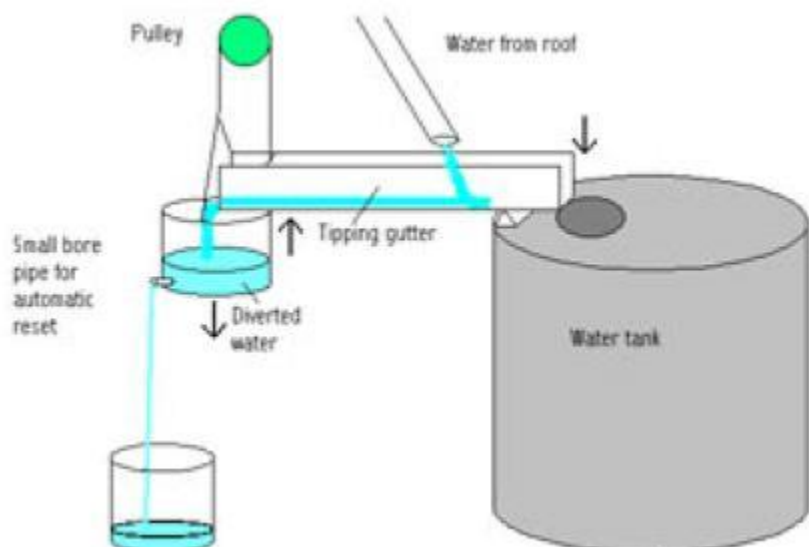
Most of the dirt and debris (leaves, bird droppings etc) on a roof are found in the first few minutes of water run-off from the roof when the rains start. After this runoff has passed and washed the roof, the water is much cleaner. A 'first flush diverter' diverts the 'first flush' of dirty water away from the storage tank and then allows the rest of the rainwater to be directed into the tank.



There are different ways of creating a first-flush diversion system. The simplest method is to move the downpipe at the start of a rain episode so that the water spills onto the ground rather than going into the tank. However, this relies on somebody being at home when the rains start, and that they remember and are prepared to go out into the rain to operate it! Other methods do not rely on somebody operating them. Here are two examples:

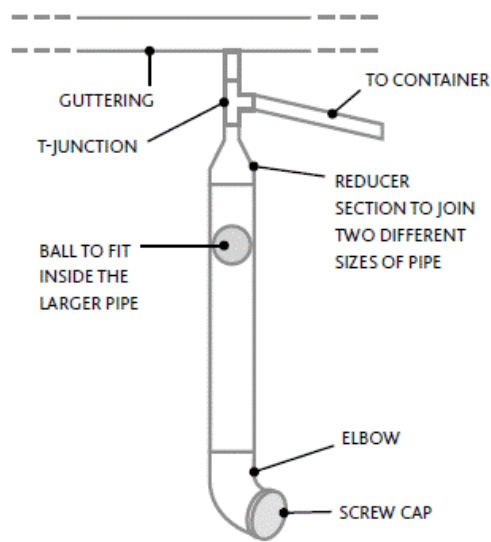
Example 1:

The first flush goes into a bucket, and the weight of this water off-balances a tipping gutter which then diverts the water back into the tank. The bucket then empties slowly through a small-bore pipe and automatically resets. The process will repeat itself from time to time if the rain continues to fall, which can be a problem where people do not want any water to be wasted. In this case a tap



can be fitted to the bucket and will be operated manually. It is possible to change the quantity of water that is flushed by changing the force required to lift the guttering.

Source: Practical Action Technical Brief

Example 2:

The first rainwater will fall down into the downpipe and the ball will float on top and rise with the water up to the reducer section. This reducer section will stop the ball from rising any further and will keep small debris from the roof inside the downpipe. The falling rainwater will then be directed into the container.

At the end of the rainfall, the screw cap at the end of the elbow pipe should be removed to let out the water in the downpipe. The ball will drop and the screw cap can be replaced ready for the next rain.

Source: Footsteps 82 – Natural Resources

Filtering and screening

Filtering and screening involve 'holding back' solid dirt and debris on a surface but letting the water pass through. The waste builds up on the filter and can be removed by cleaning.

Sometimes two filters are used – a course leaf filter and a fine filter. The course leaf filter – often a 5mm grid placed anywhere between the gutter and the entrance of the tank – traps bigger pieces of dirt. The fine filter – a fine mesh screen or a muslin cloth near the entrance to the tank traps the smaller pieces. Any filters used need to be kept clean and clear.

Most fine material that makes its way into the tank will settle within 24 hours and form a sludge at the bottom of the tank that can be removed if it becomes problematic.

Treating the water

The quality of rainwater collected in the ways described above is usually high and does not need treating – especially during the rainy season when fresh-water is regularly entering the tank. Once the rains have stopped and temperatures rise, if tanks contain some bacterial contamination (which many do), there is a risk that the water will become unsafe to drink unless it is treated first.

It may be wise to test the quality of the water once a season. This could be included in a community-run Water Safety Plan (WSP). See **Tool C2 - Water Safety Plans**. It is also important to promote good hygiene within RWH (this would also be covered in a WSP), making sure that each part of the system is clean. The stored water should not be removed by dipping hands into the tank or scooping using dirty items. It is also important to keep the area around the tank clean.

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Even during the rainy season, if particularly vulnerable people are drinking the water (babies and young children, older people, people who are ill) households may also use a technique to treat the water after it is drawn from the tank. Examples include:

- boiling the water,
- chlorination - 35ml of sodium hypochlorite per 1000 litres of water,
- SODIS (SOlar DISinfection) (using plastic bottles which are filled with water and placed in the sun for one full day. The back of the bottle is painted black).
- using a ceramic filter.



Finding out more

- Practical Action (2004) Technical brief: Run off Rainwater Harvesting
<http://answers.practicalaction.org/our-resources/item/run-off-rainwater-harvesting>
- Practical Action (2008) Technical brief: Rainwater Harvesting
<http://answers.practicalaction.org/our-resources/item/rainwater-2>
- Smet, J (2003) WELL factsheet: Domestic Rainwater Harvesting
<http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/drh.htm>
- Tearfund (2010) *Footsteps 82: Natural Resources* - article on 'New ideas for rainwater harvesting at home'
http://tilz.tearfund.org/en/resources/publications/footsteps/footsteps_81-90/footsteps_82/new_ideas_for_rainwater_harvesting_at_home/
- Thomas, T.H. and Martinson, D.B. (2007) *Roofwater Harvesting: A Handbook for Practitioners*. Delft, The Netherlands, IRC International Water and Sanitation Centre
- WEDC Technical brief on ferro-cement tanks
<http://www.lboro.ac.uk/well/resources/technical-briefs/36-ferrocement-water-tanks.pdf>

Related tools:

- B – Water for blessing (Bible study) [*B: Water, sanitation & hygiene-3*]
- B – Water for life (Bible study) [*B: Water, sanitation & hygiene-4*]
- C2 – Protecting a spring (a water source) [*C2: Water, sanitation & hygiene-2*]
- C2 – Constructing a hand-dug well [*C2: Water, sanitation & hygiene-3*]
- C2 – Community involvement in siting and constructing boreholes [*C2: Water, sanitation & hygiene-5*]

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