

E4 - Rain water recovery

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- Cross-section view of a collection system - Source : RéFEA Network 
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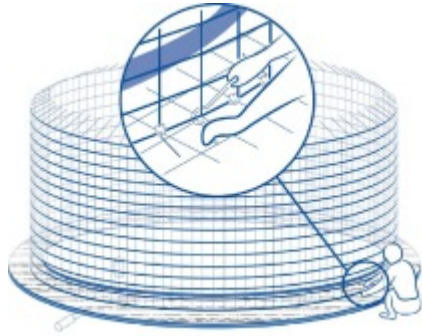


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Various methods of recovering rainwater
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1) What is involved ?



The "ad hoc system"

A system for collecting rainwater, sometimes called "impluvium" as in ancient times, generally made up of

5 elements :

- 1 roof or collection surface
- 1 gutter system that collects the water collected by the roof (bamboo, galvanised steel or PVC)
- 1 conduit draining the rainwater into a storage container
- 1 system for diverting the initial rainfall (cleaning of the collection area)
- 1 large container, a water reservoir (on the surface) or a tank (buried).

A complete range is available, from the simplest system to the most elaborate. It can be used for drinking (rarely, except after additional treatment), for domestic use, for vegetable gardens, for school toilettes, etc.

2) Who use this means and since when ?



This is a simple, robust and rather inexpensive system, that has been used for centuries, as in the atrium in Roman homes, and which was above used for irrigation and domestic uses. This technique which is often forgotten in most regions is now expanding just about everywhere, and not just in the country.

As such, it is now easy to find information seminars on the use of rainwater. Likewise, several cities or governments subsidise the equipment costs for collecting rainwater for their inhabitants. In

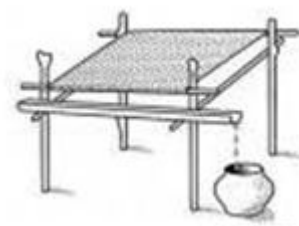
France in Bordeaux (€60 per reservoir) or Drancy (€100), etc. As for the French Tax Code, since August 2007, for private individuals installing a rainwater recovery and treatment system, a tax credit equal to 25% of the cost of the equipment (with a ceiling of €8000), with the total cost of an installation being about €2 to 3000.

3) Why ?

Water is getting harder and harder to find or expensive. Yet **this system is rather effective and inexpensive** for collecting and storing water, even if it just for gardening, vegetable gardens and domestic work. But it is especially **useful during shortage periods or the dry season**, a very difficult period for most farmers in arid or semi-arid regions.

4) Who is primarily concerned ?

Of course the inhabitants of towns and peri-urban areas, **but especially those in shantytowns and rural arid or semi-arid areas** or with long dry spells, which have great difficulty in bridging the gap, for crops as well as for cattle, with the short rain or monsoon period.



Systems are also now often installed in schools, boarding schools or in public places that lack water and toilettes and where the steel or tiled roofing have a large collection surface. But there are also simpler collection systems, but of lesser quality, such as recovery in simple tarps or fabric or recovering rainwater from the roof of a latrine to supply a hand-washing station....

Recovering rainwater is also sometimes used for irrigation. As such in the delta of the Ganges in India, the inhabitants have already dug more than 30,000 50x40m basins and 3 to 4 m deep representing one third of the surface to be irrigated.

5) What does this process involve ? How is it used ?



The actual size of the system will be according to several factors : the cost, the quantity of water to collect...**The roof** has to be of a satisfactory surface area, with non-painted steel, tiles or fibreglass. Then, the height of the roof has to be sufficient to allow the water to supply the reservoir via gravity.

Type of **storage container** : most often, this is a **reservoir** and sometimes a **tank** (cf. chapter 7, the main types), even tarps and fabric.

Sizing for this container : the volume has to take into account the duration of the dry season, the number of users and the usage time.

It must indeed allow the users to obtain a substantial supply during the rainy season.

CREPA (Research Centre in Ouagadougou), which has created like other organisations highly documented technical sheets on this subject (see the internet website indicated at the **end of the sheet which will provide you with easy access to technical dossiers that are simple in design and in**

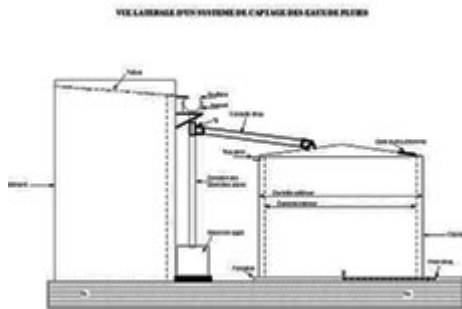
construction), recommends calculating the ideal volume for a tank as follows :

Supposing that the tank will be full at the beginning during half of the dry season and by referring to V as the average water consumption, **the volume V of the tank can be obtained using the formula :**

$V = t \cdot n \cdot q + es$ where t is the number of days in the dry season, n the number of people using the tank, q the level of consumption per person and per day and es the loss due to evaporation during the dry season.



The appearance of the reservoir, which is in general not very aesthetic, can possibly be improved. In urban areas, manufacturers offer, rather than creating a simple reservoir or burying a tank, to create a "wall of water", a vertical reservoir with low width placed along a wall near gutters or able to take the shape of more elaborate containers such as amphorae.



Cross-section view of a collection system

- Source : RéFEA Network 

Rainwater collection is a school in Burundi - Photo Caritas

6) Special difficulties and remedies - Precaution to be taken

The **environment must be taken into account**.

Indeed, if there are trees overshadowing the roof, the leaves and seeds can clog the gutters and the conduits. In addition, bird droppings and insects which fall on the roof will be washed and transported into the reservoir. A simple diversion system must therefore be provided for the first rainwater collected. If the reservoirs are buried, nearby trees cause problems due to the fact that the development of roots risks damaging the foundation or the coating of the tank, which then results in cracks and leaks. These must therefore be removed.

The presence of a hard compact or rocky ground is an advantage in building tanks. Indeed, cracks can appear more easily when the foundations are placed on ground which can subside, expand or shrink.

- **If the water is to be used for drinking**, certain precautions must be taken (see chapter 8)

- **A study** conducted by IRC (International Research Centre in the Netherlands), **concluded** that collecting rainwater is more economic in regions where the **amount of rainfall is between 100 and 500 mm** per year. If it is higher, the costs will exceed the advantages and, **if it is less, the advantages would not cover the costs**.

- **Before choosing** a system, a thorough examination should be done of the installation environment, the existing technologies and sectors for manufacture locally, materials easily available in the region and the respective costs and advantages/disadvantages in the various types of installations.

7) Choosing the type of reservoir or tank

This choice is very important as the storage container often represents the most expensive element in the installation. **This is most often a reservoir**, contrary to a tank which is buried and better protected but which requires a pump for increased commodity and often ends up being more expensive if the cost of

labour is high. There are different models available :

- the **tarp-reservoir**, the simplest system but not very common except in countries such as Uganda (cost of €35 for 6 m3) as it is too simple and has to be supplemented with protection and only has a limited use.
- the **jar or amphora** which is the simplest model and inexpensive in many countries in Asia, especially in Thailand where it is very widespread and which can be easily made yourself (cost : 13€ for a simple 2 m3 jar and €170 for more solid jar of 4 m3 made from fibrocement), a system which moreover has inspired certain designers in Europe.



- the **wooden reservoir**, most often in the shape of a barrel, with the wood forming a good insulator and often inexpensive (cost varies according to the local price of wood, but for example €190 for 400 litres, or €279 for 2000 l in France).

- the **plastic reservoir** (these can be found for €135 per m3 with support grid, or in reinforced plastic but are more expensive



(large do-it-yourself centres for example sell rainwater recover tanks made from polyethylene 2.5 m3 with anti-rodent stainless steel grids and lid for €680).

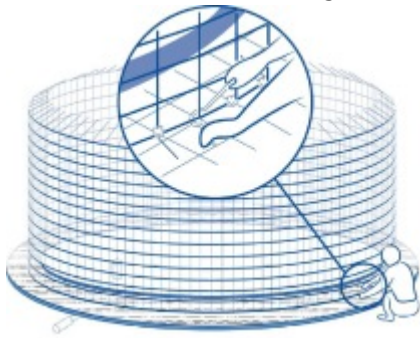


Diagram Source Wateraid 

- the **concrete reservoir**, sometimes made from simple mortar, which has the advantage of neutralising the natural acidity of the rain, of being easy to set up and at a reasonable price (€200 to €700 according to the regions for about ten m3). Plan for a diameter of 90 cm for 5 m3 and 1.4m for 10 m3.
- the **ferrocement reservoir** is of comparable advantage and the price is a little less and this is the **most widespread model**.

After having created the ground with a concrete slab, the reservoir's cylindrical structure is manufactured and its lid with concrete iron whereon is projected a **mortar rich in cement (3 parts for 1 part sand)** with a trowel over a thickness of 3 to 10 cm according to the height and the diameter of the reservoir.

- the **reservoir made from bricks, chipboard or stones and or bricks and cement** which is often less expensive, (count on between €100 and €200 for 10 m3), more aesthetic or better using materials that are available locally. Count on about one 50 kg bag of cement and about a hundred bricks per m3.
- the **stainless metal** reservoir, which is not very common and often more expensive but can be installed faster and it is prudent to provide sealed protection made of plastic.



But the storage container can also be (less frequently) a **tank**, most often made from bricks, stone or concrete. More aesthetic and better protected from heat, but more expensive.

Such tanks are sometimes constructed faster and at a lesser cost, but especially in **emergency situations, by digging holes** coated with plastic or even, as for example in the region of Gansu in China, rich in natural clay excavations, by simply using these natural holes by fitting them with simple covering or coating (cost of €100 for 30 m3)

8) Precaution to be taken in case of use as drinking water

In this case, at least one of the following 4 methods should be used (*cf. sheet E 17 "Simple water treatment methods for us in the home"*) :

- **boil** the water for 2 or 3 minutes,
- put the water in glass or plastic bottles and **place them in the sun for several hours** (destruction of bacteria and microorganisms through radiation, a process which can be accelerated by leaving a little air in the bottles and by shaking them),
- at the outflow place a small **sand filter**, which can be removable and improved with layers of gravel or charcoal)
- **chlorinate the water slightly, but be careful when dosing** : put for example 7g of calcium hypochlorite or 40 ml of sodium hypochlorite per m³ as an initial treatment, then each week 1g of calcium hypochlorite or 4 ml of sodium hypochlorite per m³ in such a way that the residual chlorine in the water (the latter decrease over time and with heat) is always between 0.2 and 0.5 mg per litre (can be checked with specific coloured tests)

9) Cost

The **total cost of construction** is **relatively low and often less than €1000 except when it entails a large buried reservoir** where the price can double. This of course depends on the type and the volume of the installation, the country and the price of the materials used and of the labour in the region. Here are a few examples, in addition to that for storage containers only indicated hereinabove :

CREPA has evaluated in 2000 the total cost in Burkina Faso for a lateritic stone impluvium of 20 m³ (i.e. 20,000 litres) at 436,300 FCFA, which is about **€655** (for which Foundation : 210, Reservoir : 200, Equipment-Plumbing : 95 and Labour : 150) and at 504 565 FCFA, which is about **€770**, if it was made from ferrocement. But this price can be lower when it is a question of simple less elaborate small equipment for family use.

CARITAS Kaolack in Senegal in 2008 made 10-15 m³ ferrocement reservoirs for an average price, training of masons and in hygiene included, of **€900** and thinks that it can lower the price to **€450** once the training of the masons is complete.

HELVETAS created in 24 villages in Sahel for a price varying from **€600 to €900** (+ participation of the population in the work valorised at €60) 10 m³ impluviums making it possible to supply a family community of 10 to 15 people for 7 months, at 3 litres per person per day.

The cost of the **maintenance** is in most cases **almost nothing**, but attention must be paid to maintaining the quality of the water over time and in the cleanliness of the installations, in particular before filling reservoirs or tanks.

10) Locations in which this technique seems the best suited

This technique is particularly adapted to domestic uses and to irrigation in regions suffering from a shortage of water, but also to certain public edifices such as schools or sanitary centres. It is sometimes used in a very rudimentary manner, as in Kerala in India where women simply suspend saris between the trees.

11) Observations, recommendations



Various methods of recovering rainwater in a village - Illustration CREPA

The roof has to be smooth, hard and dense in order to be cleaned easily, resistant and able to return the objects that fall on it. No tree must be located near the roof. Birds constructing their nests on the roof must be avoided. The ends of the gutters must be provided with grids in order to stop leaves. The storage reservoir must have a hermetic cover which does not allow light in, and an inspection port and a drainage pipe at the bottom. For tanks, contaminated water (drains...) must not be able to infiltrate here.

When the roof of the homes are of very poor quality, or when there is cultural resistance, such as in certain Miao villages in China, the NGO Initiative and development replaced the system with a water collection solution on large tarps of about thirty m2 set up on poles and connected to a reservoir.

12) Achievement examples

1) The **CREPA** team created such a system in a **school** in Ouagadougou **in Burkina Faso**. The volume of the tank took into account the number of students, their water consumption during the eight hours spent at the school, the duration of the dry season (5 months) and the number of students at the school. As such, for 200 students at 4 litres of water a day and per student, CREPA built six 20-m3 tanks which is a total of 120 m3. The 200 students are now sure to have water to wash their hands, use the toilettes and even drink it subject to certain precautions.

2) CARITAS created similar systems in schools that were impossible to connect to the water supply in Burundi and in Ethiopia.

3) See also the many achievements mentioned in the brochure from ARENE IDF which can be downloaded as indicated further on.

13) Where to obtain further information ?

a) Websites

Sites in French

a) OIE (International office for water), site allowing access to various networks, such as the RéFEA Network

(French-speaking telematic centre on water : www.oieau.fr/ReFEA/module3.h... ; where you will find several interesting practical sheets, especially those from CREPA, ((click on "Rainwater"))

b) PSEau (Programme Solidarité Eau-32 rue Le Peletier 75 009 Paris) : www.pseau.org. In the "Search" window at the top right part of the welcome site, type "rainwater recovery" and you will have access to many articles.

c) CREPA (Regional Centre for Drinking Water and Sanitation at low cost) : www.reseaucrepa.org

d) GRET : 93-page document "Management of impluviums in Androy (Madagascar)", a pertinent technical solution but which is insufficient in creating new social dynamics

<http://www.gret.org>

e) Here is an interesting article about advantages, disadvantages of the rainwater's harvesting and the methods of rainwater's recovery:

<https://connectforwater.org/natures-bounty-what-you-need-to-know-about-harvesting-rainwater/>

Sites in English

a) **CTA**, Dutch site already mentioned, where there is a simple, interesting and illustrated brochure on recovering rainwater :

www.cta.int (click in the left column "Publications" then on "Rainwater harvesting for domestic use").

b) **WELL**, portal of the Centre for Water Resources, Sanitation and Environment of the University of Loughborough, Leicestershire (UK) where there is also among the "publications" in the "Water supply" section then "domestic rainwater harvesting" an interesting sheet on the subject :

<http://www.lboro.ac.uk/research/wedc/well/water-supply/ws-factsheets/domestic-rainwater-harsting/>

c) **WATER AID**, International solidarity organisation in London, which also publishes very good sheets in

English, including the "Harvesting water" sheet that you can access directly by clicking on the following link :

<http://www.wateraid.org/internation...>

d) **IRHA, portal of the International Rainwater Harvesting Alliance (Geneva) :**

<http://www.irha-h2o.org/> ; (English version, technologies section)

e) **The Indian portal on rainwater collection (New Delhi) :** www.rainwaterharvesting.org

b) Videos

Videos on "water Channel"

- but also in other countries such as South Africa or Nepal, 8' videos in English :

<http://www.thewaterchannel.tv/en/vi...> ; (South Africa)

<http://www.thewaterchannel.tv/fr/vi...>

One **other video on You tube** :

- The "Rainwater collector" video (2' story from FR3 Savoie) :

<http://www.youtube.com/watch?v=ZC8u...>

- Emplacement : Accueil > en > Wikiwater > Technical sheet > Facilitating access to water > Searching >
- Adresse de cet article : <https://wikiwater.fr/e4-rain-water-recovery>