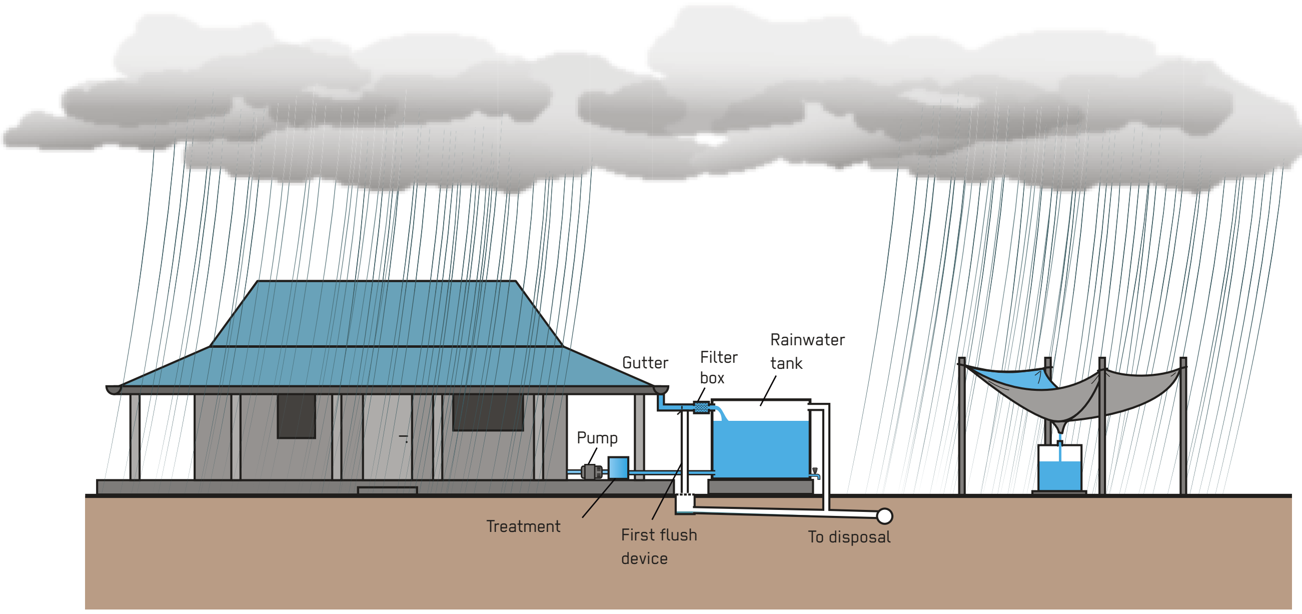
Rainwater Harvesting: Raised Surface Collection

Response Phase	Application Level	Management Level	Objectives / Key Features
* Acute Response ** Stabilisation ** Recovery	** Household ** Neighbourhood City	** Household ** Shared ** Public	Complementary water collection at the point of use, generally good quality water
Local Availability	**Technical Complexity**	**Maturity Level**	
*** High	* Low	*** High	



ROOF WATER COLLECTION SYSTEM

TARPAULIN COLLECTION SYSTEM

A Rainwater Raised Surface Collection system uses a raised surface to channel runoff water to a storage tank that is either under or above ground. It can provide convenient access to water in an emergency when alternative sources are scarce, emergency water supply systems are not yet in place, populations are scattered and/or to mitigate seasonal water shortages.

Raised surfaces are usually man-made. The most common example is a roof on a residential or communal building, though any raised surface can be used to construct simpler rainwater catchments (e.g. tarpaulin collection systems in emergencies). The key advantage of raised surfaces is that they tend to be less easily polluted than the ground surface, so the water quality is usually better. Artificial raised surfaces tend to be inorganic (such as galvanised iron roofing sheets), which prevent changes in taste and colour. Once collected, water should be stored in a covered tank.

Design Considerations: The system consists of a raised surface (e.g. roof) and a gutter to convey water to a downpipe connected to a storage tank. A first-flush device should be incorporated in the downpipe to divert the first flush of water away from the tank, preventing dust and debris from the surface from entering. The size of the gutter should correspond to the anticipated water flow (a rule of thumb is 1 cm^2 of gutter cross section for every 1 m^2 of roof area). Splashguard devices help steer any runoff into the gutter. Poorly installed or broken gutters are the main weakness in many roof rainwater collection systems, resulting in greatly reduced efficiency. For example, gutters are often poorly attached, warped or broken and are often positioned incorrectly such that rainwater overshoots the gutter. An uneven slope may also send water away from the tank to overflow elsewhere while also making puddles and stagnant pools that may lead to mosquito breeding. Underground or above-ground tanks can be used to store rainwater and should be covered to keep out insects, dirt and sunlight, the latter of which can lead to algal growth in the tanks.

The main design parameters are the rainfall quantity and pattern, the collection surface area, the runoff coefficient and the storage volume in relation to the water demand. The runoff coefficient is the ratio of the volume of rainwater that runs off the roof surface to the volume of rainwater that falls on that surface (varies between 0.5–0.9). The coefficient shows water losses (i.e. a coefficient of 0.8 means that 80 % runs off while 20 % is lost) due to splashing, evaporation, wind, overflowing gutters, and leaky collection pipes and first-flush devices. The volume of water supplied by the system can be estimated by multiplying the rainfall, roof area and runoff coefficient parameters each month. Where annual rainfall collection is greater than annual demand, there is sufficient water to meet needs, though sufficient storage will be needed to account for variations between supply and demand. This depends on how much rainfall can be collected per month (which varies) compared with the monthly drinking water demand (which is more constant and a function of the number of people and litres/month/person). By comparing monthly supply and demand over a year, a balance graph can show the storage requirements, where the maximum storage is indicated by the greatest difference between peaks or troughs in the graph. The longer the dry season, the larger the storage needed. In contrast, where annual rainfall is less than demand, the demand/expectation must be adjusted (if the existing collection area cannot be changed), or the collection area must be increased. In this scenario, community rainwater harvesting operations can be difficult to manage; in the absence of proper management, people may take more than the demand amount used in the design calculations and the tank will empty faster than intended.

Materials: These systems can be made with local materials. For the roof surface, any hard materials that do not absorb rain can be used (e.g. tiles, metal sheets, plastics). For the gutter and pipes, suitable materials include UV-resistant polyvinyl chloride (PVC), metal (e.g. aluminium), bamboo or wood. The storage reservoir can be made of different materials, such as polyethylene (PE), ferrocement, clay or concrete. During an emergency, temporary above-ground Water Storage Tanks **(D.5)** can also be made of tarpaulins with a bamboo support structure or underground with a dug hole and tarpaulin lining.

Applicability: In emergencies, rainwater collection tends to be either a short-term response to supplement existing water sources, or for scattered populations where centralised water supplies are expensive. It can also be used specifically for drinking water where other sources are low quality, such as Brackish Water **(S.4)**. Annual rainfall should be at least 300 mm. Where rainfall is over 1000 mm, there tend to be more economical medium- to long-term water source options.

Operation and Maintenance: O & M is minimal and can be carried out by the user. Water quality in roof water collection systems should be controlled by diverting first flushes and the occasional cleaning of the roof and gutters. It also includes regular inspection, tank cleaning and occasional repairs.

Health and Safety: With no screens to the tank inlet/outlet, mosquito can breed in the storage tanks. If water is used for drinking, as with many water sources, it is recommended to disinfect the water to inactivate any microorganisms.

Costs: For individual small-scale systems that can be built with local material and labour, investment costs are relatively low. For large-scale systems, capital costs can become relatively high compared with alternative water supply options, though ongoing costs tend to be lower. Quoted costs tend to be in the range of around 50–1,000 USD and often only consider the cost of the tank and pipes but not the catchment itself, which often takes advantage of the availability of an existing structure such as a rooftop. The cost per cubic metre of storage alone can range between 25–100 USD. Operational costs for inspection, cleaning, disinfection and maintenance are also low but need to be considered when calculating long-term costs.

Social and Environmental Considerations: Rainwater harvesting systems are generally well accepted in most cultures. However, if not properly planned or operated, rainwater can develop a noticeable taste and odour during storage **(see D.5, D.6)**, which may affect acceptance as drinking water source. Rainwater harvesting systems require individual household ownership and responsibility, which should be kept in mind and clearly communicated in the decision-making process. The use of rainwater is also a key aspect of climate change adaptation techniques and drought mitigation activities.

Strengths and Weaknesses:

(+) Good quality water
(+) Easily available and accessible
(+) Low operating costs with long service life

(−) Supply limited by rainfall quantity, size of the rainwater capturing area and storage capacity
(−) Possibly contaminated by air pollution, animal or bird droppings, insects, dust, algae or poor O & M
(−) Storage becomes expensive where there is a long dry season
(−) Higher capital cost compared to alternative water supply options for providing water at scale

→ **References and further reading material for this technology can be found on page 214**