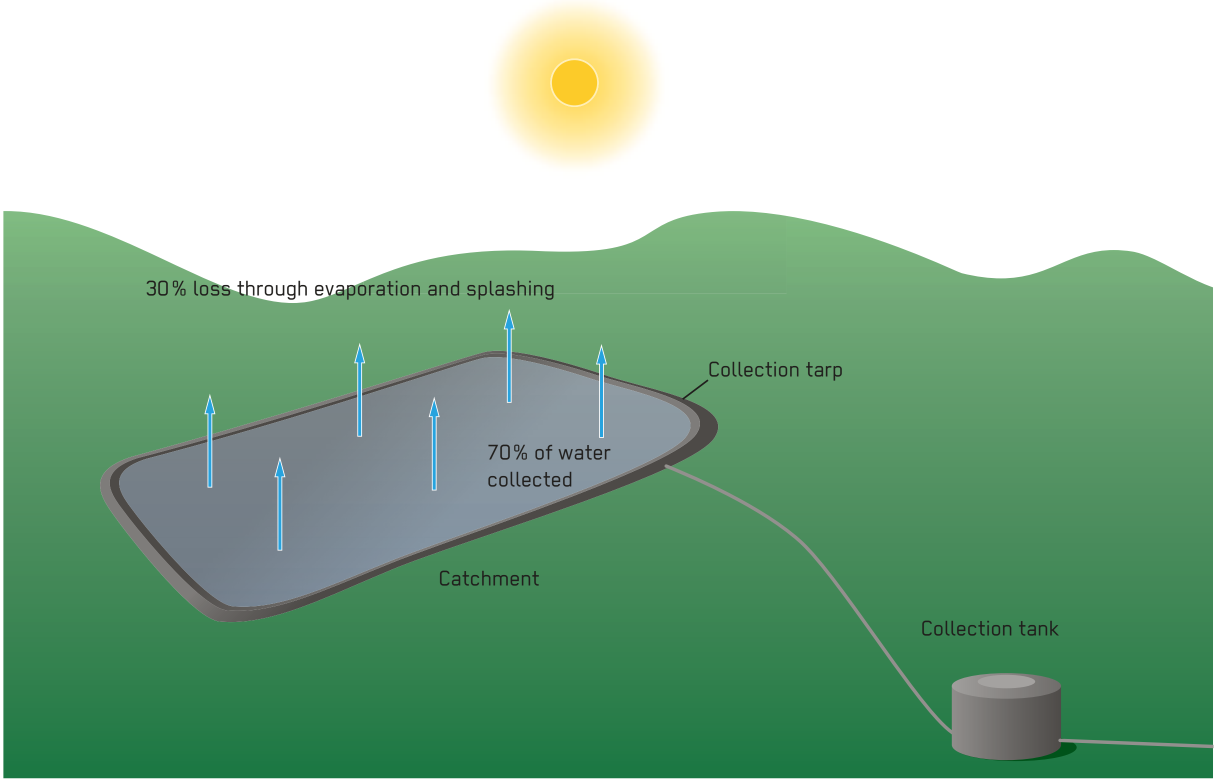
Rainwater Harvesting: Ground Surface Collection

Response Phase	Application Level	Management Level	Objectives / Key Features
* Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood ** City	* Household ** Shared ** Public	Large water volume collection, low water quality, drought mitigation
Local Availability *** High	**Technical Complexity** ** Medium	**Maturity Level** *** High	



A Rainwater Ground Surface Collection system uses the ground to channel runoff water to a storage area. Although rarely done in practice during the acute response phase, any natural or artificial ground surfaces that already exist (and certain types of rapidly installed artificial surfaces such as plastic sheeting) could be useful during the rainy season. Overall, this type of rainwater catchment tends to be more suited to long-term drought mitigation or groundwater recharge.

Ground catchments are either naturally occurring (ground or bare rock surfaces sloping towards a depression that collects rainwater) or modified/improved to minimise infiltration, increase runoff and reduce contamination. In either case, a dam wall or embankment might be added to retain water. Alternatively, the water can be channelled into storage tanks.

Design Considerations: Ground Surface Collection catchments are generally sited to minimise excavation for the drainage and water storage structures by making use of the existing topography. While some catchments will drain to an open water reservoir behind a dam **(see S.3)**, others will channel to a storage tank. In these cases, considerations include how water will reach the tank from the catchment, the tank's location in relation to the catchment and how water will be withdrawn later. Tanks can be constructed on site and are commonly subsurface **(see D.6)**, though in emergencies, they are more commonly prefabricated **(see D.5)**.
A good assessment of the ground conditions is needed, since these affect the volume of water that can be collected. In general, catchments work well in areas with intense rainfall that causes high runoff. The volume of water that can be collected depends on the runoff coefficient, which is the ratio of the volume of rainwater that runs off the ground surface to the volume of rainwater that falls on that surface. For natural, unsealed ground

surfaces, the runoff is reduced due to increased infiltration, the extent of which depends on the permeability of the ground, as well as the amount of vegetation cover which can also intercept rainfall, slow down runoff and increase evaporation. Consequently, runoff coefficients for natural surfaces tend to be much lower than for artificial surfaces (typically around 0.1 for forested sandy soil, meaning only 10 % runs off the land while 90 % is infiltrated or intercepted), though they can still vary dramatically depending on conditions (up to 0.8 for non-forested bare clay soil, or even higher for bare rock catchments). Runoff can be increased by adjusting the ground surface to reduce infiltration, for example through covering (e.g. using concrete, butyl rubber, plastic sheeting or mud/dung plaster) or compaction (e.g. puddled clay). However, these artificial catchments tend to fail over time due to poor construction techniques and lack of maintenance.
Animal and human contamination of the catchment area must be prevented to preserve or improve water quality. This can be done through fencing off the catchment, which will require maintenance over time.

Materials: Naturally occurring Ground Surface Collection catchments consist simply of the existing surface in an area (e.g. natural rock or soil). Where this surface is enhanced, commonly used materials include concrete, butyl rubber, plastic sheeting or mud/dung/clays.

Applicability: Although possibly a suitable approach for the acute response phase (where natural or artificial surfaces already exist or where certain types of rapidly installed artificial surfaces might be used), these catchments are more suited to the stabilisation/recovery phases or later, as construction can take time. They are generally suited to areas where annual rainfall is low (e.g. water-stressed arid and semi-arid areas) and where rainfall is intense and the runoff is high, making it possible to collect significant volumes of water to serve as an additional non-drinking source for part of the year (e.g. washing, bathing), leaving a limited supply of potable water for drinking and cooking during times of water stress. The speed of deployment in an acute response depends on the planned type of runoff diversion system and storage tank, and the time needed for construction.

Operation and Maintenance: Any modified/enhanced catchment surface needs regular damage inspection (checking for tears in the lining, or cracks in concrete), and any fencing needs to be maintained (which may be a challenge with communal systems). The storage tank will also need to be checked, as leaks from underground tanks can be difficult to spot.

Health and Safety: Rainwater from ground catchments is more likely to be of poorer microbiological quality than from roof catchments, so more treatment may be needed. Contamination can be minimised using fencing around the catchment as well as using an appropriate surface (e.g. concrete/rocks will be less contaminating than soil).

Costs: Capital costs for a whole system can be higher than alternative water supply options, such as Protected Dug Wells **(I.7)** or Protected Boreholes **(I.8)**, whilst running costs tend to be lower. Per area, Ground Surface Collection systems are less expensive than Raised Surface Collection **(I.1)** catchments, as they use an existing surface (so no supporting structure is needed) and because the subsurface tanks commonly used with ground catchments are generally more economical (around 1 USD per m^3). Artificial or enhanced catchments are more costly due to the work needed to modify the catchment, which depends on the type of catchment, tank size and total area. As an example, a 1,000 m^2 concrete catchment draining to a 100 m^3 subsurface tank can cost around 20 USD per m^3 of storage, which is on the low end of what a Raised Surface Collection would cost where only the tank (and not the catchment) cost is considered.

Social and Environmental Considerations: Generally, Rainwater Ground Surface Collection systems are well accepted by users, despite the poorer water quality. Preventing access and maintaining a fence around the catchment may be challenging. The use of rainwater is also a key aspect of climate change adaptation techniques and drought mitigation activities, such as through increased water storage or control of groundwater table levels using managed aquifer recharge methods.

Strengths and Weaknesses:

(+) Collects from a larger area, which can accumulate large amounts of water in water-stressed areas
(+) Costs less per cubic metre of water stored when compared to Raised Surface Collection **(I.1)** systems

(−) Low water quality depending on catchment surface type and access by animals/people
(−) Higher capital cost compared with alternative water supply options
(−) Community operation may be difficult (reduced motivation for maintenance due to being communal)

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