Runoff rainwater harvesting

What is this Action sheet about?
There are many ways to harvest and store rainwater. Action sheet 13 explains how to harvest the rain that falls on your roof. In dry parts of Africa, a lot of water is lost as surface runoff. Harvesting this runoff and storing it in reservoirs such as water pans or underground tanks makes it available for use when required. This Action sheet explains how to harvest the rainwater that falls on the land, so that it can be used in farming.

What do you need to do before building a runoff harvesting system?

1. If you are building on communal lands, the community must get together and agree on ownership, operation and maintenance of the system.
2. You need to assess whether the system will cause any problems for people in the area. Are there buildings, roads or paths nearby?
3. You will need human labour, draught animals or earth moving machinery depending on the size of reservoir or tank you plan to build.

Where can you collect runoff water from? Rain that falls on roads, fields and bush can be collected. Action sheet 15 describes collection and storage of rain falling on rocky outcrops. If there is any possibility of contamination of the water by human or animal waste, it is vital to treat the water before use if it is drunk (see Action sheet 23). Risk of contamination with industrial or agricultural chemicals should also be assessed.

WATER PANS

A water pan is a hole or pond dug in the ground, used to collect and store surface runoff from uncultivated grounds, roads or laggas. It can be square, rectangular or round.

How much water can a water pan hold? The capacity is variable and depends on site conditions and how much one wants to invest. Common ones are 400 to 1,000 cubic metres. By altering the shape of the pan, a water pan capacity can be increased with time to hold more water.

Why build a water pan?

1. Water pans are simple to construct and use.
2. They can provide water for domestic livestock use and crop irrigation.
3. They don t need much maintenance.

How to choose where to make a water pan.

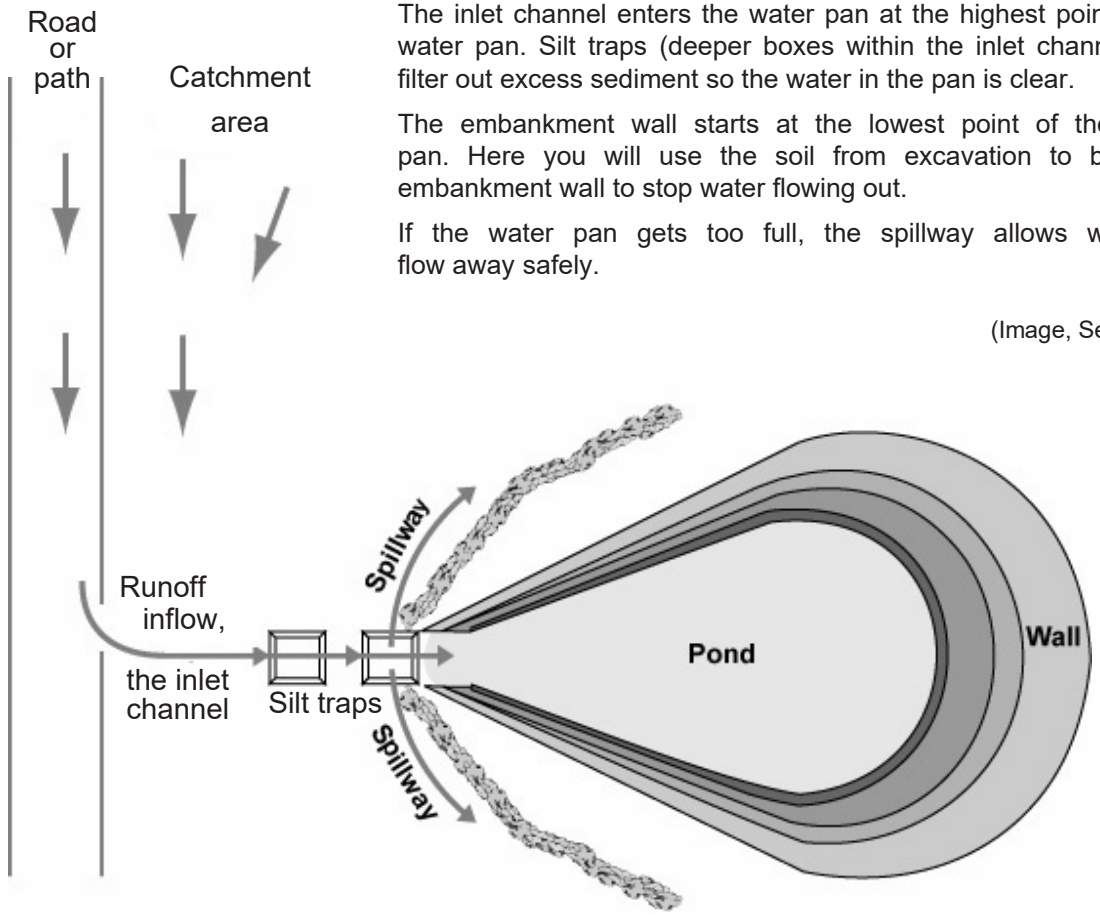
A. Choose a site with soils like clay that retain water. Avoid sandy soils.

B. Choose a natural depression or small valley so you don't have to dig too deep.

C. Choose a site with a road or lagga (dry streambed of a river that flows only in the rainy season) nearby, as these will be a source of runoff water.

D. It's good if the area from which water flows into the water pan is covered in trees or shrubs, so that the water collected is not full of soil.

The main features of a water pan



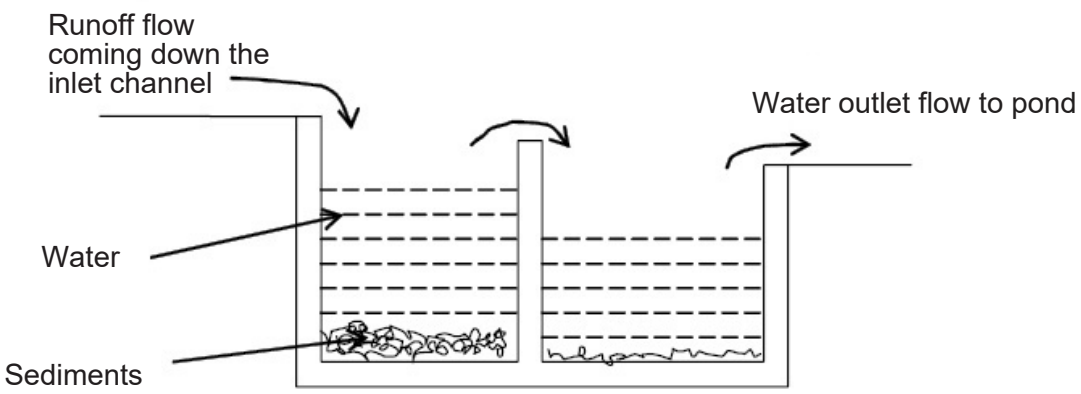
The inlet channel enters the water pan at the highest point of the water pan. Silt traps (deeper boxes within the inlet channel) can filter out excess sediment so the water in the pan is clear.

The embankment wall starts at the lowest point of the water pan. Here you will use the soil from excavation to build an embankment wall to stop water flowing out.

If the water pan gets too full, the spillway allows water to flow away safely.

(Image, SearNet)

Silt trap on inlet channel - side view (Image: International Water Management Institute)



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How do you build a water pan?

1. Site the water pan and mark the embankment, inlet and spillway.
2. Excavate the reservoir section and use the soil to build the embankment wall, with side slopes of 1:2.5 for shallow pans to 1:3 for deep pans. To minimize water losses, compact the embankment wall by rolling with drums filled with water or with roller machinery. ine the beds and walls of the water pan with clay soil. On soils that are not water-tight, line the pan with a polythene sheet.
3. Construct spillway to discharge excess runoff water when the pan is full.
4. Construct silt trap(s) along the inlet channel to filter excess sediment load.
5. Close off the water pan with live fence to keep livestock out.
6. Provide livestock watering trough outside the fenced area.

Minimise the water losses from a water pan by planting cuttings of trees such as Commiphora and Euphorbia around the edges of the pan.

To stabilise the walls of a water pan make sure the embankment sides are properly compacted during building, plant shrubs and grasses on the embankment wall, and place stones on the embankment sides.

Maintaining a water pan. It is important to repair broken perimeter fence as need arises, to avoid direct entry of livestock into the pan to prevent trampling on bed and walls, and to clean the inlet channel by removing silt every season.

How do you get water from the pan to give to livestock? This can be done by using a drinking trough fed by a pipe running through the embankment wall. Where a livestock draw off point is not provided, use portable wooden troughs, drums cut in half or old tyres to water livestock.

PLASTIC-LINED UNDERGROUND TANK

Direct runoff water can also be directed into an underground tank dug into the ground. The advantage of a tank is that it is covered. This stops water from being lost into the air by evaporation. As long as the manhole entrance into the tank is well secured, it is also safer for children.

Tanks, ponds, dams and reservoirs all need to be lined to stop water from seeping out. If the water stored in the tank does not leak away there will be more available for use in the home and on the farm.

Materials used for lining include clay, rubber, plastic, bricks, stones, concrete etc. Where clay is available locally, it is often the cheapest option. However, in areas without clay, plastic lining has proved to be appropriate mainly because of low cost and reliability of the material.

How do you avoid silt getting into the tank? The inlet channel should include a silt trap (see above), and could also be lined with grass or stones.

How do you get water out of the tank? Water is either pumped out of the tank, or collected with a bucket. If the tank is above the water collection point, gravity will allow you to collect water from an outlet pipe with a tap.

How big should an underground water tank be? This depends on how much water you want to collect, how much rain falls in the area in the rainy season, and how much money you want to spend.

What shape should the tank be? Design of the tank shape depends on the soil type, which dictates the maximum possible slope that will stay in place without falling in. For stable soils the side slope ratio can be 1:1. For unstable soils, the side slopes should have a ratio of 1:2. For easy roofing, the tank should be rectangular, long and narrow.

Plastic lined tank, filled (Image, SearNet).

Where should the tank be built? The tank should be built beneath the catchment (road, open field or roof). Mark the layout on the ground at the chosen site of the tank.

What kind of plastic lining should be used? Available gauge sizes of plastic lining range from 0.4mm to 1.2mm. Thicker gauge will last longer but may be more expensive.

How do you build it?

1. Excavate the tank site to required shape and depth.
2. Provide for water inlet and outlet (in case of over-flow).
3. Smooth the walls and floors of the tank to ensure that the plastic lining walls and floors will not be damaged. You could plaster with mortar or soil cement mixture to make it smooth.
4. Order lining material from the manufacturer. Remember to include enough lining material so that some sticks out at the top for use in anchoring down the lining. Order just enough to fit the shape of the pit to avoid waste.
5. Place the lining in the tank after ensuring that there are no stones or sharp objects.
6. Anchor lining edges to ensure that the lining lies smoothly on the walls of pit and is firmly held. The lining can be anchored at the top using a masonry wall or by burying the edge of the lining into the ground. If anchoring using a masonry wall, select bricks of high strengths, choose good structural mortar mixture and ensure good workmanship.
7. Wet bricks before laying.
8. Cure the masonry work properly.
9. Make sure that the plastic lining fits the pond loosely so it doesn t break when it is anchored.
10. Cover the top of the tank using any roofing materials to minimize loss of water by evaporation and to protect the plastic from the sun.
11. Include a man (person) hole to help with maintenance.
12. Make sure the manhole is covered, if covering is not possible then fence off the whole area as a safety measure.

Plastic lining anchored with brick wall (Image, SearNet)

Maintaining a plastic-lined underground tank

- Regularly inspect inlets, channel and collecting area.
- Clean the silt traps and sieve.
- Periodically clean tank and remove any accumulated silt. Clean with great care to make sure that the plastic is not cut/pricked. Don't use rough tools or equipment to clean.
- After cleaning, check the pond for perforations and have them repaired.

Plastic lined tank secured with bags.

Advantages of plastic lined tanks.

They are reliable, low maintenance and have a high storage efficiency when covered. They are relatively long lasting. They supply extra irrigation water, water for livestock and for some domestic uses. They can be installed by local artisans.

Disadvantages of plastic lined tanks. Plastic can get torn or pricked by sharp objects. Plastic may require replacement after some time due to exposure to ultra violet rays from the sun. This is why it is very important to shade or cover to protect the lining. They do need constant maintenance.

ACKNOWLEDGEMENTS

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FURTHER INFORMATION

International Rainwater Harvesting Alliance www.irha-h2o.org

IWSC - International Water and Sanitation Centre www.irc.nl

Water Aid www.wateraid.org

Siren Conservation Education www.siren.org.uk

The Rainwater Harvesting CD , H. Hartung, Margraf Publishers, 2002 Available by emailing: info@margraf-verlag.de or HansFHartung@aol.com

Rainwater Harvesting - The collection of rainfall and runoff in rural areas , A. Pacey and A. Cullis ITDG Publishing, 2002 (available from https://developmentbookshop.com/water-and-sanitation)

Options for increasing the Productivity of harvested and stored rainwater for smallholder farmers in the dry areas of Western Pare Lowlands: Controlling siltation in dug-out ponds, by the Soil-Water Management Research Group of International Water Management Institute and Sokoine University of Agriculture, August, 2005.

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