

RUNOFF RAINWATER HARVESTING

What is this Action Sheet about?

There are many ways to harvest and store rainwater. Action Sheet 13 explained 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 for use in farming.

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

- If you are building on communal lands, the community must get together and agree on ownership, operation and maintenance of the system
- You need to assess whether the system will cause any problems for people in the area. Are there buildings, roads or paths nearby?
- 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 X 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 to be drunk (See Action Sheet 23). Risk of contamination with industrial or agricultural chemicals should also be assessed.

WATER PANS

What is a water pan?

It 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 1,000m³. 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?

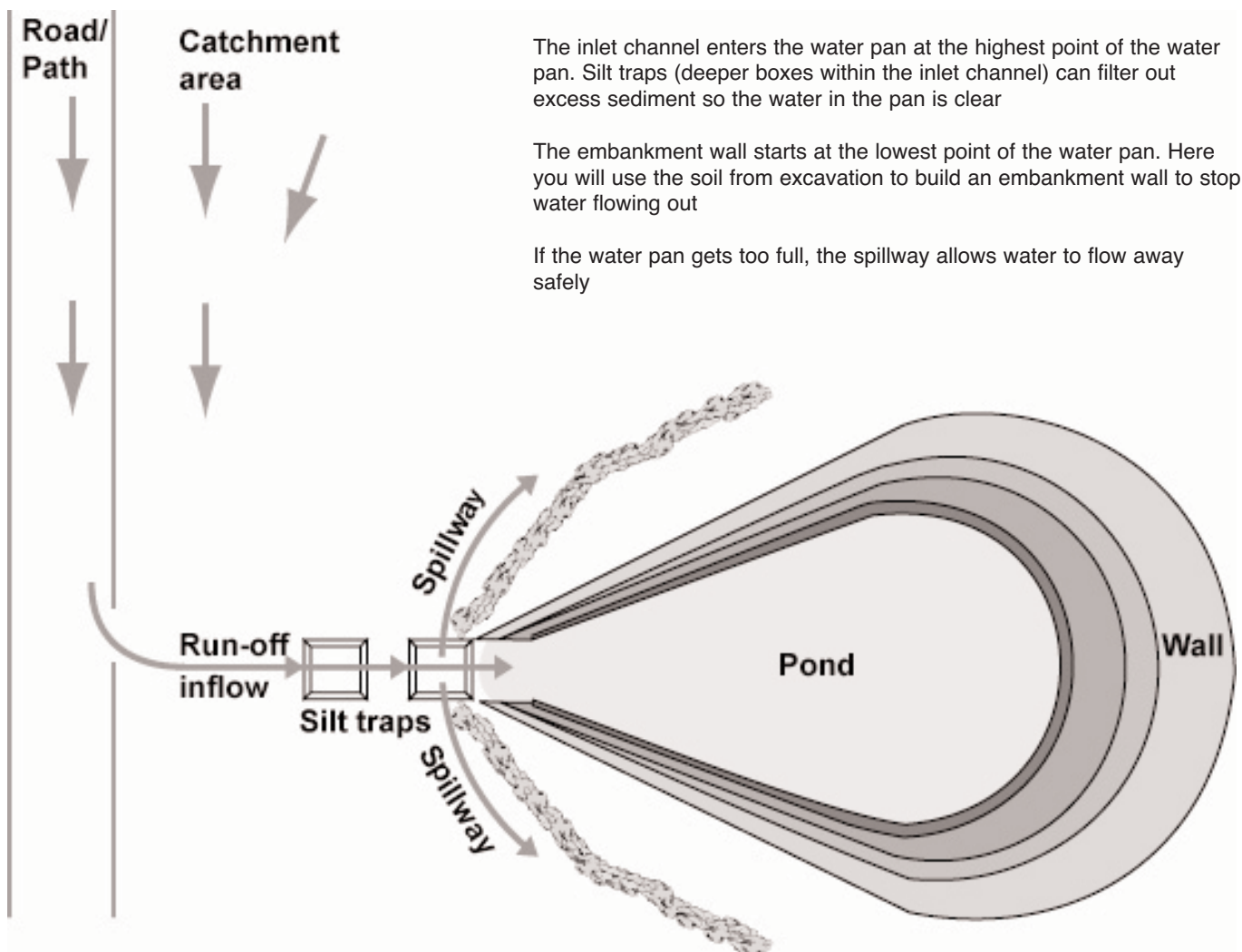
- Water pans are simple to construct and use
- They can provide water for domestic/livestock use and crop irrigation
- They don't need much maintenance

How to choose where to make a water pan?

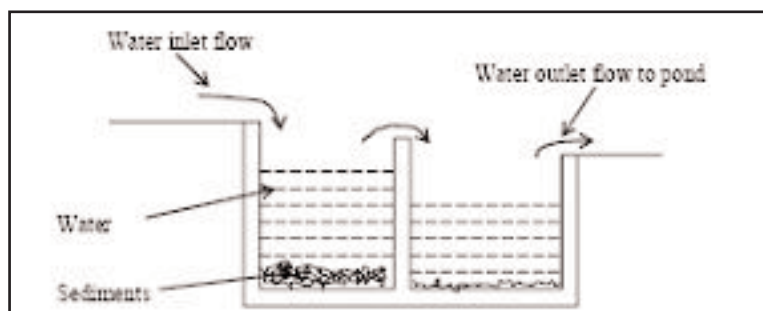
- A site with soils such as clay that retain water. Avoid sandy soils
- A natural depression or small valley so you don't have to dig too deep
- A road or lagga (dry streambed of a river that flows only in the rainy season) nearby to act as a source of runoff water
- The area from which water flows into the water pan should be covered in trees or shrubs, so that the water collected is not full of soil

What is a water pan?

It 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.



Main features of a water pan (Image: SearNet)



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

How do you build a water pan?

Step 1: Site the water pan and mark the embankment, inlet and spillway

Step 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. Line 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.

Step 3: Construct spillway to discharge excess runoff water when the pan is full

Step 4: Construct silt trap(s) along the inlet channel to filter excess sediment load

Step 5: Close off the water pan with live fence to keep livestock out

Step 6: Provide livestock watering trough outside the fenced area.

How else can you minimize water losses in a water pan?

- Plant cuttings of trees such as Commiphora and Euphorbia around the edges of the pan

How do you stabilize the walls of a water pan?

- Make sure the embankment sides are properly compacted during building
- Plant shrubs and grasses on the embankment wall
- Place stones on the embankment sides

How do you maintain a water pan?

- Repair broken perimeter fence as need arises
- Avoid direct entry of livestock into the pan to prevent trampling on bed and walls
- Clean inlet channel by removing silt every season

How do you get water from the pan to give to livestock?

- This can be trough fed by a pipe running through the embankment wall
- Where livestock draw off point is not provided, use portable wooden troughs, a drums cut into half or old tyres to water livestock



Plastic lined tank (Image: SearNet)

PLASTIC-LINED UNDERGROUND TANK

You can also direct runoff water 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 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.

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?

- Excavate the tank site to required shape and depth. Provide for water inlet and outlet (in case of over-flow)



Plastic lining anchored with brick wall
(Image: SearNet)



Plastic lining anchored with sand-bags
(Image: SearNet)

- Smooth the walls and floors of the tank to ensure that the lining walls and floors to ensure that the plastic lining will not be damaged. You could plaster with mortar or soil/cement mixture to make it smooth
- 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
- Place the lining in the tank after ensuring that there are no stones or sharp objects. 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 masonry wall, select bricks of high strengths, choose good structural mortar mixture and ensure good workmanship. Wet bricks before laying. Cure the masonry work properly. Make sure that the plastic lining fits the pond loosely so it doesn't break when it is anchored
- Cover the top of the tank using any roofing materials to minimize loss of water by evaporation and protect the plastic from the sun. Build in a manhole to help with maintenance. Make sure the manhole is closed or fence off the whole area as a safety measure

How do you maintain 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.

Advantages of plastic lined tanks

- Affordable
- Reliable
- Low maintenance
- High storage efficiency due to cover
- Relatively long lasting
- Supplies extra irrigation water, water for livestock or for some domestic use.
- Can be installed by local artisans

Disadvantages of plastic lined tanks

- Plastic may be 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/cover to protect the lining
- Need constant maintenance

ACKNOWLEDGEMENTS: This Action Sheet was prepared by Nancy Gladstone and is based on the SEARNET Rainwater Harvesting Technologies Database entry on Water Pans for Runoff Rainwater Harvesting, and Plastic-lined Underground Tanks. (<http://www.searnet.org/rhtdatabase.asp?pn=3>)

FOR FURTHER INFORMATION

CONTACTS

GHARP - Greater Horn of Africa Rainwater Partnership www.gharainwater.org/index.html
International Rainwater Catchment Systems Association (IRCSA) www.ircsa.org
International Rainwater Harvesting Alliance www.irha-h2o.org
IRC - International Water and Sanitation Centre www.irc.nl
Practical Action (formerly known as ITDG) www.practicalaction.org
SEARNET - Southern and Eastern Africa Rainwater Network www.searnet.org
Water Aid www.wateraid.org
Siren Conservation Education www.siren.org.uk
WELL (WEDC) www.lboro.ac.uk/well/index.htm

BOOKS

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 www.developmentbookshop.com)
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