“With these simple activities you will have more water for your families and livestock, and your crops will have a greater chance of withstanding droughts and overcoming soil loss.”

Photo: Malawi, 2016 © Victor Lacken/IFRC

Water Harvesting and Conservation

Water harvesting activities involve collecting water for use by families, farmers or animals. It can involve capturing rainwater from roofs or catching and storing water in the soil.
Water conservation activities help to keep captured water safe and healthy to use, and reduce water wastage or loss. Water conservation involves delivering messages to ensure households safely manage their water resources to reduce water loss.

Photo: Jamam, 2012 © Alun McDonald/Oxfam

There are many different activities that can help you capture water for your household needs or for your crops.

What does the activity look like?

Water harvesting and conservation involves researching, understanding and gathering people's agreement on which of the activities and methods are most suitable to capture, store water and use water more efficiently in their community. Once an activity has been selected, it then involves training and supporting people to implement the activities.

There are four main types of activities to harvest and conserve water listed in this section. Each method should be assessed and tested to check if it will work in a particular place and you can adapt any activity so that it is practical for people to use in their community;

1. **Surface water harvesting for farming** - These activities are simple cultivation methods and structures on farming plots to capture and store water in the soil for plants to use.
2. **Rainwater run-off capture and erosion control activities** – These activities involve building small barriers or dams to slow down the flow of rainwater that can cause erosion damage. Sand dams can also be used to capture water for use by animals or (if treated further) for drinking.

Photo: Uganda, 2014 © S. Truelove/Action on Poverty

Rainwater is really easy to capture with simple homemade structures like this plastic sheeting. Catch the rainwater on a clean surface before it hits the ground, and channel into a clean collection container

3. **Roof rainwater harvesting for gardens, livestock or drinking water** – These activities collect water from roofs and other structures with simple homemade structures.
4. **Safe water conservation and community water management** – These activities ensure that water is properly stored and kept, shared fairly to households and that water is not wasted, by people or animals. It also involves the community to monitor, maintain and improve water management methods.

Photo: Kenya, 2015 © S. Truelove/innocent foundation

This community built a large 'sand dam' to slow down the flow of rainwater that was causing erosion. The dam held back sand that then acted as a water store for use in the dry season

What are the main benefits?

Photo: Mauritania, 2013 © Katherine Mueller/IFRC

Harvesting and conserving water will increase the amount of water available for people, animals and farming.

Some activities try to slow down the flow of rainwater and floods that can carry away soil and damage land.

It keeps water in the soil and available to plants, so can help plants survive for longer without rain. This means plants can provide more food for families.

Water harvesting and conservation help people to withstand the shocks and stresses of the unpredictable rainfall and changes in climate and weather.

Some of the activities require small amounts of resources, but most require only time and effort.

The activities are particularly important in drought-prone areas where water is very scarce.

Preparations

Timing tips

Different water harvesting activities or structures can take different lengths of time to prepare. It may take a few weeks, months or longer, depending on the activity selected and the availability of people to do the work. The 'capture' of water depends on the amount of rain received and can take several attempts, sometimes over more than one rainy season to adapt and improve with experience.

Water conservation is an ongoing activity. Even when water protection mechanisms are installed – such as fences – these need to be continuously monitored and maintained to be effective.

Timing of the activity - The best time to construct surface water harvesting structures is when the ground is wet and easier to work. However, at this time people may be busy with other tasks. Most structures can be built at any time – the important thing is that they are in place before the main rains arrive.

What does the volunteer need to do before the activity can start?

1. **Get advice and support from experienced people** - Water harvesting and conservation is best designed and carried out with people who are knowledgeable or experienced in using these types of methods. Are there community members or neighbouring people who have used similar techniques, so they will know what works well locally? You could ask your local extension officers or other agencies like NGOs or international organisations like FAO (the Food and Agriculture Organisation of the United Nations) if they have soil and water conservation staff who can help.
2. Follow the steps outlined in 'Community Action Planning' in the 'Introduction' to this handbook, to identify and prioritise the problems related to water and soil conservation.
3. Try to discuss and understand what the local rainfall and land conditions are:
   - Gather information about rainfall patterns, including seasonality and intensity of rains, flooding, dry areas and erosion areas.
   - Concentrate on identifying the causes of water shortage and soil loss problems.
   - Learn about the overall landscape including how and where water drains to, is absorbed into the ground, and can collect into pools. Where are water channels (rivers, streams, canals) and where does water flow from and flow to? Keep in mind communities that live up and down stream and how your water conservation actions may affect them!
   - Find out about overall land-use patterns (where are the agricultural plots? Forests? Roads?)
4. Review which of the activities in this section or other activities that the experts suggest seem most suitable. Sometimes, it can be better to select activities which have already proved successful locally.
5. The decision on a particular technology or approach should be made together by the community, experts, and neighbouring communities who share the same source / supply of water and may be affected by any water structures. Try to select methods that local people feel will work best for addressing the causes of their own problems. No one approach is likely to suit everybody's situation. People usually have a good explanation for why!

Once you have decided on an activity:

6. Consult with the community about how to find any of the equipment, materials or funding needed to build the water harvesting structures. Things to consider include when and how the work will be carried out, who will contribute their time, tools and labour and where the materials will come from.

7. All the listed activities require money, and if materials do need to be bought, then funding needs to be secured (either from the community or from other sources) and the materials ordered. The community will need to find the resources together!
8. Agree on and begin to form any water management committee or organisation that will be responsible for maintaining and monitoring the structures once they have been built.
9. For water conservation, develop messages that will work locally, identify who are the best people to act on the messages, and 'test' the messages out by talking to a few people who are in your target group.
10. Before starting the work, it is a good idea to write down a plan on paper and show it to the community. This should show where the activity will be located and how it will look when completed.
11. It is a good idea to write down a plan for the work to be done, including when each step will be taken and who will help out. This helps to keep the activity on track.

How to avoid risks

The success of water harvesting depends on four things:

1. Rain as a source of water – if there is no rain, it cannot be harvested.
2. Monitoring and conserving the water.
3. An effective harvest method that is monitored and maintained. Structures that are run down or damaged do not work well. Badly located structures may need to be moved or modified. Making modifications is not unusual and not a failure, but it is important to acknowledge that you may need to change, modify or re-do some of the structures.
4. Making sure that any water to be used for drinking will be safe (see Section 8 'Safe Water, Sanitation and Hygiene').

Capture rainwater for safe drinking water and keep gutters clean and well maintained.

Photo: Uganda, 2014 © S. Truelove/aptuk.org.uk

Photo: Kenya, 2015 © S. Truelove/innocent foundation

How to implement the activity?

Select the most appropriate activity:

Activity 1	**Surface water harvesting for farming**
Activity 2	**Rainwater run-off capture and erosion control**
Activity 3	**Roof rainwater harvesting for gardens, livestock or drinking water**
Activity 4	**Safe water conservation and community water management**

Introducing water harvesting

Water harvesting is the first step to increasing stored water. In rural agricultural areas, this is traditionally done by capturing as much rainwater as possible on the surface of the soil and holding it for future use. Most systems channel rainfall run-off towards an area which can hold water – either a pond or reservoir or within the soil.

Water captured and held above the ground risks being lost either by evaporation or contamination (by dirt and disease). Capturing or trapping water within the soil depends on the soil type and structure. Traditional and local knowledge about water harvesting and water and soil conservation is often a good first step to gain an understanding of what has worked well in the past. It is also good to open up a discussion on some newer methods that may work well in the future.

Some common ways of capturing water are listed below – each needs to be carefully assessed and adapted to local conditions. All the activities listed require rainfall but make the most of the amount of rainfall by channeling the flow of water to one area, so that it has more time to soak into the soil or be captured and stored in some form of container or pond.

Activity 1: Surface water harvesting for farming

For many of the activities that harvest surface water for farming, you will need to mark out a level line across the slope of farm land. Here are some instructions for how to do this:

How to mark out a level line across a slope to create farming strips for surface water harvesting

The line across the slope should be as close to level as possible. Remember to keep the width of the cultivated strips suitable for locally used ploughs. On very steep slopes, the cultivated strips may need to be narrower so the lines you make across the slope will need to be closer together. Your local extension officer should be able to advise.

To mark these level lines across the slope, construct a simple wooden A-frame structure measuring 1.5 m high with legs 1.5 m apart. The horizontal support cross-piece is marked at the centre or half-way point.

A string with a weight (stone or metal object) is attached at the top point of the 'A' and allowed to hang freely, similar to a pendulum as in the diagrams here:

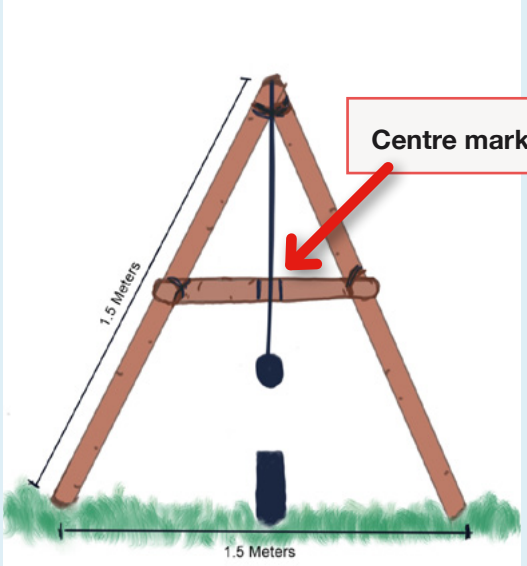


Photo: 2020 © J. Zaremba

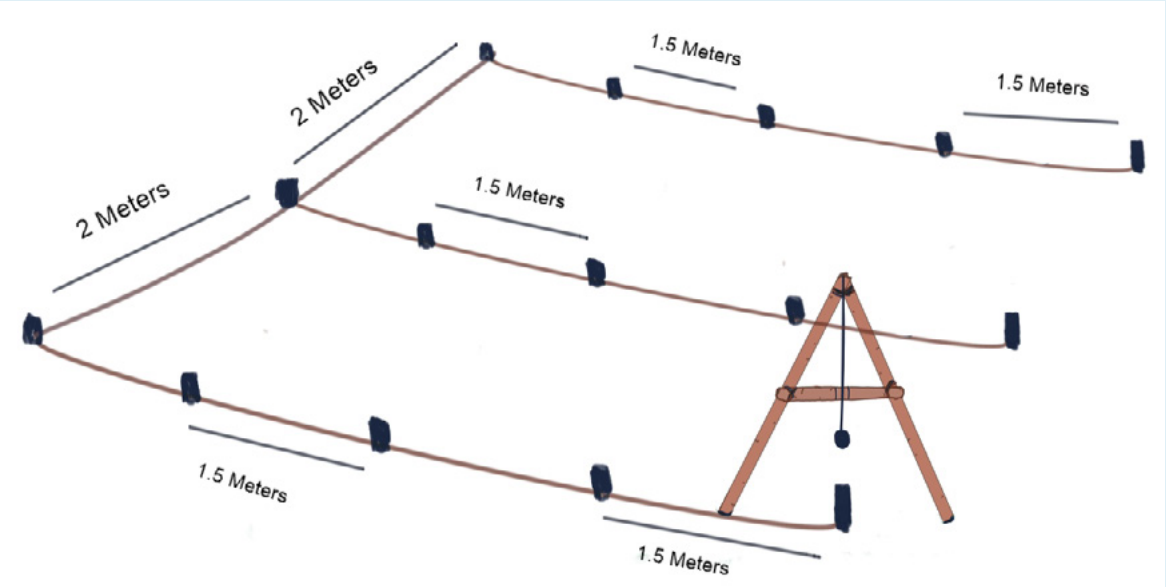


Photo: 2020 © J. Zaremba

Starting at the bottom of the slope, 'walk' the A-frame across the slope by rotating it from one leg of the frame to the other. Place a marker at each point on the ground where the pendulum lines up with the centre mark on the A-Frame cross-piece. Continue this for the length of the field that you wish to farm. The markers show a line across the slope that is approximately level.

Locate the next contour line 2 metres up or down hill from the first row. Follow the same marking procedure until the entire field is marked out.

The main goal of the surface water harvesting activities listed below is to collect water for growing plants. The technologies listed are suitable for slopes up to 5% (for every 20 metres, the land rises by 1 metre) and are simple to construct. Volunteers can find more details about these activities in the resources which have been listed in the Annex at the end of this handbook.

Strip farming

This is one of the simplest ways of conserving water for plants and reducing soil being washed away in areas where there is a slope and soil erosion problems. It involves growing the usual cultivated crops in strips across the slope and leaving thin uncultivated strips in between. The strips are arranged to be approximately level across the slope of the land (see box on 'how to mark out a level line across a slope'). **Strip cropping** helps to slow the flow of water running down a slope, creating natural untilled vegetation barriers so that the trapped water has more time to soak into the soil, as shown in the diagram below.

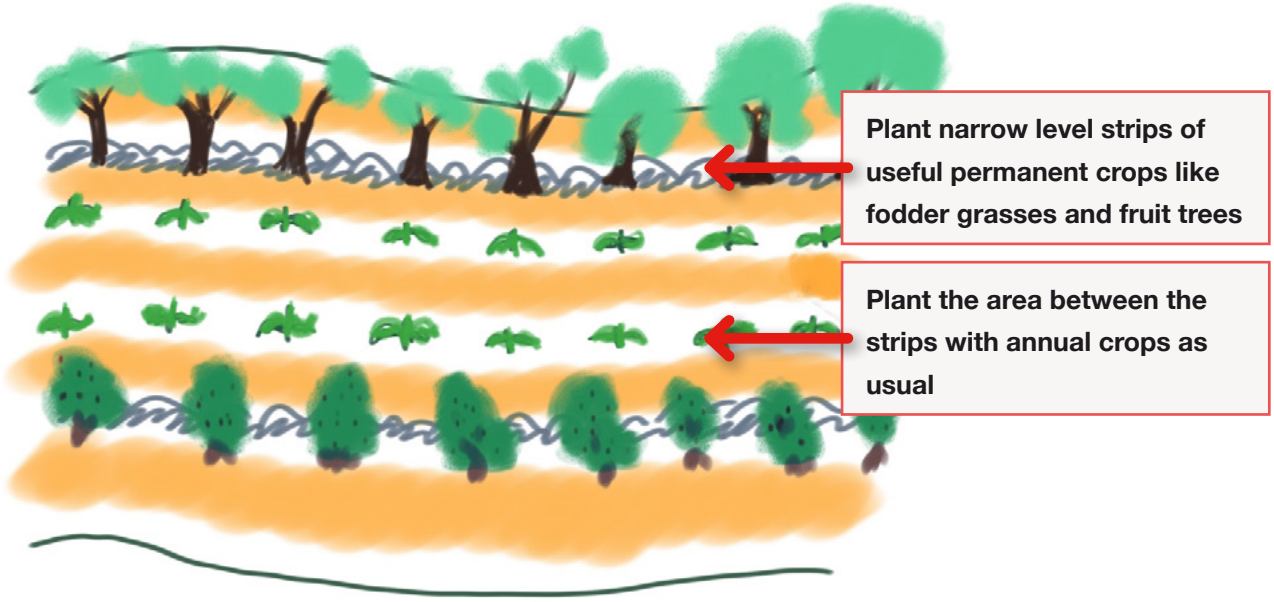


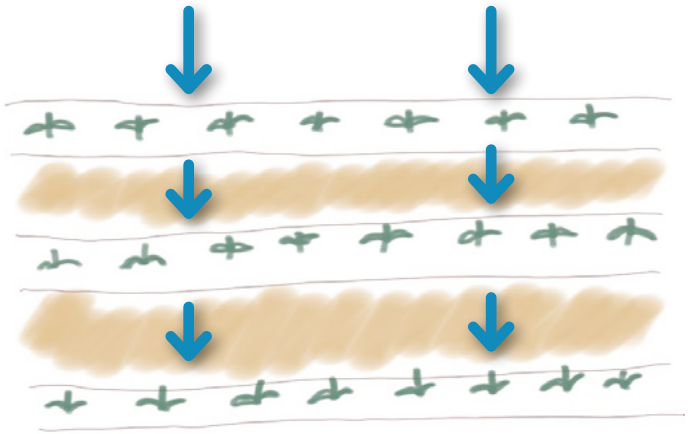
Photo: © J. Zaremba

Strip farming with wide cultivated strips and narrow uncultivated strips of fodder grasses.

Farmers can grow any permanent crops on the uncultivated strips. Many choose to grow improved fodder grasses or shrubs. Your local extension officer will be able to suggest types of plants that can fix Nitrogen (called 'leguminous' plants) which not only help add fertility to the soil but add extra nutrition to the animal feed. Some farmers also grow a few fruit or wood fuel trees to help supplement their income.

Strip catchment tillage

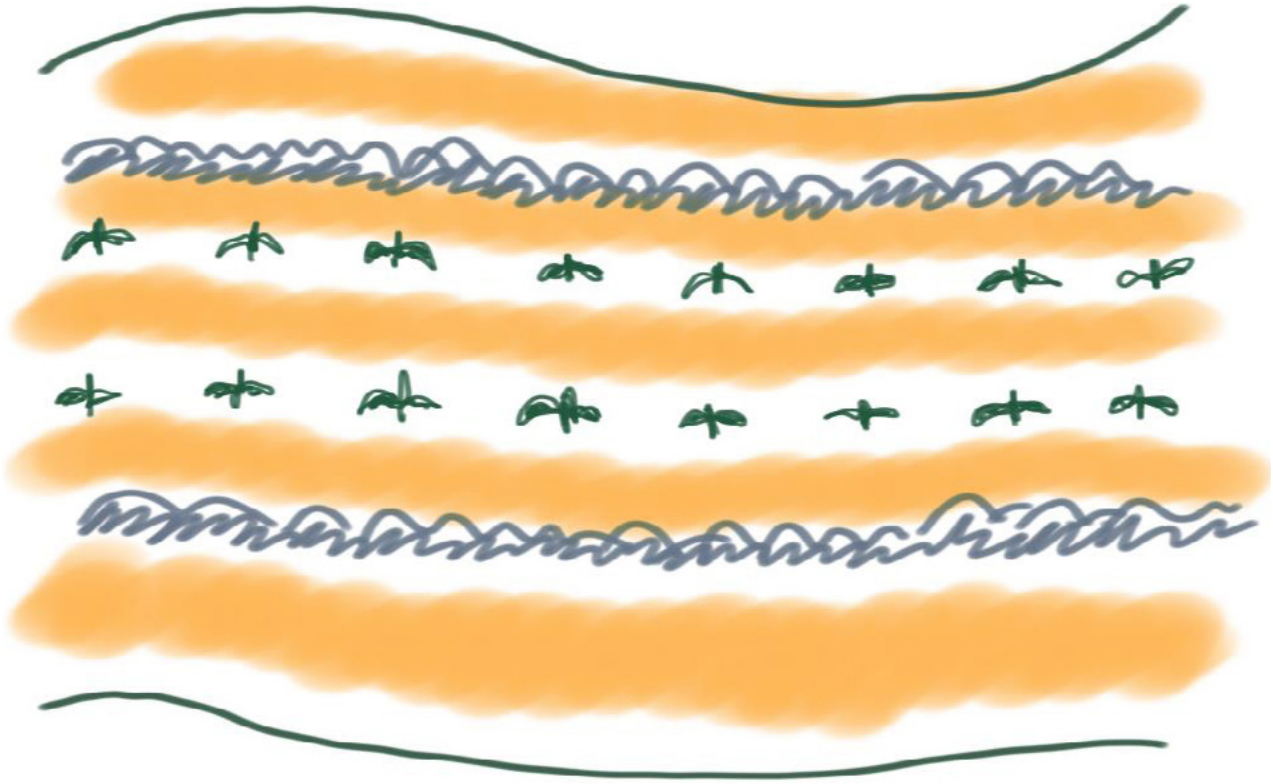
This tends to be used in drier areas and involves planting crops in rows across the slope but leaving space between the rows for water to run-off to the lower row. It is normally used with gentle slopes and the space between each row is about twice as big as the row for planting. Remember the strips run across the slope, not up and down the slope which would make the rainwater run away even more quickly and leads to even more soil loss!



Strip tillage: in dry areas, strips are left untilled to allow water to run off into the planted area just below.

Strip bunds or ridges

Strip bunds are small embankments, ridges or walls, made of stones, rocks, rubbish and earth placed across the slope. The ridges slow down the water that runs down the slope and traps water which settles into the soil behind the ridge. Strip bunds are easy to construct and can be used where the slope is less than 5%. Some people plant fodder grass strips across the ridges to protect the ridges and reduce rainwater run-off, erosion and damage to crops from strong winds.



Strip bunds or ridges.

Photo: © J. Zaremba

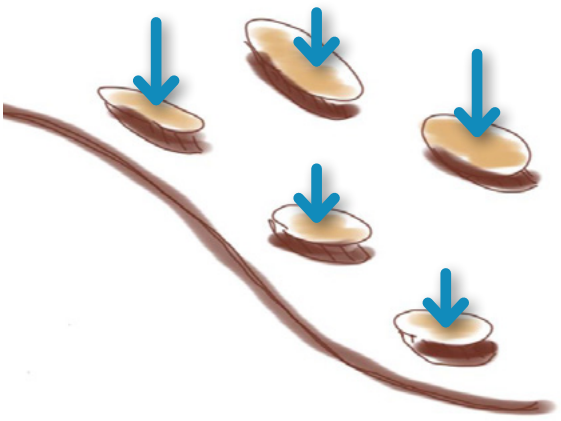
Soil pits or '*Zai*'

Soil pits or '*Zai*' is an activity where people dig small planting pits in the soil before the rains to catch water and concentrate compost. The technique is traditionally used in the dry areas of the Sahel to restore degraded drylands and increase soil fertility.

Dig small planting pits that are 20-30cm wide and 10-20 cm deep, and place the soil from the pit or small rocks or stones on the downhill edge of the pit to form a small dam. The pits are then filled with soil mixed with manure or compost where the crop will be planted at the centre of each pit. Water and soil captured in the shallow pit by the ridge of stones or material start to build up and provide better soil and water conditions for the plants.

Millet growing in zai pits in Burkina Faso.

Photo: Burkina Faso © H. Sawadogo/ECHO



Soil pits or 'Zai' layout.

Photo: © J. Zaremba

Photo: Niger, 2009 © S. Truelove

Semi-circular bunds or 'half-moons' ('Demi lune' in French)

Semi-circular bunds or 'half-moons' are constructed from stones, earth or rubbish. They are effective where the slope is not very steep or less than 3% and the annual rainfall is 100 mm or more. The bunds or half-moons are built along a level (or 'contour') that is spaced to form a 'staggered' effect, as shown in the photo and the diagram here. Water is collected in each half moon or semi-circle and sinks into the soil. Extra water flows around the edges of the bund into the next semi-circular bund just down the hill. The size of the semi-circle is not important, they can be small or up to 20 to 24 metres across the top edge of the half-moon shape.

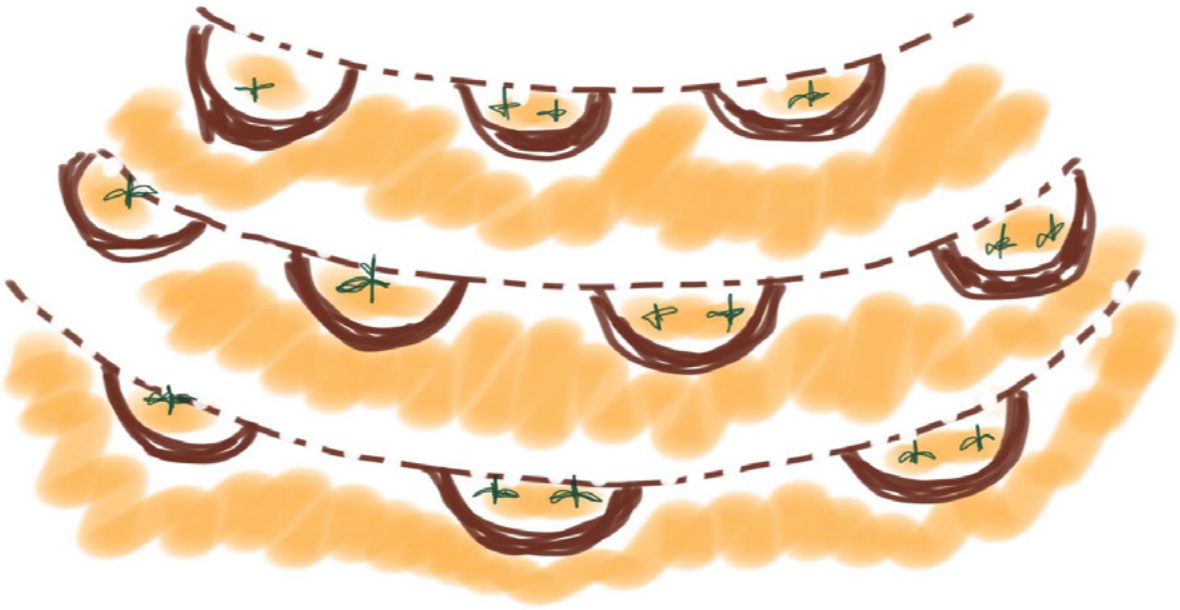


Photo: © J. Zaremba

Offset or stagger the 'half moon' shaped semi circular buds.

Photo: Niger, 2009 © S. Truelove

Constructing semi-circular bunds can be hard work so share the load by working in groups.

Activity 2: Rainwater run-off capture and erosion control

When water runs at speed down slopes it can take away the best soil and erode deep channels as shown in the photo below.

Photo: Kenya, 2015 © S. Truelove/innocent foundation

Fast running water erodes deep channels.

Check dams and sand dams can help to reduce this problem.

Check dams

Check dams are small dams built from simple local materials (when the river or stream is dry) across channels, streams or rivers to slow down the flow of water. This helps the water go into the soil and reduces the erosion of the channels. Soil carried in the water is also deposited behind the check dam.

Photo: Malawi, 2018 © Juozas Cernius

A check dam can be build with local materials such as stones, sticks, fence poles, or wire mash.

Sand dams

Sand dams are built across a seasonal, sandy river to capture water in a reservoir and in the sandy banks around the 'dam'. The dam is built from a combination of support material, like timber or rocks, and filled in with general rubble (stones, mud). The reservoir fills up with water during the rainy season and the trapped water soaks into the sand. Once all the surface water has dried up, the water below the sand surface is still available and can be used.

Photo: Kenya, 2015 © S. Truelove/innocent foundation

Water builds up behind the sand dam and can be used for farming or animals or cleaned for drinking.

Photo: Ethiopia, 2012 © S. Truelove/Humanitarian Coalition

Ponds for livestock can be planted with crops but avoid drinking the water unless it is cleaned (see Section 8).

Ponds

Ponds are a popular way to store water for livestock. Once the water levels drop, the area can be planted for food (see Section 1 on 'Gardens') or fodder for livestock. Larger ponds, basins or reservoirs can be used to store water and to channel water to irrigate land further downstream.

Drainage channels for flood water to run-off into specific plots of land can also be an effective way of capturing water during the rainy season and help to reduce flooding in some areas, while helping drier areas downstream to water their crops. Channels cut into the land can capture water from larger areas, such as hilltops or farmlands in a higher-up area. The water is channelled into a holding basin – such as a pond or reservoir - or onto farmlands lying lower down a hill.

Larger scale water harvesting schemes need to be carefully planned using local and historical knowledge about the layout of the land and soil structure and water flows. They are best carried out with expert advice and guidance.

Activity 3: Roof rainwater harvesting for gardens, livestock or drinking water

Roof rainwater capture can provide a source of water for gardens or livestock and can be done with any type of roof surface, homemade gutters and any kind of water capturing device.

If the rainwater is to be captured for human consumption it must be done so that the water is safe to drink. Water can be harvested close to homes, schools or clinics. Capture systems are easy to install but do require maintenance. Roof capture requires a roof, guttering and piping and a storage tank and taps. For the roof, corrugated sheets or tiles are best – although thatching and wood roofs can also be used. For the guttering, plastic piping can be used, or bamboo or sheets of corrugated steel bent into a 'v' shape. Piping and taps may need to be purchased from a store. Technical details on how to construct roof water harvesting using different types of materials is available from ***WaterAid*** and from ***Practical Action***.

The roof, guttering and piping must be cleaned regularly and checked often for any cracks, blockages or leaks. Always have a plan for cleaning and maintaining the system.

Photo: Uganda 2014 © S. Truelove/aptuk.org.uk

Capture rain from a roof in whatever way you can.

Water which is collected from clean surfaces can be used for drinking **only if it is treated carefully** (see Section 8 'Safe Water, Sanitation and Hygiene'). People should be encouraged to be careful, as water from roof capture can trap insects, rodents and bird or animal droppings and other rubbish that can contaminate water and encourage algae to grow. Seek advice from the technical guides on how to construct roof capture mechanisms that can minimise contamination and always promote safe drinking water practices as outlined in the activities in Section 8.

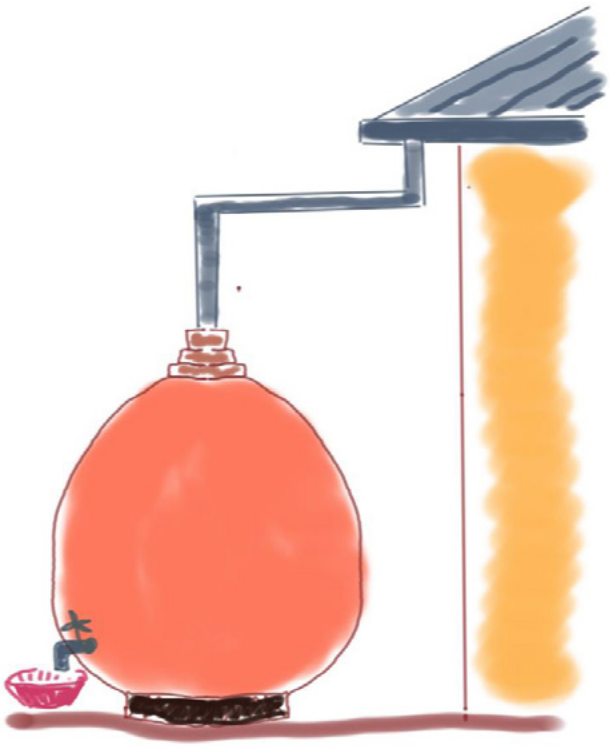


Photo: © J. Zaremba

Roof rainwater harvesting.

Activity 4: Safe water conservation and community water management

Once water has been harvested, or where it naturally collects and settles, various methods can be used to ensure that it does not evaporate, get used inefficiently or become contaminated.

One of the most important steps in water conservation is developing a system that people agree to and will follow and keep to. Community based water management ensures that water is:

- properly stored and kept
- shared fairly between households
- not wasted by people or animals
- monitored carefully and improved by the community

Methods for conservation are different depending on the type of water harvesting or capture system and the local needs of a community. Some conservation measures are carried out by communities, some by groups within the community such as schools or hospitals, and others by households. The activities outlined below provide an example for each type of water conservation.

Community Actions

Water sources and areas where water is captured need to be protected from livestock, people and getting worn down by the environment. Water that is captured in ponds, tanks or other basins should be kept covered (with lids, corrugated iron sheet or a roof). This helps reduce water loss and reduces the risk of illness from contamination by flies and mosquito-borne diseases. Planting hedges and trees can be a good way of replacing costly fencing to protect water sources. Agreeing with livestock owners on the use of areas containing water is necessary and monitoring that agreements are upheld is an important part of conservation.

Photo: Yagha Province © Sarah Oughton/IFRC

Communities need to agree how to manage and protect water sources.

Actions for public buildings

In schools or hospitals, water captured using roof rainwater harvesting needs to be stored and used safely and efficiently. Set up regular monitoring of the water captured to check for infestation or contamination, and check for leaks in the water storage and taps. Also set up a clear set of steps that anyone who finds a problem can follow to resolve it, setting out how to report problems and who is responsible for dealing with them. Set up a regular weekly monitoring schedule and a monthly maintenance plan to clean gutters, piping, washers and tanks and follow-up to confirm it is achieved. Check for leaks and do general repair and clean up as needed. Finally, prepare short trainings or demonstrations on how to extract water carefully and without spillage, how to avoid contamination and ensure minimum wastage, and follow the same practices for all households to save water and keep it clean (see Section 8 'Safe Water, Sanitation and Hygiene').

Household actions

Water conservation can be improved by delivering messages and training on good and safe water management practices. See the general guidance on messaging in the 'Introduction' to this handbook to deliver the key messages below.

Key messages:

1. **Maintain**: A household's water storage and sources can become run down and need to be regularly checked, cleaned and maintained to remain safe and efficient. Set up a regular schedule to check and maintain water sources and storage devices, including jerry cans and home tanks (see Section 8).
2. **Keep safe**: Keep water storage areas safe so children do not fall in and keep livestock away from drinking household water sources.
3. **Reuse**: Reuse water that has been used for washing or cleaning, for gardens or composting (see Section 1 'Gardens' and Section 2 'Compost'). Be careful that any reused water has not been contaminated with pollutants, strong shop-bought detergents or soaps or industrial oils.

Photo: © S. Truelove

Rainwater harvesting for gardens. Keep water storage containers safely covered to avoid children falling into them. Covering them also reduces contamination and prevents them becoming breeding grounds for insects and disease.

Photo: India © S. Truelove/innocent foundation

Keep drinking water sources safe and fenced off to avoid people falling in and to keep animals from contaminating the water.

Things to watch out for

⚠ **Installing water harvesting methods is only half of the work! Making sure that people understand how to keep the water safe for drinking is just as essential (see Section 8 'Safe Water, Sanitation and Hygiene').**

⚠ **Make sure that the community agrees on how to manage water sources and keep them safe.**

Top tips

- ✓ **Plan and gather input from the community to design the best system.**
- ✓ **Monitor what happens with the system you install.**
- ✓ **Be willing to change your design and do regular maintenance to ensure that the amount of water captured and conserved is maximised.**
- ✓ **Keep records of successes and failures to improve the design of future installations.**
- ✓ **Make sure to consult and ask people from all different parts of your community to be involved, including the most vulnerable and people from different religious, ethnic or language groups.**

Photo: Malawi, 2016 © Victor Lacken/FRC

Section 8 describes activities on how to use the harvested water for safe drinking water, sanitation and hygiene.

Links to other sections in this handbook

If any of the water will be used for drinking water then it is essential that you consult and use the activities in Section 8 'Safe Water, Sanitation and Hygiene.'

Section 1

Gardens

Section 2

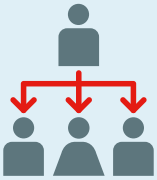
Compost

Section 3

Shaded Seedling Nurseries

Section 5

Improving Farming Practices



Section 6

Lead Farmers and Demonstration Farming

Section 8

Safe Water, Sanitation & Hygiene

Resources and skills needed

What resources are needed to run the activity?

- Volunteers will need the usual meeting and community space to discuss, plan and work with the community to design water harvesting and conservation activities. Paper, pens and notebooks to write down decisions and draw up plans are helpful but not always essential.
- Depending on the method and technology used, materials and tools will be needed. These are likely to be digging instruments (shovels, trowels, pickaxes etc.) for the surface water harvesting methods.
- Conservation measures that involve planting trees, bushes or grasses will require the seeds, seedlings and tools for planting.
- Fencing material may be needed for fencing off and protecting water sources.
- Roofing or covers and containers are needed to keep water from evaporating and protect it from some contamination.
- Access to technical guides – such as booklets or a computer with internet to find the technical references specified in this section – will be helpful for the roof rainwater capture design.

Approximate costs

This will depend on the technology used, so it is worth drawing up a list and estimating costs. Costs can range from zero if using local materials and tools to higher costs for purchasing water storage containers, guttering and piping for roof rainwater harvesting.

What skills or knowledge do volunteers need?

- It is important to have knowledge of the environment, including the slope of land, how rainwater has flowed in the past and previous mechanisms that have been used for harvesting water. Some of this can be gained by talking to elder people.
- For some of the options listed in this section it will be important to have some access to technical advice, either locally or through the internet where guides are available.

What skills do participants need?

- People's labour is important along with the tools that they can bring to build some of the structures outlined.
- Some basic plumbing skills will be very helpful for the roof-rainwater capture techniques.
- It is helpful if everyone is committed and takes part in conservation of water!

What needs to be monitored or followed-up?

Monitoring the water harvesting and conservation structure is an important part of maintenance. This is done by checking structures regularly and making repairs quickly.

Measuring the amount of water collected can identify leaks or wastage, and can be helpful for improving the design of a water harvesting or conservation mechanism. Simple tools can be made such as a stick with lines on it that measures the height of water at different times. Record the levels before and after rainfall and at regular intervals during the month or year.

Photo: Malawi, 2018 © Juozas Cernius

This community in Malawi built a 'check dam' to hold back water for drinking water and for watering their crops in the dry season.