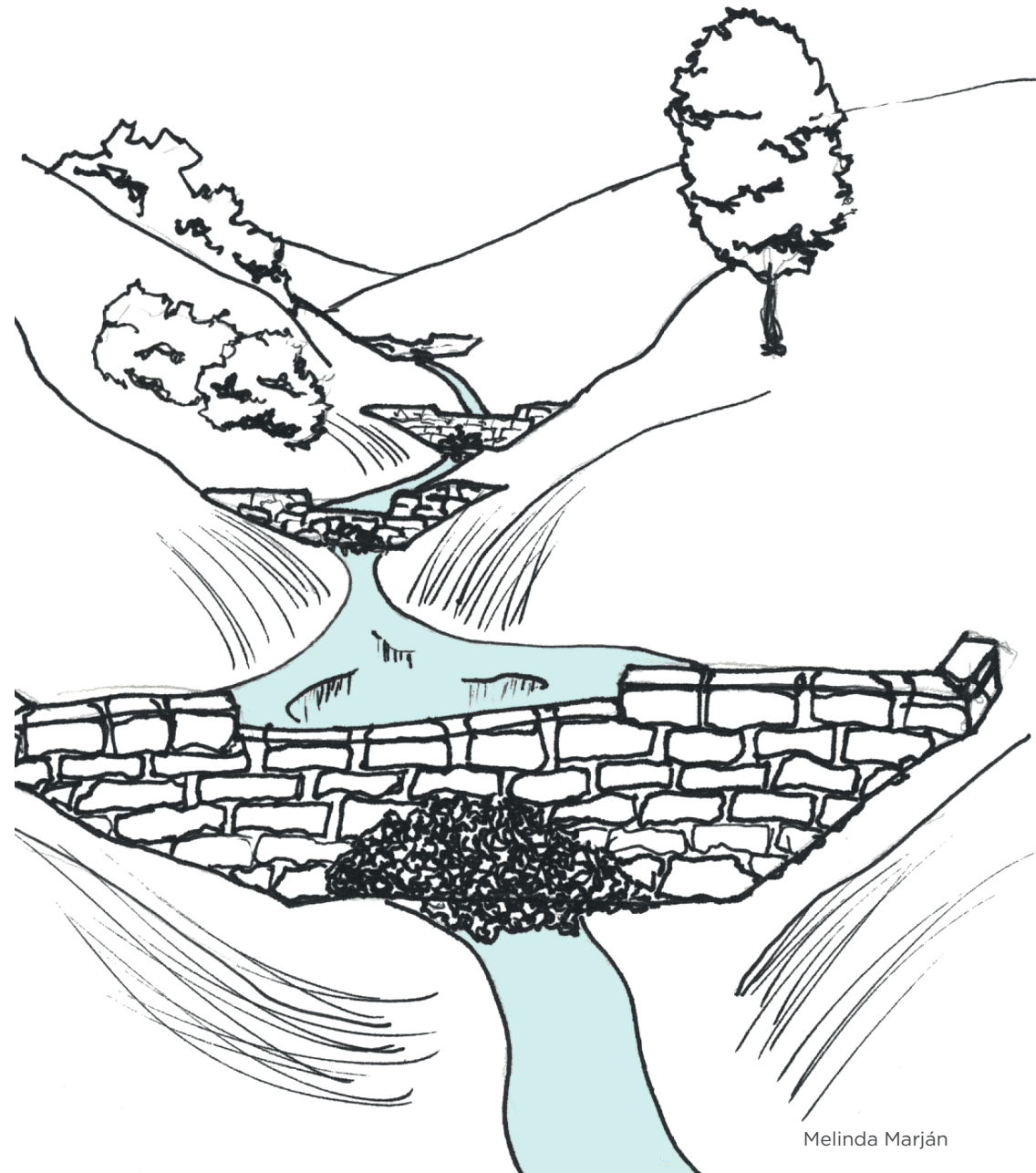
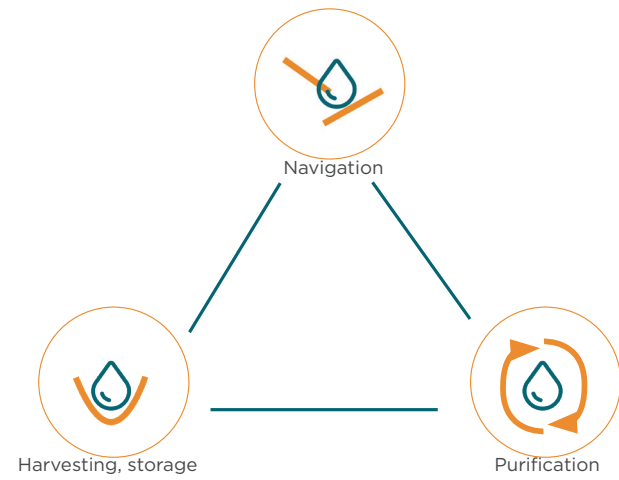


# Re- Connecting with water

Solutions for water harvesting, storage, guiding and purification in rural areas





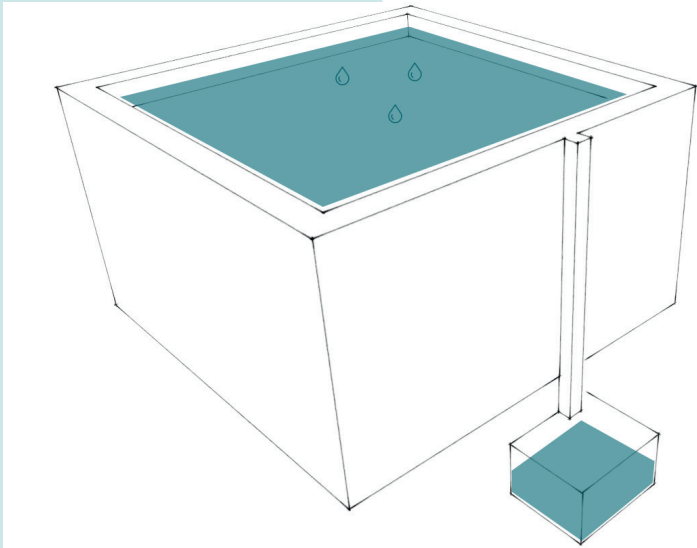


The brochure lists low cost solutions for water harvesting, storage, navigation and purification that can be constructed by using local materials and can be easily maintained by the locals.

Note: The collection is a work in progress. There are many traditional and modern solutions to be explored!



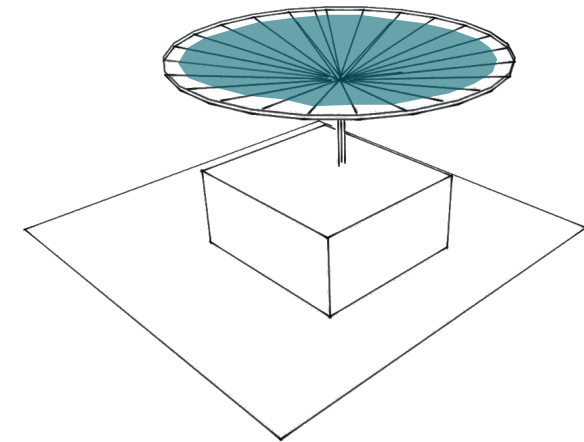
Water harvesting, storage techniques



### Rooftop rainwater harvesting

Rooftop rainwater harvesting is an easy, low cost solution for alternative freshwater collecting. RWH is a good solution to implement in rural areas as it can be placed in individual households and does not need a centralised system. The rooftop acts as a waterproof catchment surface to collect the rainwater that can be stored immediately in an underground or surface storage.

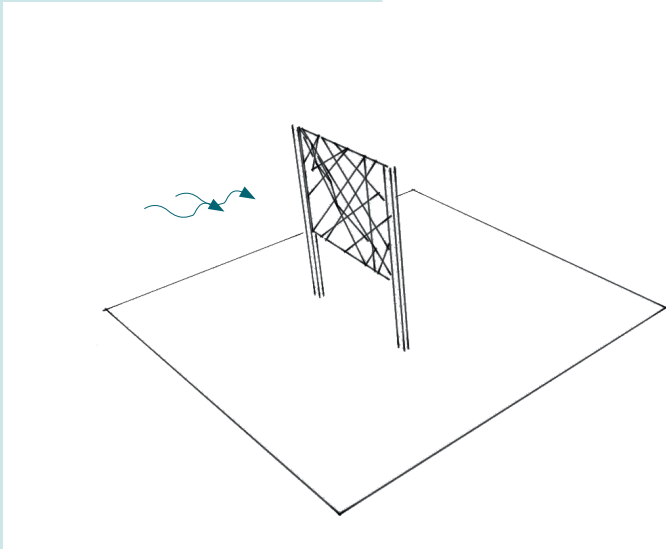
- The quality of harvested rainwater may differ due to air pollution or rooftop pollution.
- Regular maintenance and cleaning of the surfaces and elements is needed to provide higher quality water.
- The system does not affect the ecosystem



### Rainwater harvesting garden furniture

Rainwater harvesting garden furniture operates in a similar way as rooftop rainwater harvesting. The waterproof catchment surface collects the water and stores it in a barrel through a tube. The element can be moved and can act as a sitting, playing furniture according to its design.

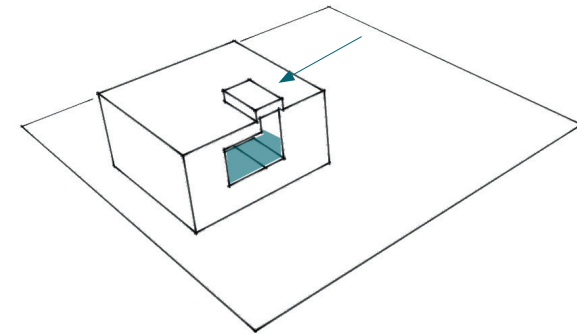
- The quality of harvested rainwater may differ due to air pollution or catchment pollution.
- Regular maintenance and cleaning of the surfaces and elements is needed to provide higher quality water.
- The system does not affect the ecosystem



### Fog water harvesting

Fog water harvesting is a more recent technique to capture water from the air. Fog droplets are smaller than rain droplets and their movement is influenced by the winds making them capable to travel horizontally. The fog collector consists of post supporting a rectangular mesh made out of nylon that traps the droplets and collects them in a storage. The mesh collector needs to be oriented perpendicularly to the winds to operate adequately. The collected water can be used for domestic, agricultural or livestock purposes.

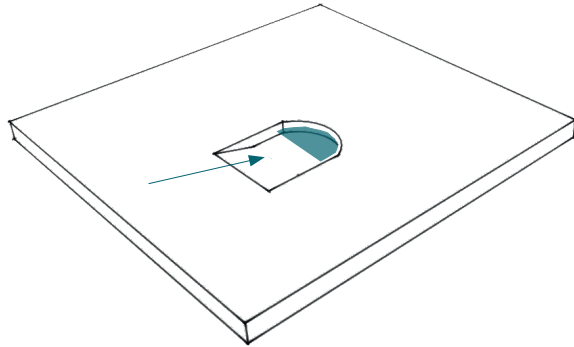
- The quality of harvested rainwater may differ due to air pollution or catchment pollution.
- The costs of the system are low and maintenance can be done locally
- The collector does not require energy to operate



### Subsurface tank

Subsurface can be used to store harvested rain or runoff water for future use. The tank is located below ground to prevent evaporation or further contamination. The tank can differ in size according to the quantity of harvestable water. It needs regular maintenance and cleaning as the collected water might contaminate it.

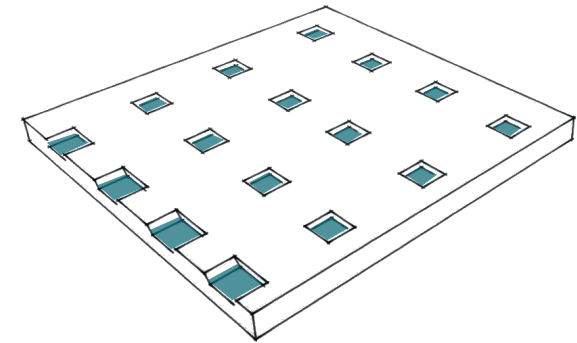
- Collects water during the wet season to be used in need
- Water needs to be filtered before entering the tank



### Micro basin

Micro basins are an easy and well known runoff and rainwater harvesting technique in agricultural areas. Micro basins can differ in size, but are small pools with soil, rock walls surrounding it. The captured water can be used for irrigation or to tree plantation. The basin can be constructed around the plant as well to hydrate the soil directly around it.

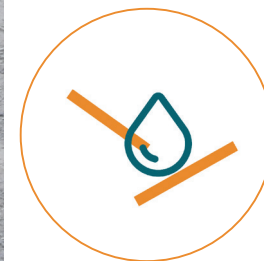
- Regular maintenance needed
- Easy and low cost construction
- Can be used in small scale



### Planting pits

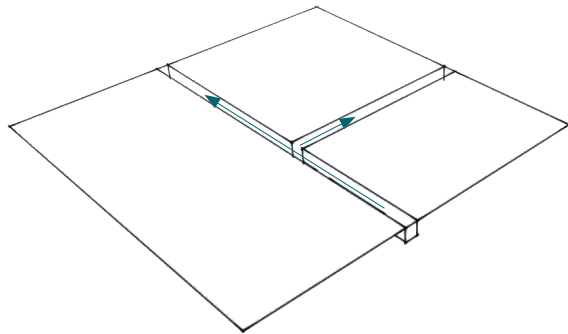
Planting pits are used in agricultural areas to harvest rainwater, prevent erosion or water runoff. This technique works best on low permeable soils, such as silt or clay. Small holes are dug in the ground where the rainwater can be captured and used for irrigation. The technique can be used in arid, semi-arid regions for annual and perennial crops as well.

- Easy implementation, low maintenance
- Flexible planting pit pattern
- Increases infiltration
- Manpower needed for constructions and maintenance as well
- Water logging is possible during extremely wet seasons



Water guiding techniques

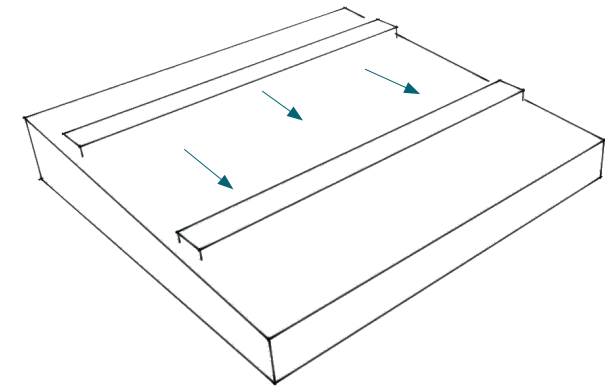




## Irrigation channels

Irrigation channels can be constructed on agricultural areas to provide water to the crops. The channels can be small in size and built out of local materials. This system is a good option for irrigation water navigation.

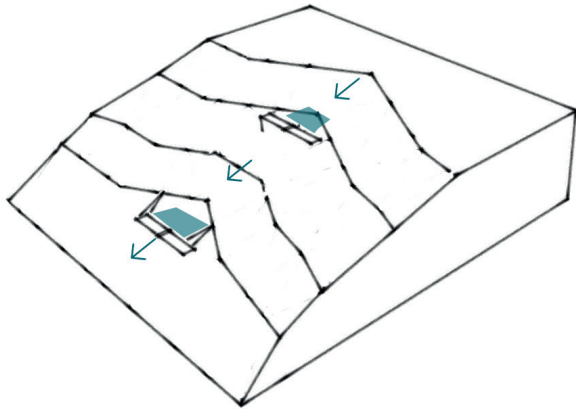
- Easy to construct, needs low maintenance
- Makes crop watering more effective
- Low cost solution
- Pollution or contamination can easily occur
- High amount of water loss due to evaporation



## Bunds

Bunds are a common technique to collect runoff water on agricultural areas. By their design bunds can be built for slightly different uses but their construction and operation is similar. Bunds are built among contour lines to slow down the runoff water, recharge the soil moisture, prevent soil erosion and be stored for future use. They are constructed with soil and stones can be used on slopes up to 5%.

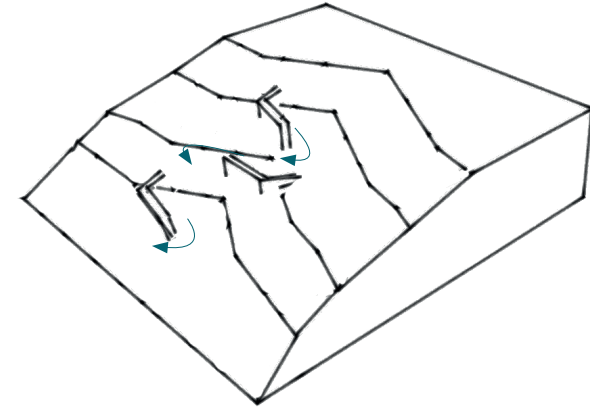
- The construction is low cost but needs regular maintenance
- Can be used in uneven grounds



### Check dam

Check dams can be a solution for soil erosion and landslides. They are mostly used on slopes where the runoff water flows in case of heavy rainfalls and creates occasional streams. These, with the help of check dams can be slowed down, navigated and increase infiltration. The elements can be constructed from local materials and with different methods, therefore it can blend into the landscape easily.

- Reduces erosion, slows down water speed
- Can be made out of local materials
- Allows groundwater recharge
- Needs maintenance
- Needs careful design



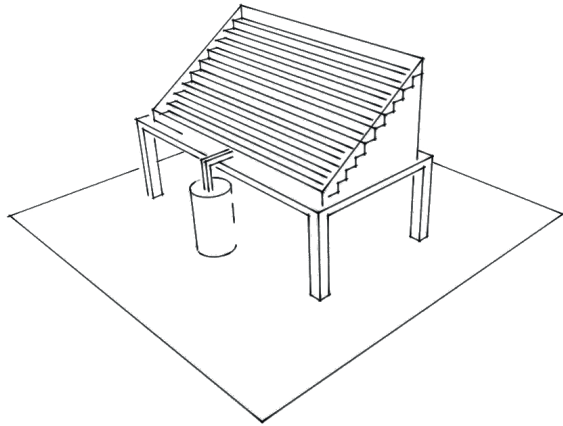
### Water spreading bunds

Water spreading bunds are used to spread, navigate runoff water from hills and slopes. They are easy to construct and can be made out of local materials, soil, rocks. Regular maintenance and checking is needed, instant repair is required for them to work properly.

- Can be used in arid, semi-arid climate
- Easy to construct, manual labour is needed only
- Can be constructed out of local materials
- If not the right material is used for the amount of runoff water, the construction can collapse
- Regular maintenance is needed



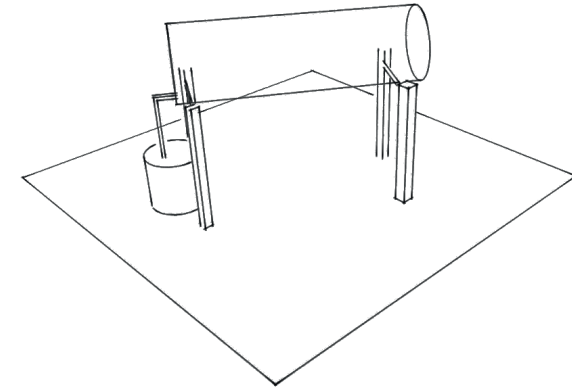
Water purification techniques



### Solar still

Solar stills may differ in design and effectiveness, but are reliable distillation techniques. A solar still consists of a glass cover with an oblique top and a container made out of concrete, steel or other waterproof, heat absorbing material, where water is placed. Solar radiations are transmitted to the absorbing surface containing the contaminated water. The water is distilled in the glass box and is stored apart from the untreated.

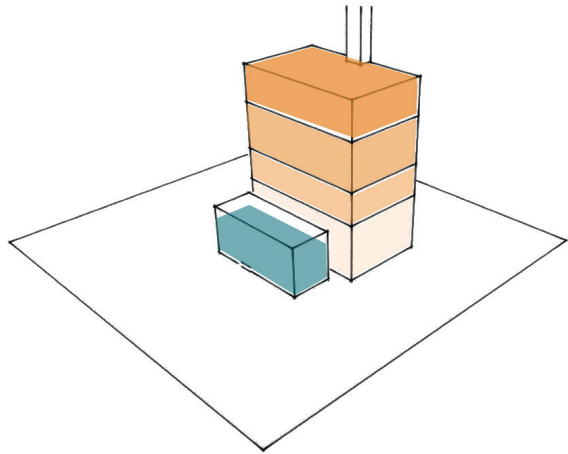
- No electricity is needed to operate the still, only solar energy is used
- The amount of distilled water is very limited the solution can be used on household level



### UV- radiation

UV- radiation techniques use the direct sunlight for water disinfection. UV-A radiation coming from sunlight has a germicidal effect that purifies the water. UV-A radiation interacts with the DNA of the pathogens in the water that leads to the death of the cells. Along with the radiation, this technique uses the heating effect of the sunlight, as the high temperature is able to pasteurise the water, as a further treatment. Microorganisms are sensitive to high heat that leads to their death.

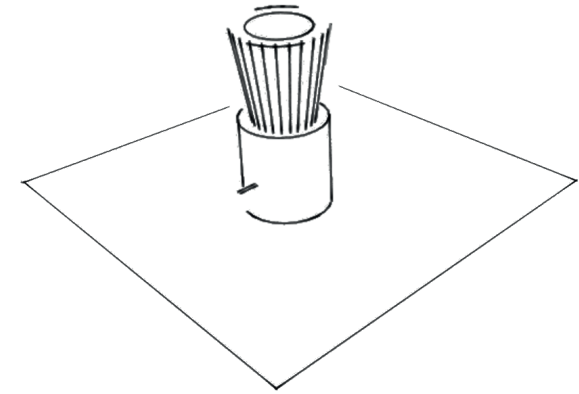
- Improves the microbiological quality of the drinking water
- Simple to use and maintain
- Can be used in household scale
- Sufficient solar radiation is required for it to work properly
- Requires clear water and does not change the chemical quality of water
- Only works on small scale water treatment



### Biosand filter

Biosand filters are easy to construct and maintain. It consists of a container, filled with specific sand and gravel. The water flows through the filter materials and it removes iron, pathogens, turbidity and manganese. The filtered water will be free of any additional colour or smell.

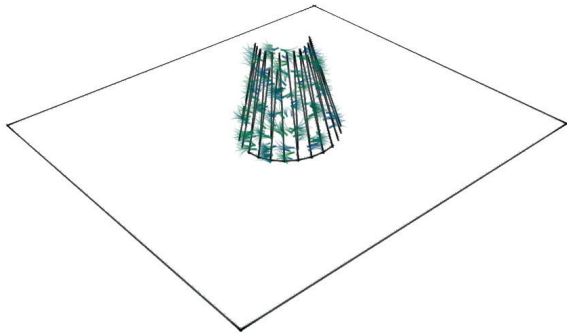
- Easy to construct and maintain
- Cheap solution and can be made out of local materials
- High flow-rates (30 l/ hour)
- Removes pathogens, colour, smell, iron and turbidity
- Does not remove viruses
- Filter can be clogged by high amount of solids
- Can be contaminated easily
- Needs to be used on a regular basis



### Ceramic filter

Easy to use and construct ceramic filters are made out of a two containers. The water is first put into a clay ceramic container and as the water absorbs through the material, it removes any turbidity, solid materials and pathogens. The filtered water is stored in a container below. The device acts as a water filter and storage at the same time.

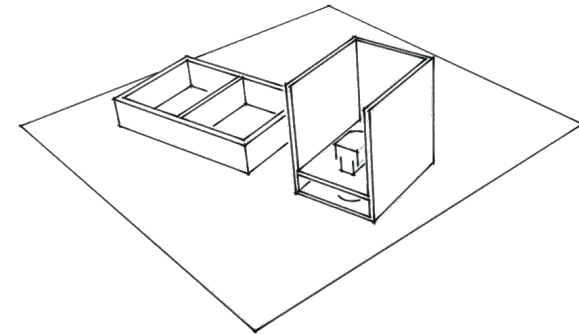
- Easy to construct, can be made out of local materials
- Removes discoloration, smell, turbidity
- Removes viruses and iron on some level
- Does not remove chemical contamination
- The pores of the clay container can be plugged easily
- Low flow-rate



### Greywater tower

A greywater tower is a micro scale greywater treatment option. Bathing, cleaning water can be filtered through the construction which is a circular bag or a box filled with sand and gravel with plants on its sides to filter the water with their roots. The water is poured from the top of the tower and as it flows to the bottom.

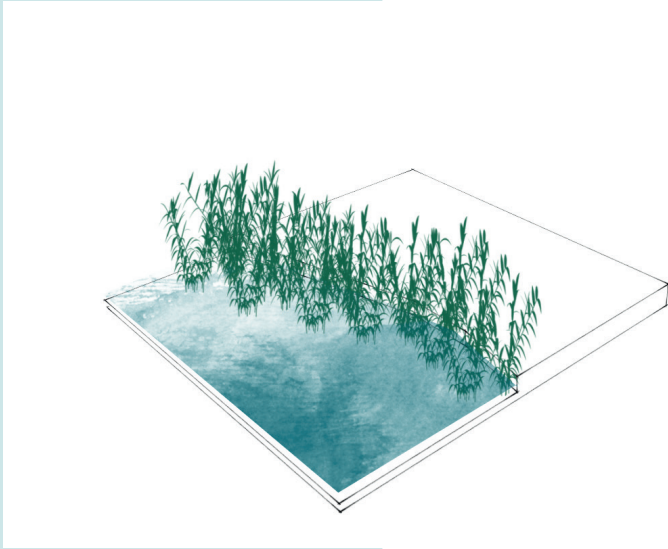
- Low cost and easy to construct from local materials
- Can be built close to the house, but additional odour may occur



### Compost toilet

Composting toilets, or dry toilets can be used in rural areas where the proper water system is not available. The human waste gets collected below the toilet either in a removable container or underground storages. The waste is stored in a composting bin and needs proper maintenance to operate well.

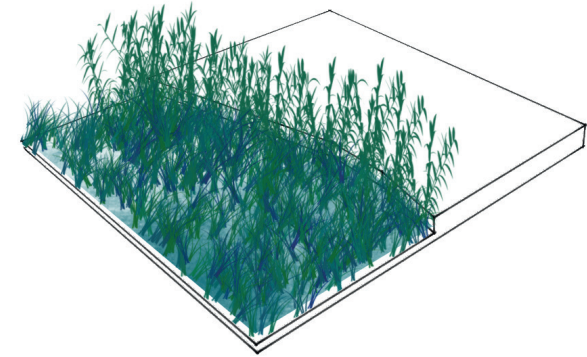
- Composting toilets in colder climates, where the compost is not able to achieve temperatures above 40°C might not work properly
- Hygienic preparations are required when maintaining the compost toilet



## Pond

Ponds can be used as surface reservoirs to store rainwater. With natural vegetation the stored water can be purified and used for irrigation. On warm climates ponds produce a high amount of water loss due to evaporation.

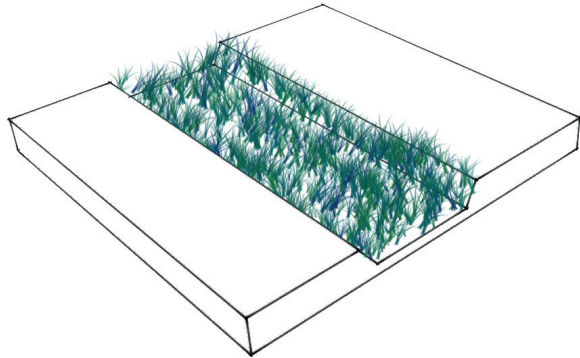
- Needs regular maintenance
- Creates new ecosystems
- Recharges the soil moisture



## Constructed wetland

Constructed wetlands are man made wetlands that use natural processes to purify wastewater. The wetland built similarly to swamps, the plants are planted in soil and gravel and the water gets filtered by the soil and roots. A constructed wetland can be used individually or in a system with multiple wetlands for better results. The treated water can later be used for irrigation or be discharged to nature.

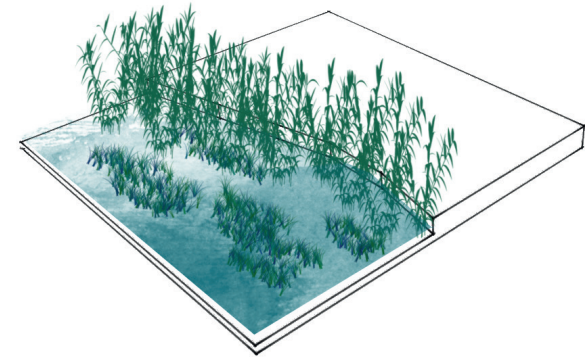
- The design of constructed wetland may differ according to spatial limitations
- Regular maintenance is needed



## Bioswale

Bioswales are more natural alternatives to storm sewers. The linear vegetation lines absorb, filter and transport runoff water while increasing soil moisture. The construction is effective both during small rain events and storms. Bioswales create micro ecosystems and have a positive effect to the flora and fauna.

- Does not need intensive maintenance, but the vegetation coverage needs to be constant
- Blockage needs to be checked and cleaned regularly



## Floating plant pond

Floating plant ponds are water treatment ponds using natural processes to purify water. Plants such as duckweed float on top of the pond and the roots take the nutrients out of the water. This technology can work along with treatment or stabilization ponds to purify waste water.

- Attractive and creates new ecosystem
- Can be built and maintained with local materials
- Construction and maintenance can create new job opportunities
- Needs large land area
- The chosen plant species can be harmful to the natural flora



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