Buried clay pot irrigation

This Action Sheet is about an ancient method of irrigation which uses buried clay pots to deliver water to crop plants and trees. It was invented by farmers in Northern Africa thousands of years ago. Wherever water is scarce, as in Africa's drylands, buried clay pot irrigation can help improve crop production. It can even help people to grow food and trees where the available water or soils are salty.

Illustration by Godfrey Semwaiko

How does buried clay pot irrigation work?

Clay pots are porous if they are fired at moderate temperatures and not glazed. This means that they have very small holes in them, which allows water to seep out slowly. A crop plant is planted next to a buried clay pot that is filled with water. Water in the pot seeps out in to the soil next to the roots of the plant. As the plant uses up the water, more water seeps out from the pot. In this way, the pot feeds exactly the right amount of water to the plant when it is needed. The farmer just checks the pots regularly, and tops them up as required.

What is good about this method?

- It's up to 10 times more efficient than watering plants from above with a watering can or bucket and because less water is needed it is more feasible to do with a rainwater catchment system and a cistern as water source. In Mexico, it has enabled farmers to grow two crops of maize in a year, where before they could grow only one.
- It works well with transplants or direct seeding, and helps improve seed germination and establishment even in very hot, dry conditions.
- It's less work for the farmer. There will be less water to fetch and carry, and less weeding to do because the water in the pot is given to the crop, not to weeds. Using buried clay pot irrigation with a treadle pump attached to a hosepipe makes for further labour savings.
- It's good for the soil structure. Because water is not poured on to the soil, the seedbed stays loose and plenty of air can circulate.
- Soil amendments like manure, compost or inorganic fertilizer can be placed where they will help the crop and not the weeds.
- It's cheaper and more reliable than many high tech drip irrigation systems, which are more likely to be clogged up by insects or damaged by animals and usually require flat fields. The whole system can be made with locally available materials and skills, and doesn't need a pump to work. As long as the farmer keeps checking the pots, the system cannot fail.
- It's good for business. The people who make the pots can sell more pots and lids.

Are their any drawbacks?

The pots may need to be moved if the soil is to be tilled. During installation or removal, they must be handled with care to avoid breakage during installation or removal. The buried clay pots may clog up over time, especially if left dry for a long time. If this happens, they need to be removed from the soil and scrubbed, or soaked, or refired to clean out the pores. The clay mixture, firing time and temperature and choice of clay need to be right to be sure that the pot is porous enough for this method. It is easy to test pots and refine the mixture and firing times. If silty muddy water is used, it will block the tiny holes in the clay pot and reduce efficiency. The system doesn't work very well with some types of clay soils, but mixing sand and/or organic matter in to the soil when "planting" next to the clay pots can help make it work.

The right clay pot

Buried clay pot. Image, David A. Bainbridge

- The number and size of the pots needed depends on the type of crop, the distance between individual plants, and how long the farmer wants to leave between refills. Two to five litres is convenient, but larger pots of ten to twenty litres could be used for larger plants or if you plan to leave the pots for a long time between refills.
- If clay pots are already made where you live, you can test whether they are porous enough for this method by spraying them with water or filling them with water. If the surface becomes damp rapidly, they are porous.
- If pots need to be made especially for this purpose, then experiment with different wall thickness and types of clay before producing a lot of pots. The firing temperature should be below 1000°C. Copper melts at 1083°C. A copper bead can be put into the kiln to help to manage the temperature.
- The rims of the pot can be painted with non-toxic white paint to further reduce evaporation and make the pots more visible. This will help you to see the position of the pot, and stop water evaporation. If the roots of the plant are quite deep, the upper part of the pot could be painted with varnish or plastic paint so that less water escapes from the top of the pot.
- The pots need lids. Lids must fit firmly to stop livestock from drinking the water, and prevent mosquitoes and other creatures from living inside. A small hole in the lid will allow rainwater to drain into the pot.

Using pots in your fields

- Dig a hole about three times as wide and two times as deep as the buried clay pot. Break up the soil at the bottom of the hole with a fork.
- Mix 1⁄3 compost or aged manure in with the soil that was removed from the hole, breaking up the clods. If the soil is very heavy, mix in some sand. If the soil is very saline or alkali, add some gypsum.
- Place enough of the soil mix in the hole so that the top of the clay pot will be 2 cm above the land surface. Set the pot in place, with the lid on. Fill around the pot with the soil mix, and firm it up. Fill the buried clay pot with water and put the lid back on.
- Once the pot is in place, it is time to plant the seeds or plants. You will be able to see how far away the soil is wetted before you plant. In most soils, the seeds or plants should be placed within 1 to 3 cm of the outer edge of the buried clay pot. The spacing of the pots depends on the crop and the soil. The most common mistake is placing the plant too far from the clay pot, outside the wetted soil zone.
- Leave a space between plants on one side of the clay pot to make lifting the lid and refilling easier when the plants are fully-grown. On planting, a small amount of water should be added to the seed spot or transplant to help start off the seepage of water from the clay pot.
- Check the pots regularly and try not to let them dry out. The time between refills will vary during the growing season. Small pots will need refilling every few days, whereas large pots could last two or three weeks between top ups.
- If you add fertilizer, compost or manure tea to the water in the pot, make sure it is well diluted with extra water.

Can buried clay pot irrigation be used for trees?
Yes. In Burkino Faso, eucalyptus trees planted in communal woodlots are watered through buried clay pots. In Zambia, experiments have shown that fruit tree seedlings watered through buried clay pots grow faster and are healthier than tree seedlings watered from above. Clay pots have also been very effective in reforestation in Pakistan and the deserts of the USA.

How does this system help with crop irrigation in soils affected by salinization?
When soils in drylands, like the Sahel of Africa, are irrigated, water evaporates from the crops and the soil surface fast, leaving behind the salts contained in the water. When these salts are not washed away by more water, they build up in the soil. The result is salinization, a major problem for agriculture because most crops cannot tolerate salty soil. Crop yields decline and eventually the land has to be abandoned. About 50% of the world's irrigated land now has this problem.

Clay pot irrigation is very useful technique to help farmers to grow crops in areas with salinity problems. Salts are moved out of the root-zone to the edge of the wetted soil, so the water around the plant's roots is less salty. However, very low-fired pots may break up in very salty soil because of chemical reactions.

What about if the water itself is salty?
Experiments in Kenya and India have shown that buried clay pots work better than usual irrigation methods where available water is salty. Yields of tomatoes and watermelon were excellent with salty water.

Can todays farmers improve on this ancient system?
Experiment with pot size, type and crop plant placement for the best results with different crops. Agricultural extension workers from governmental and non-governmental organisations could help you to design experiments and to spread any innovations that are discovered.

Buried clay pot irrigation can be combined with other water conservation methods. For example, harvested rainwater from the roof can be re-used to fill the pots in a backyard garden. To save on scarce water, dirty dishwater and clothes washing water can be used in pots.

In Chiredzi, Zimbabwe, farmers have been experimenting with buried clay pipes instead of pots. Short lengths of locally made clay pipe are joined to form a tube with an inside diameter of 7.5cm. The pipe is laid along the entire length of the crop beds in a level trench, 10 to 20cm deep depending on the crop. At one end, a right angle fitting is attached and an upright section of pipe installed. The trench is then filled in with soil, and crops planted next to the joints in the pipe where most of the water will seep out. Water is poured into the porous pipe through the upright pipe at regular intervals.

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More information

Practical Action: www.practicalaction.org

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www.sakia.org

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For a list of references on buried clay-pot irrigation, also known as pitcher irrigation, visit Dr Thomas M. Stein's on-line bibliography on www.vl-irrigation.org/contact/dr-thomas-manuel-stein/

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