Introducing 100-Fold Gardens

Dawn Berkelaar and Tim Motis

Network member Lance Edwards works in Zimbabwe. He told us about using and promoting inexpensive, water-conserving planting beds that he calls 100-fold gardens. These are a type of "wicking bed"; they are lined with plastic so that water pools at the bottom in a reservoir. From there, water moves up towards the plants' rooting zone. 100-fold gardens are a way to maximize vegetable production on raised beds.

100-fold gardens in Zimbabwe.
Source: Lance Edwards

Lance learned about wicking beds online, but the ones he saw were primarily built above ground and used expensive containers and other materials. Proponents recommended potting soil to fill the beds. Lance began experimenting with local materials to reduce the cost of the beds. He did not want to have to purchase expensive containers or soil, so he decided to dig the beds 30 cm into the ground. That way, the ground would serve as the container, and they could sieve the soil from the hole and use it as the growing medium; it ends up being a fine growing medium that remains friable and that wicks water and nutrients well. Lance and his colleagues use the rocks and other large objects that were left in the sieve as part of the filler for the bottom of the beds (Figure 1). They also dispose of old tin cans, bottles, broken glass, bones, etc. in the bottom part of the beds. Beds are 2 m x 2 m in size, with a 1 m walkway between beds.

Figure 1. Incorporating fill material into water reservoir of a 100-fold garden. *Source:* Lance Edwards

Lance told us, "I have put about 150 of these 100-fold gardens into rural communities, and people have loved them. I've found them to be especially well-received and looked after by people who struggle to get water: the elderly, single moms, etc. They quickly see the value of the gardens and really take good care of them. One nice thing is that we can put it right next to their home and they can use their grey water in these gardens. By contrast, most of the gardens tend to be away from the homes, down in the river beds in the rural areas, and it makes it much more difficult for people to secure them and take care of them."

100-fold gardens are extremely efficient in their use of water (Table 1), making them an excellent option for dry areas or dry times of the year. They do not have to be watered as often as conventional garden beds, so they are also a good option for situations in which daily watering is not possible. 100-fold gardens are less suited to areas with high rainfall; flooding is a problem without adequate drainage, and large influxes of water make it more difficult to feed nutrients to the plants.

Table 1. How wicking beds prevent water loss that occurs when supplying water to the soil surface.		
Sources of water loss with surface irrigation*		**Mechanism by which wicking beds prevent water loss**
Runoff		The reservoir keeps water in the wicking bed. Some rainfall or surface-applied irrigation water could run off the top of the bed. Mulch helps with this, as well as watering from below by adding water through the irrigation pipe.
Leaching		The plastic liner blocks drainage past the bottom of the reservoir.
Evaporation		As long as the growing layer is not too shallow, the surface remains dry, minimizing evaporation.
*The extent of water loss varies with irrigation method. For example, losses are much less with drip irrigation than with watering cans or overhead sprinklers.		

100-fold gardens offer many benefits:

Versatility. 100-fold gardens can be constructed in areas where the soils/conditions are otherwise not favorable.

Water conservation. 100-fold garden beds conserve water, because no water travels down past the plastic layer. Water management is simple, with known quantities applied at known intervals. Mulching prevents soil surface evaporation. Because water is added below the plants, and is filtered through soil before reaching plant roots, grey water can be used for irrigation.

Nutrient management. Nutrients can be easily managed, because they remain in the reservoir and are never leached into the ground. Mulch keeps the soil soft and friable. Lance recommends urine as a primary source of fertilizer; he adds a 1:5 mixture of urine and water through the irrigation pipe. The urine never contacts the above-ground portion of the plants, allaying concerns about disease. It is out of sight and underground, making the use of urine as a fertilizer more socially acceptable than it might otherwise be.

Minimal labor. After the initial labor of setting up the garden beds, little labor is needed. For example, weeds are minimal because a heavy layer of mulch on top means almost no weeds grow; also, plants receive water from

below ground through their roots, so fewer weed seeds near the surface receive the moisture they would need in order to germinate.

Sunlight. The design also means that plants have good access to sunlight on all four sides and good light penetration to the center of the bed.

Convenient design. The size of each garden bed means it is easy to protect. For example, simple hoops can be made to span the bed to protect against intense sun, cold and insect movement. The size also means individual beds can be quickly constructed. An initial bed can be in production while additional beds are constructed, and earnings from the first beds can be used to pay for subsequent beds.

Plants can be spaced quite densely in a 100-fold garden. Lance suggests spacings similar to those on Mel Bartholomew's square-foot gardening planting (https://squarefootgardening.org/?s=chart) chart. Be sure to plant seeds or transplants deep enough for the seeds or roots to contact moist soil. If you use stakes or trellises to support tall or vining plants, do not push them all the way to the bottom of the wicking bed, or the liner might puncture.
Lance commented, "In line with Mel Bartholomew's recommendations, I tend to suggest that people grow leafy greens in 100-fold garden beds. We plant these crops densely, but as the plants grow, people pick the leaves and naturally thin them. I do not suggest that people plant things like cabbages in these gardens, because they grow so big--the number of cabbages you could plant in one of these beds is low compared to something like collards."

Lance added, "I also do not promote tomatoes for these beds, because tomato plants get very big and take up a lot of room. Instead, I suggest that people plant tomatoes in a similar way, but that they use the principles of the 100-fold garden in 20 L buckets and plant a tomato plant in each bucket. It works well, and the nice thing about one of these is that a person can place it anywhere in their yard or garden where it can get adequate sunlight, and they can place it far away from other crops for disease prevention."

Instructions for how to construct Lance's 100-fold gardens are found in a newly available *ECHO Technical Note* (http://edn.link/6twx93) (TN). The TN also includes information about how wicking beds work. In brief, water molecules are polar, with a positive charge on one end of each molecule and a negative charge on the other end. The positive end of one water molecule is attracted to the negative end of the next, making water molecules slightly "sticky." Attractive forces between water molecules and soil particles mean that, to varying degrees, water molecules in soil resist the downward force of gravity (through something called soil water tension) and wick upward through soil pores (through capillary action). For water to wick upward, the water and soil must be kept in constant contact. 100-fold beds have about 30 cm of soil above the reservoir, which is within a range that allows for good capillary action.