

Specialized Garden Designs

Arid and drought-prone environments



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LEARNING OBJECTIVE

Gardeners will learn sustainable gardening techniques for arid and drought-prone environments.

DURATION



MATERIALS NEEDED

Bring with you:

- Flipchart and markers
- Multiple seed options
- Seedlings for demonstration

Prepare at the training site:




- Compost or composted manure
- Local tools such as hoes, axes, and spades
- Mulching materials



KEY CONCEPTS

- Some gardeners live in environments that have very little or erratic rainfall and soils that do not have good water holding capacity. This makes it challenging to grow vegetables as vegetables can quickly become water stressed.
- In areas where gardeners grow gardens in hot, water-stressed climates, it is especially important to store water in the soil for future use. This can be done by using sunken beds and zai pits that trap water and funnel it to where plant roots will find it.

TRAINING AGENDA

1	Why is watering so important for home gardens?	 DISCUSSION	45 min
2	Different bed designs for arid and drought-prone environments	 DISCUSSION	30 min
3	Building sunken beds and zai pits	 PRACTICAL ACTIVITY	1.5 hour

1. Why is watering so important for home gardens?

INTERACTIVE DISCUSSION

GOAL OF DISCUSSION: Gardeners will understand the importance of reducing water stress on vegetable plants.

MATERIALS NEEDED: Flipchart and markers

1. Ask gardeners why they think vegetables require constant access to water, but other crops may survive without irrigation.
2. Write the key stages of a plant's life on the board. Ask gardeners to describe what is happening at each stage and how water is needed to do this work.

KEY MESSAGES

WHY DO VEGETABLES REQUIRE REGULAR WATERING?

- Vegetables have **short roots** compared to other crops.
- Vegetables are **rapidly growing** and need water at every stage so their growth is not stunted.
- Vegetables grow much quicker than many other plants. They need water constantly to quickly **establish their root structures** and **grow above ground structures** (stems and leaves).
- Vegetables contain a lot of water in their **stems, leaves, and fruits**. They need to pull water from the soil in order to build these parts.
- Compared to trees and shrubs, vegetables have very short roots. Trees and shrubs can reach deep into the soil to access water, but **vegetables have to rely on what is near the surface**, which can quickly get dried out. Even maize has much deeper roots (1.8 m or 6 ft) when mature than most vegetable plants. Tomato roots are some of the deepest vegetable roots (0.9 m or 3 ft) whereas onions have some of the shallowest roots (0.4 m or 1.5 ft).
- **Fruiting crops** (eggplants, tomatoes, maize) cannot develop flowers or set fruit well if they are water stressed. It is especially important to make sure these crops have adequate water during their flowering and fruiting stages.
- **Leafy vegetables** need water at every stage of growth to make sure they are continuously growing the leaves that we eat.
- **Root crops** (carrots, beets, onions, potatoes) do not have very deep roots and therefore cannot access water deep in the ground.

The life cycle of plants

GROWTH STAGE	WHAT IS HAPPENING?	WHY IS WATER IMPORTANT?
Germination: when a seed starts to grow	Seed is taking in water from soil, the seed coat is softening, and the young plant is emerging from the seed coat.	Water is needed to start this process and ensure the young seedling does not dry out.
Establishment: true leaves have emerged and plants are starting to grow	Early shoots are growing and roots are elongating in the soil.	Water is needed to fuel this growth and make sure root structures are fully formed. Stunted roots can lead to poor water and nutrient absorption later on.
Vegetative growth: plants are putting their energy into growing roots, stems, and leaves	Root masses are increasing and roots are getting deeper. Plants are growing the stems and leaves they need to capture energy from the sun through photosynthesis. The more green leaves they have, the more energy they can capture.	Lots of water is needed to fuel this rapid growth.
Reproductive growth: plants start putting their energy into flowering	Plants start to produce flowers. Flowers are fertilized and start to grow fruit. Leaves may die as plants focus on fruit growth.	Water stress during this stage can cause flowers to die and fruit to become withered.
Ripening and dying: Fruits are maturing and vegetative parts of plant may die	All the plant's energy is put towards ripening its fruits and the seeds within these fruits.	For many vegetables, water is less critical during this stage. Too much water may actually cause fruits to crack because they take up too much water.

2. Different bed designs for arid and drought-prone environments

INTERACTIVE DISCUSSION

GOAL OF DISCUSSION: Gardeners will understand how sunken beds and zaï pits can help them store water and nutrients so that they are more readily available to plants growing in arid conditions.

1. Describe sunken beds and zaï pits and discuss how they trap water and retain it longer than other bed designs.
2. Review the key criteria of selecting a site for your garden beds and explain how these same principles are used for sunken beds and zaï pits.

KEY MESSAGES

SUNKEN GARDEN BEDS ARE BETTER THAN RAISED GARDEN BEDS IN ARID CONDITIONS FOR SEVERAL REASONS:

- They are easier to water efficiently by flood irrigation.
- The raised pathways give the moist soil and young seedlings some protection from drying winds and sun.
- Young plants can easily be protected by laying palm fronds or other material across the beds.
- When wet season rains are intense, garden soil is not eroded and rainwater is funneled into the beds.

ZAÏ PITS ARE ALSO BENEFICIAL IN ARID CONDITIONS. THEY GROW FEWER VEGETABLES THAN SUNKEN BEDS, BUT ARE ALSO LESS WORK.

- Zaï pits are a farming technique that store water and soil nutrients in "pits" before the planting season. The pits are typically 20–30 cm in diameter and 20–30 cm deep.
- Pits are spaced 90 cm apart in each direction if the gardener wants to cover a field, but pits can also be strategically placed where vegetables are desired.
- Zaï pits protect vegetables and store water and nutrients in the same way as sunken beds, but require less space and labor.

3. Building sunken beds and zai pits

PRACTICAL ACTIVITY

GOAL OF ACTIVITY: Demonstrate to gardeners how to build sunken garden beds and zai pits that trap water and nutrients in environments where water and nutrients are scarce.

MATERIALS NEEDED:	Bring with you:	Prepare at the training site:
	<ul style="list-style-type: none"> • Multiple seed options • Seedlings for demonstration 	<ul style="list-style-type: none"> • Compost or composted manure • Local tools such as hoes, axes, and spades • Mulching materials

STEP 1. Build a sunken bed with gardeners

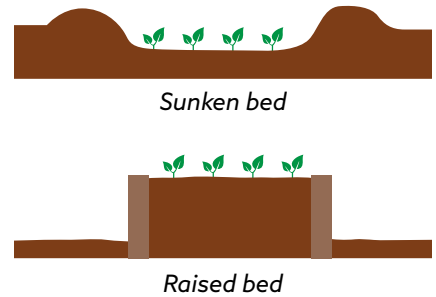
STEP 2. Construct 4–5 zai pits to plant a few select vegetable plants, like squashes, tomatoes, or watermelon. Put 2–3 seeds per hole, instructing gardeners to thin down to only one plant per hole when seedlings have developed a few true leaves. Gardeners should select the healthiest seedling to keep. Alternatively, plant one transplant in each zai pit and apply much around it.



HOW TO

CONSTRUCT A SUNKEN BED

1. Determine the appropriate site for your sunken beds. Consider proximity to a water source, nutrients, sunlight, and other key elements of a garden bed when determining where to place your sunken beds.
2. Use an A-frame to mark out the contours found within the landscape. Even with sunken beds, it is important to build your garden beds along the contours of the landscape to minimize erosion from the beds and most effectively capture rainwater.
3. Mark out beds so they run perpendicular to your slope and each bed is on the same contour line, i.e. does not go down or up slope. Bed widths should be slightly narrower than normal so that gardeners can continue to access the center of the beds without stepping in them. Alternatively, add some stepping stones to the bed.
4. Remove the richer topsoil from the bed and set it aside. Stop digging when it is clear that another soil horizon has been reached. Topsoil is typically found in the first 1–10 cm of the soil.
5. Continue digging 30–45 cm (1–1.5 feet) to remove the subsoil from the pit.
6. Use the subsoil to raise the pathways around the bed. By raising the pathways, you can make the pit as deep as 60 cm (2 feet).
7. If the bottom of the pit is severely compacted soil, use local tools to loosen it.
8. Create a level surface in the bottom of the pit before adding the topsoil back into the pit.
9. Fill the pit with enough compost or composted manure to plant into.
10. Sow seeds or plant seedlings directly into the compost.
11. Apply mulch to the bed as appropriate.
12. Palm fronds or large branches can be laid over the bed to provide shade and extra protection for young seedlings.





HOW TO

CONSTRUCT A ZAÏ PIT

1. Look at your landscape and find the slope. Even land that appears flat will have a slight slope that will determine which way water will flow. This is very important in arid environments where we want to trap any water that flows across the landscape.
2. Using a hoe, dig zaï pits in orderly lines. Each pit should be spaced 90 cm apart from each other in every direction.
3. Dig each pit so it is around 20–30 cm in diameter and 20–30 cm deep.
4. Excavated soil is placed down slope of the hole to form a berm.
5. A spade of compost or composted manure is placed in each hole. Fresh manure should not be used since seeds are sown directly into this material.
6. Sow seeds or place seedlings directly into compost or composted manure.
7. Mulch should be placed on top of pits to slow down water evaporation from pits.
8. Evaluate if other measures, such as stone barriers placed upslope from the zaï pits, can slow and spread water so that it can be more easily captured within the pits.

