IRRIGATION 1:

HOW MUCH WATER AND HOW OFTEN

GLOBAL GARDENS REFUGEE PROGRAM AT THE IDAHO OFFICE FOR REFUGEES

What is this user's guide?

This guide will assist trainers who want to teach non-literate and/or non-English speaking farmers about how to use irrigation to deliver the optimal amount of water for different weather conditions, soil types, specific crops, and stages of growth. It is especially appropriate for farmers from tropical and subtropical regions who must adapt traditional practices to temperate conditions.

ISED SOLUTIONS
INSTITUTE FOR SOCIAL AND ECONOMIC DEVELOPMENT

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Who made this guide?

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WHY IS THIS TRAINING NEEDED?

Crop irrigation and/or water conservation practices from tropical and subtropical regions where rainfall is either abundant or rare can cause crop failure or under performance when applied in temperate regions. Demonstrations and discussion of the participants' experience and field observations are used to determine the optimal amount of water for a given crop. Each of several factors -weather, soil type, crop, stage of growth- which affect a plant's water needs are discussed. Emphasis is placed on the negative effects of both under- and over-watering.

VARIATION:

Throughout this guide, boxes (like this one) contain variations and adaptations that serve varying programs and farmers. They are suggestions and reflections from other programs based on how they made this workshop work for them.

TEACHING TIP:

Throughout this guide, boxes (like this one) contain teaching tips to help you better facilitate farmer learning. Most come from other programs who have tested and reflected on using this lesson.

Objectives and Skills

NEW VOCABULARY:

- Rain gauge
- Root zone
- Inch
- (Stomata)
- (Evapotranspiration)

OBJECTIVES: At the end of this module, growers will be able to:

- Understand that crop plants suffer from both under- and over-watering
- Adjust irrigation rates in relation to weather, soil type, specific crop, and stage of growth
- Use a rain gauge to measure rainfall and irrigation water
- Estimate amount of water delivered by a drip irrigation system.
- Estimate the amount of water delivered to a field by flood irrigation.
- Identify specific symptoms of over watering on vegetable crops.

PROOF OF LEARNING: I will know that farmers have achieved learning objectives because:

- They plan for delivery of the optimal amount of water to each crop, rather than a maximum or a minimal amount.
- They keep newly planted seeds and seedlings well watered.
- They check for soil moisture in the root zone, and not just at the soil surface, when deciding whether established crop plants need irrigation.
- They reduce the amount of water delivered at the proper time to encourage ripening crops such as tomatoes and peppers and/or prevent spoilage of root crops.
- They don't leave supplemental sprinklers running overnight and overwatering their crops.

Table of Contents

Audience

WHO: **Refugee farmers and growers**

LANGUAGE / LITERACY: **All language levels**

FARMING EXPERIENCE: **Beginner to advanced**
Appropriate for any experience level.

PREREQUISITES: **Skills, experience and knowledge**
Participants will need to understand 'inches' (or centimeters) as a measurement of length/depth and be able to read numbers on the rain gauge.

REGION / CLIMATE: This module was developed in Idaho, where summer rain is rare and farmers therefore have almost total control over how much water crops receive.

PROGRAM STRUCTURE: **Incubator Farm**
Farmers sell at farmer's markets, restaurants, and a program-supported CSA where each farmer has their own members.

SEASON: **Any season**
This is a classroom session. We deliver it in the off-season but it could be used any time.

Resources needed

TIME: **This is session one of two on Water Use and Irrigation. 45 minutes to an hour for each session.**

STAFF / INTERPRETERS: **2 staff, Instructor plus Interpreter**

LOCATION: **Classroom.**

RESOURCES AND MATERIALS NEEDED TO COMPLETE THE SESSION:

Instructional MATERIALS AND RESOURCES:

- Slide show: Part 1: Water & Irrigation

Icebreaker

1

TIME: 15 Minutes

OVERVIEW:
This is an ice breaker that uses humor to introduce the concepts of under- and over-watering.

MATERIALS NEEDED:
- Drinking cups and water
- 3 volunteers
- Optional: hats or pictures to “dress” the volunteers as plants.

OBJECTIVES:
By the end of this activity, participants can:
- Understand that crop plants suffer from both under- and over-watering

LESSON STEPS:

1. Explain that plants need the same things people need: food, water, and air. Today we are focusing on water. Volunteers will be our plants.

2. Volunteer One gets no water. Volunteer Two gets one glass of water to drink. Volunteer Three gets 6-10 glasses of water set on table in front of her and is supposed to drink it all.

3. Ask each volunteer how they feel, the point being that Volunteer Two probably got the right amount of water, and the others too little or too much.

Weather, Soil Type, Crop, and Stage of Growth

2

TIME: 15 Minutes

OVERVIEW:
A slide show and demonstrations are used to show how a crop's water needs are affected by weather, soil type, crop, and a crop's stage of growth. Farmers apply their own experiential knowledge in combination with new information about temperate soil-water relations to adjust their traditional irrigation practices for better harvests and reduced costs.

MATERIALS NEEDED:
- Slide show: 'Part 1: Water & Irrigation'
- 2 or 3 funnels made from empty, liter-size plastic soda bottles
- Sample of sandy soil

MATERIALS NEEDED, CONT.:
- Sample of clay and/or loam soil
- Measuring cup
- Water
- Optional demo: houseplant & clear plastic bag

.OBJECTIVES / LEARNING:
By the end of this activity, participants can:
- Adjust irrigation rates in relation to weather, soil type, specific crop, and stage of growth
- Adjust irrigation rate in response to conditions that affect the amount of water lost via evapotranspiration.

LESSON STEPS:

1. How much water and how often depends on several things:
- Weather
- Soil
- Kind of Plant
- Stage of Growth

2. Weather

a. More water in very hot weather, less water in cooler weather (Slides 3 & 4).
b. Vegetables need about 0.75 inches/week in cool weather, and as much as 2 inches/week in very hot weather (Instructors: This may vary by region) (Slide 2).
c. Of course, if it rains, your plants will need less irrigation water. If you use a timer to water, it's important to turn it off after a rain so your plants don't get overwatered and you don't waste water.
d. How do plants take in water? Through their roots (Slide 5).
e. How to plants lose water? Plants are like water pumps. They pull water

from the soil into their roots. The water then moves up through the plant and into the flowers, fruits, and leaves. Very small openings in the leaves -called stomata- open and close like a door to let water exit from the leaves. We can't see this water leaving -just like we can't see water moving out of a wet cloth as it dries, but plants can lose a lot of water this way, especially in hot weather. Show a picture of this and explain that it happens faster in hotter weather. When plants lose too much water this way, they look wilted (Slides 5, 6 & 7).

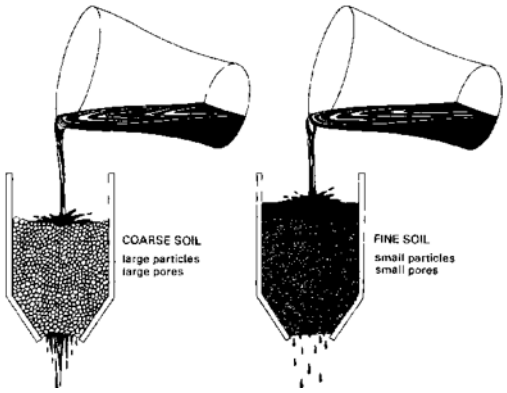
f. Optional vocabulary:
   1. **Stomata:** tiny openings on leaves that allow water to exit when they are open
   2. **Evapotranspiration**: The process by which plants transfer water from the soil into the atmosphere.

g. Optional demonstration: Get a houseplant, tie a clear plastic bag over one of the leaves, and wait to see if water condenses in the bag. You could put the bag on at this point in the class and check it again at the end (Slide 6).

3: Kind of soil (Slide 8)

a. More water and more often for sandier soils, less for clay and loam soils that hold water longer. What kind of soil do you have at your farm?

b. Hands-on activity – have two or three soda bottles with the bottoms cut off and the spout pointing down. Fill one with sand and the other with a clay and/or loam soil. Pour water in each and measure how much and how fast the water flows through each type of soil.



VARIATION: In this demo, clay and loam samples might have similar results. This could be an opportunity to talk about the benefits of loamy soils and organic matter per water retention.

VARIATION: You can engage participants with the different types of soil by asking them to match which soil to what kind of water needs it has.

4: Kind of plants (Slide 9)

a. Some plants use lots of water (corn, greens) others like less water (tomatoes, potatoes, root crops)

5: Stage of development of plants (Slides 10 - 13)

a. New transplants and seeds need less water but watering more often.

1. Show an above and underground picture showing both plants and roots (Slide 11). Water only needs to go as deep as the now small plant roots, but seedlings may need more frequent watering.

2. Show a picture of a seed germinating. It's easy for the first shoots and leaves to dry out when they are very tiny. Sometimes when people think their seeds didn't germinate, it's actually because they didn't get watered at the right time (Slide 10).

b. Established plants are usually happier with less frequent, deeper watering (Slide 12).

1. Show another above and underground picture of a more mature plant. Roots can only go as deep as the water goes, so short, frequent watering tends to limit root development.

2. Established plants also usually like the soil to dry out between watering. Ask students how they feel if they take off their shoes and take a 10-minute shower, vs. taking off their shoes and standing in a bucket of water for an hour or all day. When plant roots stand in water all the time, they are unable to get enough oxygen and can end up rotting.

3. At this stage, the surface of the ground being dry does not mean that the plants need water. If you dig beneath the surface, you may find that the root zone is still wet.

4. Some plants should have their water drastically reduced later in the season, to help fruit ripen (Slides 13 - 15).

- Tomatoes: Idaho farmers usually cut off the water completely sometime in late August or early September, which helps most of the fruit ripen before the first frost hits. If you have lots of green tomatoes and no ripe ones, the plants are likely getting too much water.

- Peppers are similar. If you want them to turn red, reducing water should help.

- Potatoes: Once the flowers have bloomed and start to wither, potatoes don't need much water. The potatoes are ready to harvest and will rot in the ground with too much water. Leaving them in the ground is a

good way to store them, as long as they don't get too wet

- Other root crops are similar. Mature and overwatered carrots and beets can decline in quality (Slide 16).

- Overwatering can make leaves and stems soft and attractive to diseases and pests like aphids (Slide 17).

Conclusion: Because different plants have different watering needs, an ideal water system will allow you to give some areas of your field more water, and some less. This isn't always possible, but it is important to think about the amount of water each crop needs when planning your field layout.

VARIATION:

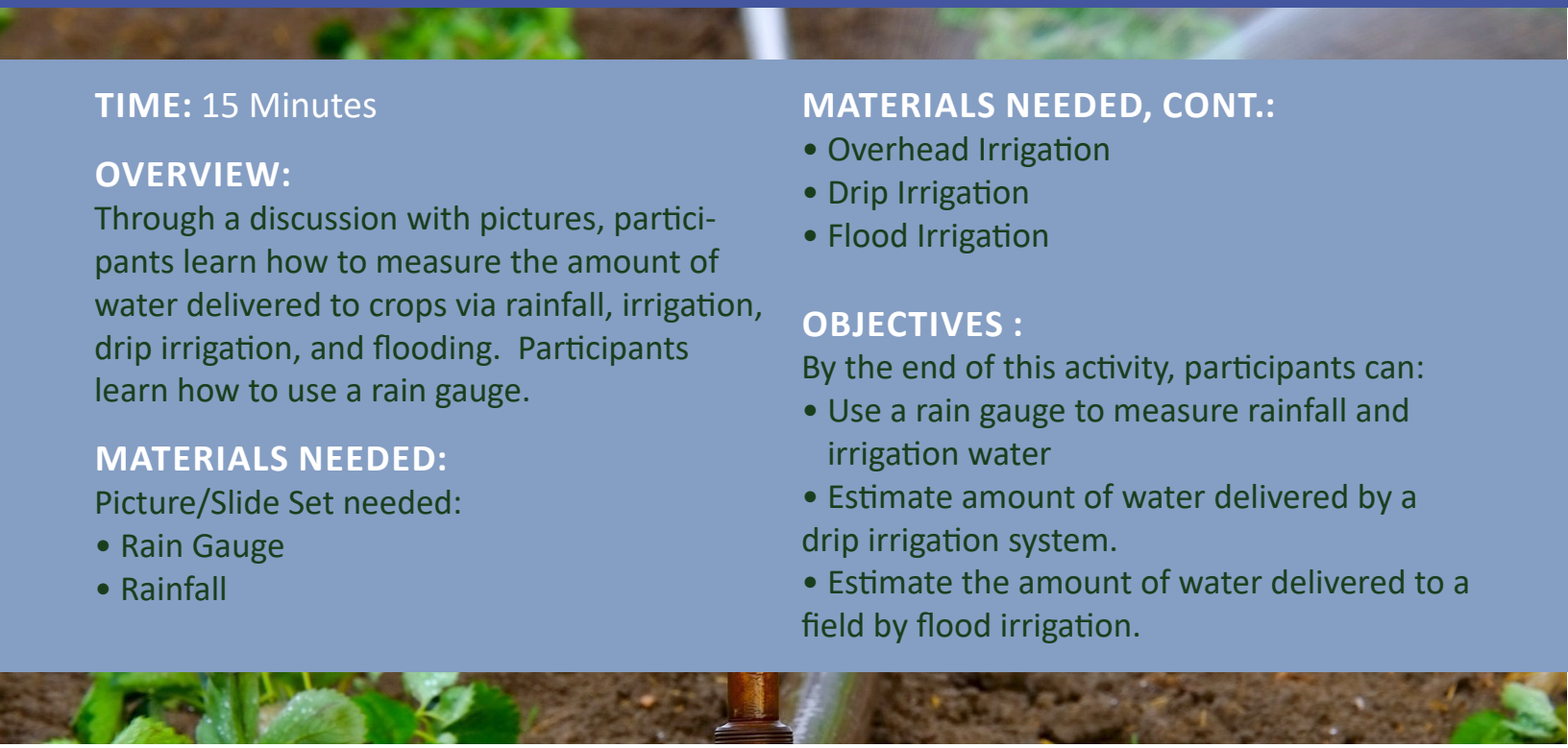
We have partnered with our extension service to do both classroom and in-field workshops.

TEACHING TIP:

Engage farmers in describing what they see happening in the slide show pictures, especially the ones depicting over or underwatered plant.

Measuring How Much Water Reaches the Plant

3



TIME: 15 Minutes

OVERVIEW:
Through a discussion with pictures, participants learn how to measure the amount of water delivered to crops via rainfall, irrigation, drip irrigation, and flooding. Participants learn how to use a rain gauge.

MATERIALS NEEDED:
Picture/Slide Set needed:
- Rain Gauge
- Rainfall

MATERIALS NEEDED, CONT.:
- Overhead Irrigation
- Drip Irrigation
- Flood Irrigation

OBJECTIVES :
By the end of this activity, participants can:
- Use a rain gauge to measure rainfall and irrigation water
- Estimate amount of water delivered by a drip irrigation system.
- Estimate the amount of water delivered to a field by flood irrigation.

LESSON STEPS:

1. How do you measure the amount of water getting to your plants?

   a. "One inch of water" means the amount of water that would fall into a rain gauge if it were raining. Show a picture of a rain gauge. In a sprinkler system, you can either get an actual rain gauge, or bury a small plastic cup in your field, and measure the amount of water that falls into it during your watering time. If you think your field has wetter spots and drier spots, you could use more than one.

   b. In a drip system, it's a little more complicated. You have to know the flow rate of your drip tape to know how long to leave the system on. According to Penn State extension, could take between 2 and 11 hours to deliver 1 inch of water via drip.

   c. In a flood system, you have little control over how much water comes onto your field. In some locations, you can ask for more or less water from the ditch company, or control when the water comes on and off. In some places, you can't do either of these things, but you can use

soil to block some parts of the field from getting too much water. Loam soil can absorb on average 0.5 inches of water per hour when flooded, so it would take 4 hours of flooding to reach 1 inch of water. Absorption is faster with sandier soils and slower with higher clay content.

d. We will discuss more about these kinds of irrigation systems in the next lesson on Irrigation (Users Guide: Irrigation 2).

Review & Conclusion 4

TIME: 15 Minutes

OVERVIEW:
Using photographs from the slide show Water & Irrigation' to lead a discussion, participants review the negative effects of under- and over-watering. Symptoms of and problems caused by over-watering on specific crops are shown and discussed.

MATERIALS NEEDED:
•Slides 14-17 from 'Water & Irrigation'

•Real-life examples of affected plants if available

OBJECTIVES
By the end of the activity, participants will be able to:
• Identify specific symptoms of over watering on vegetable crops.

LESSON STEPS:

1. How do we know if plants are under watered or overwatered?

   a. Under watered plants may look wilted (Slide 14). Many spring crops like lettuce, arugula, broccoli, can bolt more quickly if not watered enough. Regular water also reduces the soil temperature to prevent bolting.

   b. Overwatered plants may also look wilted, especially if this happens when the ground is wet. They may look yellow or have blossom end rot (Slide 15). Overwatered vegetables, especially tomatoes, may crack in the field, and sometimes don't taste as good because they taste watery.

   c. Root crops that show rot, soft or black spots, or other damage could be overwatered (Slide 16).

   d. Aphids may attack either overwatered or under watered plants. They like to get on a weak plant, and either one can make a plant weak and unhealthy. Aphids can also get on plants that are old (Slide 17).