

Module 2: Building Resilience Part I >> Water Resources and Infrastructure



## Fact Sheet 2: Select the Right Irrigation Strategy

Many farms rely on irrigation to produce crops or raise livestock. Irrigation practices vary across the U.S. depending on climate, water sources, crop or livestock type, and local or regional infrastructure. If you currently use irrigation, or want to develop an irrigation system for your farm/ranch, then there are some important guidelines to consider as you work on building the resilience of this aspect of your production system. This fact sheet lists some of the tools and resources to help you select, design, and manage an appropriate and efficient irrigation system.

**Topics Covered:** ♦ Water Rights ♦ Irrigation System Selection ♦ Design and Management ♦ Irrigation Scheduling ♦ Irrigation Management During Droughts ♦ Deficit Irrigation

Note: Related tools and resources are included in the factsheet **Stretch Water Resources in the Dry Season**.

### How to Use This Fact Sheet

This fact sheet includes tools and strategies that are generally applicable across a range of climates and production systems in the U.S. However, every farm or ranch exists within its own environmental context, and not all tools and resources will suit your particular operation. Therefore, use this fact sheet as a starting point for your own process of exploration and discovery, focusing on what would work best in your circumstances. Before making any changes to your production system, do your research, talk to your Extension advisor or other experts, and get input from your own farm team and other farmers in your area. Then see how well those changes align with your own goals, priorities, and resources. If you decide you want to move forward with any changes, test out your ideas in a small section of your farm/ranch before scaling up to a larger area.

## Water Rights

As part of your assessment in Module 1, you evaluated your water rights: current status, what you have access to, and where you stand in terms of priority when water supplies are short. If you are just beginning to farm and have not purchased or leased property yet, this is something to keep in mind when you are looking at land that you may farm on. Every state has its own set of regulations regarding water rights, so make sure you familiarize yourself with local and state regulations. Your local extension office may be able to provide some information about this. For those in Oregon, see the following resources for more information and guidance:

- [Living on the Land: Using Irrigation Water Legally](#) (Oregon State University Extension). Provides an overview of how water rights work in Oregon.

- ☑ [Oregon Water Resources Department \(OWRD\)](#):
  - [Water Rights in Oregon: An Introduction to Oregon's Water Laws \(OWRD\)](#). Provides detailed information about the system of water rights in Oregon.
  - [Do Small Farms Need a Water Right?](#) (Oregon Water Resources Department).
  - [OWRD Water Rights Lookup Tool](#)
  - [OWRD Regional Offices and Water Master directory](#)

According to Oregon's water law, if you are a water right holder, you must use the water rights *beneficially* at least once every five consecutive years. *Beneficial* uses include irrigating crops, instream leasing to allow more water into main surface water bodies (e.g. Deschutes River), temporarily transferring water rights to other landowners, or transferring a section of your property's water rights from one mapped area to another more productive area. To learn more, see: [Central Oregon Irrigation District Video Series](#).

A key aspect of knowing the amount of water that may be available to you during the growing season is understanding when (and under what conditions) your water rights may be restricted during the growing season. Stay informed by seeking out information from your local Irrigation District, state water agency, or any other water authority that could help you protect your water rights. These agencies can provide data on current water levels, and anticipated supply throughout the growing season.

## Irrigation System Selection, Design & Management

Different irrigation systems work better for different farming situations. [Choosing the Right Irrigation System for your Small Farm on the Oregon Coast](#) provides an overview of various types of irrigation systems and links to resources comparing and contrasting them. (Note that the information shared in the article is also applicable to small farms outside of the Oregon Coast).

Whatever type of irrigation system you have (or develop), make the efficiency of the system a top priority—both in terms of design and management. Below are some resources related to irrigation efficiency:

- ☑ [Irrigation Manual](#) (Food and Agriculture Organization of the United Nations). A comprehensive resource covering various aspects of irrigation, including planning, design, operation, and maintenance. Modules 7, 8, and 9 specifically focus on surface irrigation, sprinkler systems, and localized irrigation, respectively.
- ☑ [Irrigation Guide](#) (USDA). Provides information for planning, evaluating, and managing irrigation systems. Chapter 6 provides more information about irrigation system design for multiple system types (surface, sprinkler, micro, and subirrigation systems).
- ☑ [Irrigation Efficiency in Urban and Small Farm Setting](#) (Webinar recording from Utah State University Extension). Provides more detailed information about how to apply these principles.
- ☑ [Landscape Irrigation Design Guides](#) (Rainbird). Mention of a product or company does not constitute an endorsement of the product by Oregon State University.

- ☑ [Irrigation Calculators](#) (Washington State University). Includes tools to assist you in determining your irrigation needs considering your growing practices, soil characteristics, and vegetation (e.g. system pumping requirements, pressure loss, and water application rates among others).
- ☑ [Small Acreage Irrigation System Operation and Maintenance](#) (Utah State University Extension Service). Describes what types of maintenance are needed to maximize the efficiency of the main types of irrigation used on small farms.
- ☑ Irrigation scheduling is another important component of irrigation system efficiency; see the Irrigation Scheduling section of this factsheet (below) for more information.

The considerations around irrigation system selection and design look somewhat different for field crops than they do for other crops. Below are some resources on irrigation management for these special cases:

- ☑ [Forage Crop Irrigation Systems and Economics](#) (University of Missouri Extension). Discusses different irrigation systems for forage crops and considerations when selecting a forage crop irrigation system. This article also links to a forage irrigation system cost analyzer tool that you can use to determine which forage irrigation system may be most economically viable for your farming situation.
- ☑ [Irrigation Management in High Tunnels](#) (Utah State University Extension). Provides specific information about irrigation scheduling and management for high tunnel production.

We recommend you contact your local irrigation company representatives when designing your irrigation system, as they often provide free irrigation design services if you purchase equipment from the supplier that they represent.

## Irrigation Scheduling

Below are several publications and tools that can guide you as you determine an appropriate irrigation schedule for your crops:

- ☑ [Irrigation Scheduling for Small Farms on the Oregon Coast](#) (Oregon State University Extension Service). Provides an overview of how to use soil moisture data, weather data, and plant water status data for scheduling irrigation, along with links to more detailed resources on each component. (Note that the information shared in the article is also applicable to small farms outside of the Oregon Coast).
- ☑ [Irrigation Scheduler Mobile](#) (Washington State University). Helps farmers determine an appropriate irrigation schedule for their crops using evapotranspiration data from the nearest publicly available weather station.
- ☑ [CropManage](#) (University of California ANR). This is an app that provides real-time recommendations for more efficient irrigation and nitrogen fertilizer applications (currently for CA only).
- ☑ [Irrigation Calculators](#) (Washington State University). Includes tools for developing an appropriate irrigation schedule.

- ☑ [Understanding Soil Water Content and Thresholds for Irrigation Management](#) (Oklahoma State University Extension Service). Provides detailed information about the different options for developing an irrigation schedule based on soil moisture as well as the principles behind these different strategies.

Irrigation scheduling should be tailored specifically to your crops, soils, and environmental conditions—so weather data is key. However, many small farms exist in unique microclimates and may not have access to weather station data that matches their growing conditions. Under those circumstances, we recommend you set up your own weather station or install soil moisture meters to collect the relevant data for formulating an irrigation schedule. Below are a few irrigation scheduling tools that are relevant for farmers in Oregon.

- ☑ [Oregon Crop Water Use and Irrigation Requirements](#) (Oregon State University Extension Service). Provides information about typical water use for various crops across the state.
- ☑ [Western Oregon Irrigation Guides](#) (Oregon State University Extension Service). Contains information about how to calculate crop water needs for many commonly produced crops in Western Oregon
- ☑ [Irrigation Management in High Tunnels](#) (Utah State University). This fact sheet discusses how to manage irrigation scheduling for a range of seasonal growing conditions and crops.

Once you have decided on your irrigation schedule, you will want to put it into practice. Many farmers turn their irrigation systems on and off manually. However, this can be a time-intensive practice, and irrigation timers are an option. Below are several resources that discuss technologies that can be used for automated irrigation scheduling:

- ☑ [Irrigation Scheduling Methods](#) (University of Georgia Extension)
- ☑ [Smart Irrigation Technology: Controllers and Sensors](#) (Oklahoma State University Extension)
- ☑ [Precision Irrigation Scheduling Tool Now Available](#) (Washing State University)

## Irrigation Management During Droughts

During periods of drought, you may need to adjust or adapt your irrigation management to accommodate low water supply. It's important to think through your response to drought conditions ahead of time, so that you'll know what to do when it hits. [Be Prepared: Drought Monitoring and Planning for Your Small Farm](#) (Oregon State University Extension Service) includes links to example drought management plans and tools for developing your plan. Below are some other resources that provide guidance about how to make decisions about water management during droughts.

- ☑ Different crops use different amounts of water at different growth stages, and there are some growth stages where water is more critical for crop development than others. Understanding this principle and how it applies in the crops that you grow can help guide your decisions about when you can reduce water to various crops on your farm. [Crop Water Use and Growth Stages](#) from Colorado State University Extension provides more information about this topic.

- ☑ [Limited Irrigation Management: Principles and Practices](#) (Colorado State University Extension). Describes the principles of irrigation and water stress, discusses the economics of limiting irrigation, and provides some recommendations for agronomic management when water is limited.
- ☑ [Irrigation Water Management Strategies for Drought](#) (Washington State University Extension Service). Provides information on a range of topics related to managing irrigation in drought. It includes general recommendations for how and when to limit irrigation in drought as well as specific recommendations for several crops commonly grown in the Pacific Northwest.
- ☑ [Irrigation decisions with limited water: Irrigate all area partially or partial area fully?](#) (Ministry of Agriculture, British Columbia). Walks through an example of how to determine what irrigation decisions make the most economic sense during situations of limited water.

Deficit irrigation and dry farming are also water management strategies that you can use to stretch your water resources, whether water is limited due to drought or to other reasons. Many of the practices used in both dry farming and deficit irrigation can be applied to limit crop water stress in periods of low water regardless of whether you fully implement either strategy. Learn more about deficit irrigation in the following section of this fact sheet. Information about dry farming is included in the fact sheet **Stretch Water Resources in the Dry Season**.

## Deficit Irrigation

Deficit irrigation involves decreasing the amount of irrigation water applied to plants at specific points in their growth cycle. It can have the benefits of reducing water applications and, in some cases, controlling diseases and/or insects and increasing the quality of some agricultural products. With deficit irrigation, you monitor plant water stress throughout the season to determine an appropriate deficit irrigation schedule. (For more information on monitoring plant water stress using stem water potential, see the resources in the *Irrigation Scheduling* section of this factsheet.) Based on that data, full levels of irrigation are applied to the crops until a critical point in the plants' growth cycle. The critical point will vary by crop, and could be something like hull split in almonds or number of days after full bloom in apples. Once the critical point is reached, stem water potential measurements are used to monitor plant water status and reduce the volume of water applied, causing a mild level of water stress in the plants. This level of water stress is maintained until harvest. The amount of allowable water stress varies by crop, so you'll want to do some research about how to apply this practice to the specific crops you want to grow. Below are several resources on deficit irrigation:

- ☑ [Presentations from Extension Deficit Irrigation Workshop](#) (University of Nebraska-Lincoln). Includes several presentation recordings with more information about how to develop and implement deficit irrigation schedules.
- ☑ [Deficit irrigation of a diverse irrigated rotation: Jake Madison](#) (Washington State University Extension). A case study of one farmer's process of developing and implementing a deficit irrigation schedule on his farm. Although the system described is not a small farm, this resource provides detailed information about the farmer's process of developing his deficit irrigation schedule.

- ☑ [Managing Irrigation in Fruit and Nut Trees During Drought](#) (University of California Cooperative Extension Service). Describes how and when deficit irrigation can be applied in various tree fruit and nut crops using different irrigation systems.
- ☑ [Strategies for Deficit Irrigation of Forage Crops](#) (Utah State University). Describes how deficit irrigation can be applied in several important forage crops and details the results of recent deficit irrigation research conducted in forage cropping systems.

### Where to Find Local Assistance

Whatever your goals are for managing your water resources, we encourage you to connect with other people who can provide expertise and advice, and support you in your efforts to build greater climate resilience. Below, we include an initial list of potential contacts to get you started. In addition to offering technical guidance and information, some state and federal agencies may also have funds available for farmers and ranchers in the form of grants, cost-share programs, or loans that can help cover some of the costs of implementing the climate resilience and water management strategies highlighted in this course.

**Extension Service.** You can find your local county Extension Service by searching your county name followed by 'Extension Service'.

**USDA Natural Resources Conservation Service.** To find your local office, see [NRCS—Find Your Local Service Center](#).

**Resource Conservation Districts.** Conservation districts are local units of government established under state law to carry out natural resource management programs at the local level. Districts work with millions of cooperating landowners and operators to help them manage and protect land and water resources on private and public lands in the United States. Search this website to see what is available in your area: [List of Resource Conservation District's nationwide by region](#).

**Other types of conservation districts and rural development organizations.** In addition to Resource Conservation Districts, your state may also have other organizations with similar goals and are ready to support you in your climate resilience work. Search this website for more information on your state (scroll down for clickable map): [Land Conservation Assistance Network / Soil and Water Conservation Districts](#).

**State and local nonprofits** who work with farmers and ranchers. Ask your Extension advisor or other farmers in your area for suggestions.

**Farmer-to-farmer networks.** Ask your Extension advisor or other farmers in your area if they can recommend any groups that work in your region.

**In addition, check with your:**

- Local water regulatory agency (in Oregon this would be Oregon Water Resources Department).
- Local irrigation district or ditch organization.

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