Strategies for Addressing Extreme Weather and Climate Change:
Estimating water needs during dry periods

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Climate Adaptation and Mitigation Fellowship
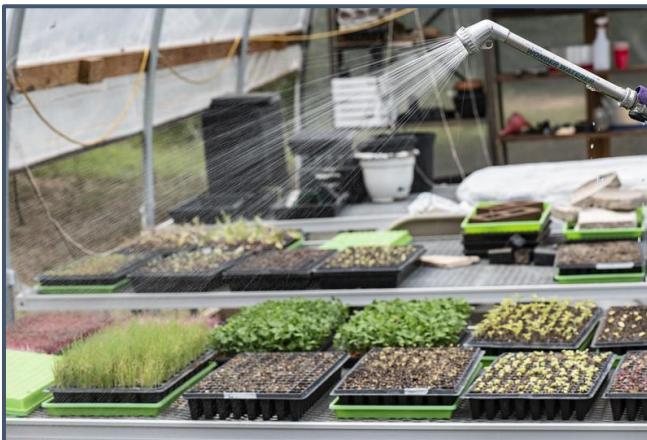www.adaptationfellows.net
https://agroecolab.com/
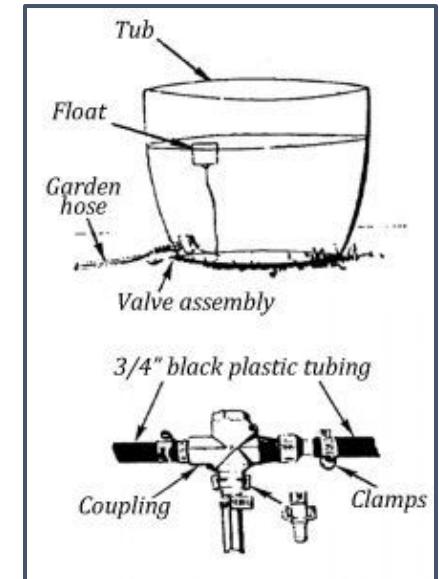
The Agroecology Lab

How do you use water on a farm?

Livestock watering

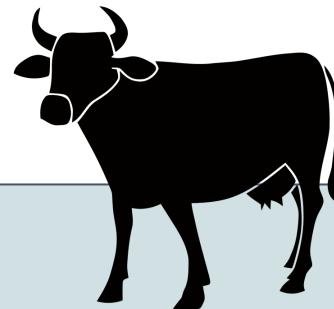Greenhouse or high tunnel irrigation

Field irrigation

Frost protection

I have too much water!

+ Washing equipment
+ Washing product
+ Household uses
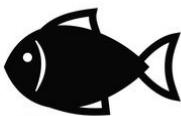+ Anything else?

Image sources: NRCS, Pasture Prophet, MSU Extension

Why make a water management plan?
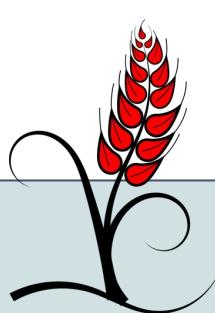
Grow crops and livestock more effectively and efficiently, in a changing climate

Balancing agriculture with conservation

Potential for future increased competition

Changes in supply and availability

Regulatory enforcement & access to funding programs

Ingredients of a water management plan

Step 1: What are your needs?

- How much water do your crops need and when?
- How much water do your animals need, and where?

Step 2: What are your sources?

- Surface options: Rivers, streams, ponds, lakes
- Ground options: Shallow or deep wells
- Municipal or delivery

Step 3: What's your delivery system?

- Pumps, backflow preventers, pipes
- Drip or overhead
- Small scale or large scale
- Permanent set or temporary

Step 4: What regulations apply?

- Federal, state, and local
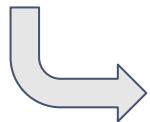
Step 1: What are your water needs?

Differs by crop…
- Development needs
- Fruiting habit
- Root depth
- Stress resistance
- Amount of time in the ground

…and based on environmental conditions
- Precipitation
- Temperature
- Evapotranspiration
- Soil characteristics and conditions

Image source: NRCS

Crop water requirement = Evapotranspiration (ET_c)

ET_c includes evaporation of water from the ground *and* loss of water through the plant itself
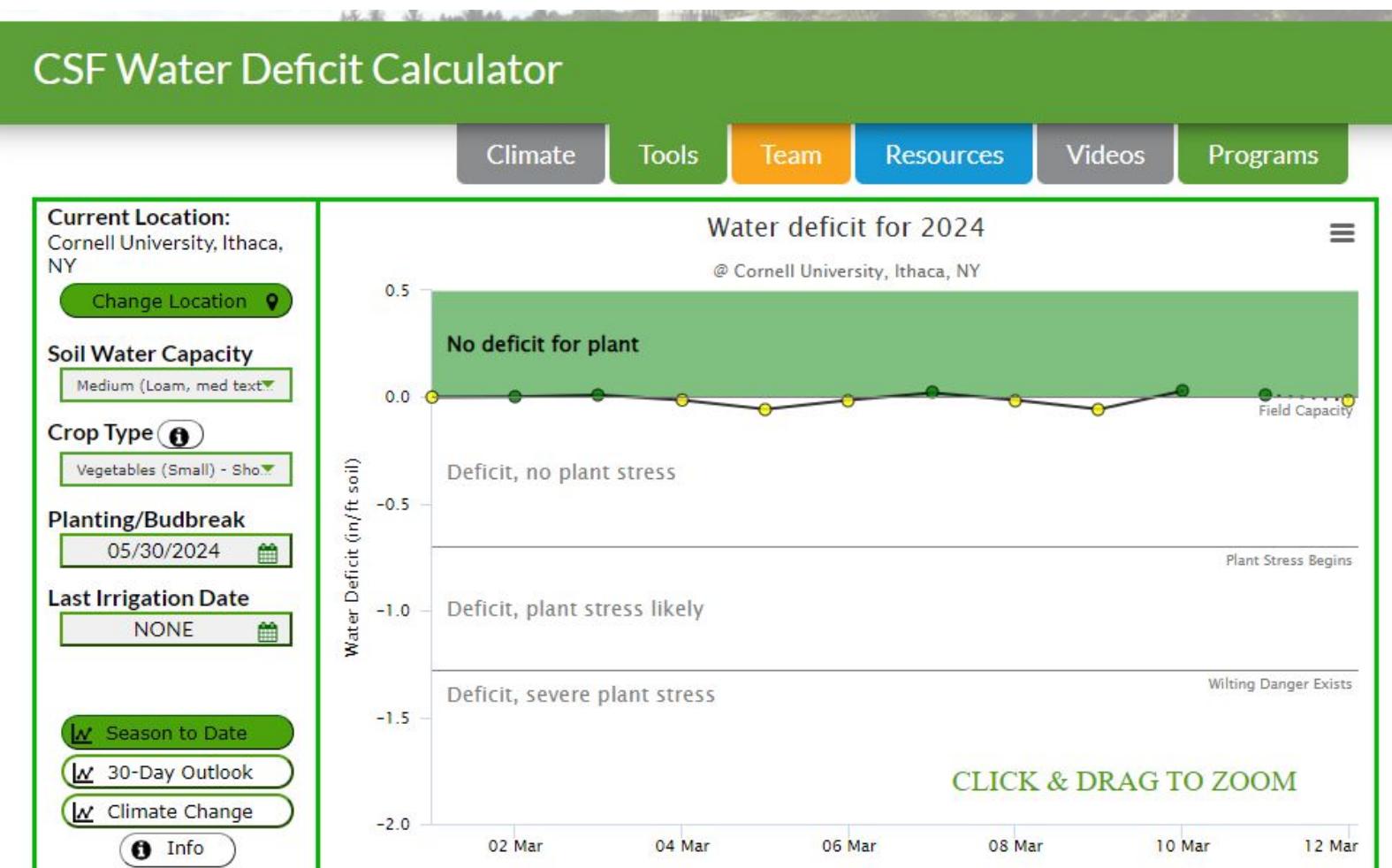
Irrigation is needed when ET_c > soil water + precipitation

What do you need to know (and keep track of)?
- Soil water content
- Rainfall in the past week
- Rainfall forecasts for the coming week

Need a shortcut?

Calculating needs across a season

Common advice is to water at least 1" of water per week (~27,000 gallons per acre). However…

Most crops are most sensitive to drought 2-3 weeks prior to harvest, and at harvest time

Leafy vegetables

These crops are shallow rooted. Keep soil near or at field capacity from leaf expansion → harvest. Too much water can = split heads in cabbage.

Broccoli & cauliflower

These crops are sensitive to drought at all stages of development. Shallow rooting. To develop heads w/good flavor, keep well watered.

Roots, tubers, bulbs

Most sensitive to drought during below-ground bulking. Inconsistent water conditions can lead to poor formation.

Fruiting vegetables

Flowering, fruiting, and seeding periods are critical. Inconsistent application can lead to cracking, blossom end rot. REDUCE water as fruit and seed crops mature, in some crops.

Information on this slide has been adapted from the UMass Center for Agriculture, Food, and the Environment
UMass Extension Vegetable Program,
Irrigating Vegetable Crops fact sheet (2013)

Image source: NRCS

Table 1. Critical Periods of Water Need (by crop)

CROP	CRITICAL PERIOD
Asparagus	Brush
Beans, lima	Pollination and pod development
Beans, snap	Flowering and pod enlargement
Broccoli	Head development
Cabbage	Head development
Carrots	Root enlargement
Cauliflower	Head development
Corn	Silking and tasseling, ear development
Cucumbers	Flowering and fruit development
Eggplants	Flowering and fruit development
Greens Continuous	Lettuce Head development
Melons (musk melons & watermelons)	Flowering and fruit development
	Bulb enlargement

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Image source: NRCS

Planning ahead if you don't know your ET_c

Image source: NRCS

CROP:	Fresh market or storage Onion				
				Amount of water needed	
Week	Days		Growth stage	Inches	Gallons
1	7	Pre-bulb	Seeding	1	27,000
2	14			1	27,000
3	21			1	27,000
4	28		Radical and flag leaf emergence	1	27,000
5	35			1	27,000
6	42			1	27,000
7	49		1-2 true leaves	1	27,000
8	56			1	27,000
9	63			1	27,000
10	70		3 - 4 true leaves	1	27,000
11	77			1	27,000
12	84			1	27,000
13	91		5-7 true leaves	1	27,000
14	98			1	27,000
15	105			1	27,000
16	112		8- 12 true leaves	1	27,000
17	119	Post-bulb		1.5	40,500
18	126		Bulb diameter 2.5 - 4.0 cm	1.5	40,500
19	133			1.5	40,500
20	140			1.5	40,500
21	147			1.5	40,500
22	154		Bulb diameter 4.0 - 7.5 cm	1.5	40,500
23	161			1.5	40,500
24	168		Bulb diameter 7.5 cm +	0	0
25	175		Blub enlargement complete. Wait until 50% crop drops to dry down	0	0
			Total needed	27	715,500

Sources:

Onion IPM, Washington State University

Successful onion irrigation scheduling, Oregon State University

Putting it all together in a water management plan
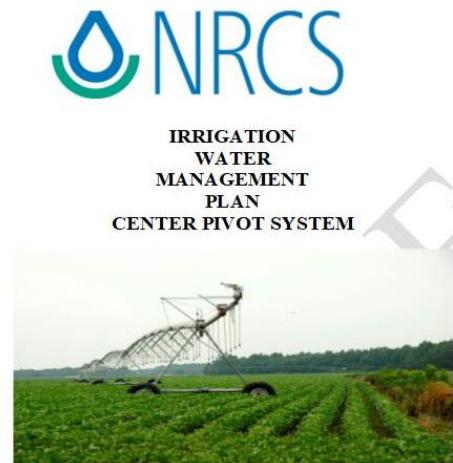
Do you have access to all the information you need?

- How and when should water be applied? (Crop needs, soil water conditions)

- Do you recognize runoff and erosion?

- Do you know where the water goes once you apply it (soil and subsoil conditions, soil intake characteristics, crop root zones, available water holding capacity)

- Can you assess uniformity in water application, and troubleshoot nonuniform application?

- Can you assess weather conditions to make real-time irrigation decisions?

- Are you keeping the relevant records? (rainfall, daily ET, soil water content, plant available water, amount of irrigation water applied)?

[Irrigation calculator](#) developed by Maine DACF is available online

*** Download before using (it will only work in Excel)

While this tool is specifically designed for Maine soils, you can estimate similar soil types and approximate with fairly good outcomes!

Summary

❖ Diversified farms use water for many different purposes;

❖ Knowing how much water you need (and matching that with water availability) is important.

❖ There are tools available!

Thank you!

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