Farming for Success in the 21st Century: Water Stewardship

Scientists predict that climate change impacts on California agriculture will include less available water, drier and hotter conditions, more unpredictable and extreme weather events, and new pest and disease pressures. Growers can cope with a changing climate and extreme weather events more effectively by employing water stewardship strategies such as increasing water use efficiency (WUE), maximizing yields, and reducing soil erosion — all important for enhancing the resilience of farm operations and controlling costs.

Agriculture uses about 80% of California's developed water in order to irrigate roughly 9.6 million acres. Other competing uses of water include:

1. Urban (residential, commercial, municipal) — California's steadily increasing population increases water demand even as water conservation measures are implemented.
2. Environmental — Fresh water allocation for conserving fish and other wildlife.
3. Hydroelectric — As California transitions to cleaner energy sources to meet growing demand, more water is needed for hydroelectric power.
4. Salt-water intrusion prevention — Rising ocean levels will require more fresh water for saltwater displacement, particularly in the Delta.

The predicted impacts of climate change will continue to exacerbate California's chronic issues with water scarcity by altering the pattern, variability, amount, and temperature of precipitation. Deeper and more frequent droughts are expected. In addition, the Sierra snowpack is predicted to store less water and melt earlier and faster, effectively diminishing the volume of water stored in the state's most important reservoir. More rapid snowmelts may lead to flooding in some areas in the spring and water scarcity and drought in the summer.

Growers can prepare for greater water scarcity in California by improving water and soil management, reducing overall consumption of water, and storing water on farms and ranches. Building soil organic matter and improving soil structure are key drought and flood management strategies (see "Soil Building" fact sheet on this topic). What follows is a list of practices to help farmers bank more water in soils and catchments and improve WUE on-farm, thereby increasing the water independence and resilience of farming systems when water is scarce and increasingly costly.

Water stewardship benefits:

- Save money, maximize yields
- Reduce water and energy use
- Lower carbon footprint
- Improve water quality
- Reduce soil erosion, tail water runoff
- Store water for drought periods
- Recharge groundwater


photo: USDA NRCS

Practices that capture, conserve, and recycle water:

- **Farm ponds:** *On-site collection of water for storage, irrigation, or filtration*
- **Recycling water:** *Capturing, cleaning & purifying wastewater via on-site constructed wetlands*
- **Rainwater catchment:** *Collection & use of rainwater from rooftops*
- **Swales:** *Contour ditches that increase water infiltration, reduce runoff & soil erosion*
- **Keyline system/Yeomans plow:** *Soil management method that slows water flow & maximizes absorption*
- **Vegetative filter strips/buffers:** *Strips of perennial vegetation that slow overland runoff & trap sediment*
- **Irrigation efficiency:** *Combining furrow & sprinkler; pressurized system; fine tuning the timing & amount of irrigation*
- **Soil moisture monitoring:** *Augmenting evapotranspiration data with soil moisture conditions to increase WUE*

This is one in a series of fact sheets providing practical information on enhancing the resilience of California farms to climate change. For fact sheets or technical resources on soil building, water stewardship or biodiversity, see www.calclimateag.org.

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Water Stewardship Techniques

Water Catchment Systems – *Farm ponds; Tailwater ponds & return systems; Constructed wetlands; Rainwater catchment; Recycling water*

Benefits
- Offset reliance on purchased or well water
- Maximize seasonal water availability
- Ponds recycle nutrients & prevent erosion
- Trap, filter & store water; return sediment to fields
- Ponds provide water for livestock & habitat for wildlife

Case Studies
- Parducci Wine Cellars & Fetzer Vineyards reclaim 100% of their winery water via on-site constructed wetlands for reuse in vineyards.
- Tailwater recovery & recirculation system at Suncrest Nurseries cut water use by 50% *(EcoFarm Water Stewardship Project)*.

Considerations
- Water storage capacity is limited by catchment size
- Permits can be costly, restrictive
- Cost of construction, maintenance & permitting
- Farm ponds remove land from production
- Ponds function best on clay versus porous soils

Soil Surface Management Practices – *Keyline system/yeoman's plow, swales, contour farming*

Benefits
- Keyline systems help control flooding & erosion
- Yeoman's plow effective on highly compacted soils
- Swales trap & settle suspended solids, increase water infiltration, reduce nutrient & pesticide losses in runoff

Case Studies
- For every 1% increase in soil organic matter, 16,500 gallons of water per acre can be held in soil up to one foot deep *(Arkansas Water Resources Research Center)*.

Considerations
- Must be suited to farm topography
- Swales are ideal for runoff from roadways, parking lots or equipment yards
- Long slope length, mild gradient provide best filtration

Plant Management Practices – *Vegetative filter strips, cover crops*

Benefits
- Vegetative filter strips can reduce herbicide applications near susceptible water sources, cool watercourses
- Easy to incorporate into landscape; aesthetically pleasing
- Cover crops reduce winter runoff & nitrate leaching

Case Studies
- Higher irrigation tail water quality from winter cover crop vs. winter fallow field — significantly lower concentrations of nitrate, ammonium, and total dissolved nitrogen *(UC Davis/Sustainable Agriculture Farming Systems Project)*.

Considerations
- Short-term time & resources involved in establishing filter strips, weed control & irrigation
- Timing cover crop kill & incorporation is important for conserving soil moisture for subsequent crop

Reduction of applied water – *Soil moisture monitoring; Irrigation scheduling & efficient technology; Dry farming*

Benefits
- Reduces water, energy use & improves yield
- Alternate furrow reduces soil salinity, nitrate leaching
- Automated systems save on labor costs
- Pressurized systems increase distribution uniformity
- Drip reduces greenhouse gas emissions

Case Studies
- WUE is 90% for drip, 83% for center pivot, 68% for furrow *(CAWSI)*.
- Alternate furrow used 25% less water than every furrow with no yield decrease *(UC Davis, LAWR)*.
- Nitrous oxide emissions from drip fertigated tomatoes were 60% less than furrow irrigated *(UC Davis, Plant Sciences)*.
- Frog's Leap Vineyard saves about 16,000 gallons/acre with dry farming compared to lightly irrigated vineyards *(CAWSI)*.

Considerations
- Availability, cost & maintenance of moisture monitors
- Deficit irrigation may only work for certain crops
- High initial cost of drip; center pivot cheaper
- Increased energy use for pumping & pressurizing
- Dry farming needs soil with good water holding capacity