To The Point
Water Efficiency in Agriculture

Water is a foundational necessity for all agriculture. But increasingly, US farmers are facing the risk of water scarcity. Increasing the efficiency of irrigation systems is critical to helping farmers build resiliency and preserve threatened water resources. Investing in more efficient water practices can save money and energy and help farmers do more with less water.

Drought and Irrigation Statistics

Drought was the leading cause of crop losses in 2023, representing 29% of all US crop failures.[1] These losses, combined with heat and wildfire, cost farmers $16.6 billion.[2] Farmers rely on irrigation to meet their water needs where precipitation is scarce or unreliable. Over half of US farmers irrigate at least some of their crops, totaling 58 million acres of cropland that rely on irrigation for production.[3]

Irrigation helps farmers buffer against the risks of drought, but sources of irrigated water are under threat. Irrigation makes up 42% of US groundwater withdrawals[3] and is competing with growing demand from cities and other sectors to draw from fresh and groundwater resources. Meanwhile, droughts are becoming more frequent and extreme, hurting our ability to replenish critical reservoirs and aquifers. The Ogallala Aquifer, which underlies 8 states in the central US and provides water for 30% of all US crops and livestock[4], is being drained by agricultural use faster than it is replenished by rainfall. As the water runs dry, farmers risk losing their livelihoods.

Drip and Microirrigation

Microirrigation systems apply water only where needed, directly at the plant's roots or stems. These systems achieve high water efficiency compared to sprinkler systems, which lose large amounts of water to evaporation, or surface systems, which deliver much more water than the plant needs.[5]

Drip irrigation is a specific type of microirrigation where water is run through buried pipes or pipes lying directly on the soil. Drip irrigation systems can save up to 80% of the water needed in other systems.[6] They can also be used to apply water-soluble fertilizer.

While these systems can be expensive to install upfront, they help farmers save water, energy, and labor costs in the long run. Because of the high upfront costs, drip irrigation systems tend to be best suited for high-value or specialty crops.

LEPA/LESA Technology

Many large-scale farmers use center-pivot irrigation systems, where equipment rotates around a central point to spray water. For farmers with these existing systems, upgrading existing systems with Low Elevation Spray Application (LESA) or Low Energy Precision Application (LEPA) technology is a more cost-effective approach to water savings.

LESA

Most center pivot irrigation systems today use Mid-Elevation Spray Application (MESA), spraying water from nozzles about 5-15 feet off the ground. Using a LESA system, farmers suspend the nozzles closer to the plant, about 1 foot above the ground, and move the nozzles closer together. By applying water much closer to the soil surface, LESA systems reduce water losses to wind and evaporation. They also save energy because they can be run at far lower water pressure. LESA systems achieve good water application uniformity and allow enough time to infiltrate soils. By reducing standing water, they also lower the risk of erosion and runoff.

LEPA

In a LEPA system, sprinklers are run directly onto the soil surface at a very low pressure. This decreases water loss to wind and evaporation even further than LESA systems and saves significant energy because of the low pumping requirements. However, LEPA can lead to standing water and runoff issues compared to LESA since water is applied directly to the soil surface.

While LEPA and LESA systems require time and labor for upgrades, the components are inexpensive and simple to install or replace.

Comparing Irrigation Efficiencies

An irrigation system's water efficiency shows the percentage of delivered water stored in the soil's top layer. Drip irrigation and LESA/LEPA technologies achieve far greater efficiency, helping farmers save any precious water that the plant cannot use.

Surface Irrigation | 60% efficiency[7]

MESA | 85% efficiency

Drip Irrigation | 95% efficiency[8]

LESA or LEPA | 97% efficiency

Smart Management Technology

Producers can further improve their water use efficiency by pairing their irrigation systems with smart technologies.

Soil moisture monitors or probes are available for producers at various price points and accuracy. Basic soil tension monitors are relatively inexpensive and allow farmers to manually read data on their fields' current soil moisture levels. More advanced systems can measure and analyze soil moisture remotely.

Farmers may also choose to monitor and control their irrigation technology remotely. For example, pivot telemetry systems allow producers to remotely monitor and automate their irrigation schedules on a center pivot system.

These tools enable farmers to react in real-time to varying precipitation conditions. By fine-tuning irrigation strategies, farmers can conserve water when it is not needed and build resilience against drought conditions.

Water Reuse and Recharge

Beyond irrigation efficiency, farmers focus on water reuse and retention. Farmers can use drainage systems to direct excess precipitation during a wet season for storage in a pond or reservoir.[9] However, it can be expensive to install new drainage or ponds. The water can later be used to irrigate crops without drawing from groundwater resources.

Farmers have also developed strategies to recharge groundwater reserves. In climates like California, which can swing between very wet winters and long periods of drought, farmers can intentionally flood existing irrigation channels or entire fields during a period of high rain. This water slowly seeps back into soils and replenishes the groundwater basins beneath. Farmers in some regions may be eligible to earn financial credits for the practice, so they should work with local advisers to learn if it is locally recommended.[10]

Other farm management strategies can also help conserve precious water. Soil health practices like cover crops and no-till have demonstrated water retention benefits, allowing soils to store excess rainfall in reserve and build resiliency during drought. Farmers can also consider switching to crops that can thrive with less water.

Cost Savings

Choosing to implement any new practice on a farm is a business decision. While whole-farm irrigation solutions are large investments, there are opportunities for farmers to realize cost savings in the short and long term.

Decrease Water and Energy Costs | If a farmer is not ready to replace their irrigation system with a new one, making smart choices about water management can save money in the short term. Soil moisture sensors and pivots are relatively inexpensive, starting at $40 per sensor. One 2018 Texas farmer study found that using probes to strategically adjust water pumping levels allowed for cost savings of $25/acre/year.[11]

The costs to upgrade to a LESA or LEPA system can be recouped within a few years of installation. A study by Washington State Extension estimates that LESA systems save $925/year primarily due to low pumping costs, with a typical payoff period of 3.2 years for the upgrade.[12]

Save Time and Labor Through Automation | As water monitoring systems continue to evolve, farmers have opportunities to save on time and labor spent in the field. Remote monitoring apps and systems allow farmers to check in on moisture levels and adjust water schedules without ever going into the field. Precision management software can also help farmers optimize water costs, as well as integrate decisions around water, energy, and other input needs into a single planning process.

Increase Long-Term Financial Security | For producers who live in highly water-stressed regions, conserving water for the future is a critical business need. Without serious action, much of the Ogallala Aquifer could be depleted by the year 2100.[13] Farmers and agricultural communities will face extreme financial hardships without this water source. By increasing their water use efficiency, farmers will decrease their reliance on dwindling groundwater resources and protect communities from the risk of running dry.

Importance of Water Efficiency

Investments in water-efficient practices, such as drip irrigation, microirrigation, and water reuse and retention, offer numerous benefits. As the risk of water scarcity for farmers grows, the advantages of efficient irrigation systems become increasingly important:

- Saving money on water and energy costs.
- Preventing erosion and runoff.
- Providing resilience against drought.
- Improving crop yield and quality by applying water and nutrients only when needed.
- Reducing weed growth by applying water only on intended crops.
- Lowering the risk of diseases and pests by keeping the foliage above the roots dry and less prone to fungal disease.[14]
- Reducing the rate of drawdown for critical groundwater resources.

Learn More & Connect

For more information on protecting your business, contact your local risk engineer, visit the Chubb Risk Consulting Library, or check out www.chubb.com/engineering.

Resources

Technical Guidance for Farmers

- Texas Alliance for Water Conservation Resources, www.depts.ttu.edu/tawc/resources/index.php
- Soil Moisture Sensors, extension.umn.edu/irrigation/soil-moisture-sensors-irrigation-scheduling
- LEPA and LESA Factsheet, irrigation.wsu.edu/Content/Fact-Sheets/LEPA-LESA.pdf
- Costs, Benefits, and Limitations of Irrigation Management Technologies, ogallalawater.org/wp-content/uploads/2021/03/IrrigationMgtTech.ResourceGuide-21.pdf

Funding Opportunities

- NRCS's EQIP WaterSMART Initiative (WSI), www.nrcs.usda.gov/programs-initiatives/watersmart
- State governments and local utilities may offer rebates for irrigation projects, for example:
  - Texas Agricultural Water Conservation Grants, www.twdb.texas.gov/financial/programs/AWCG/index.asp
  - California State Water Efficiency and Enhancement Program, https://www.cdfa.ca.gov/oefi/sweep/
  - Oregon Utility Rebates, www.midstateelectric.coop/agriculture-energy-efficiency-rebates
- State and local funding opportunities may be available through trusted organizations:
  - Find Your Extension Office, www.uaex.uada.edu/about-extension/united-states-extension-offices.aspx
  - Find Your Soil and Water Conservation District, www.nacdnet.org/general-resources/conservation-district-directory/
  - Find Your NRCS Office, www.nrcs.usda.gov/contact/find-a-service-center

1. 2024 Crop Insurance Update, Rain and Hail Insurance Society, www.rainhail.com/pdf_files/MKTG/MKTG_0123.pdf
2. Major Disasters and Severe Weather Caused Over $21 Billion in Crop Losses in 2023, American Farm Bureau Federation, www.fb.org/market-intel/major-disasters-and-severe-weather-caused-over-21-billion-in-crop-losses-in-2023
3. Irrigation & Water Use, U.S. Department of Agriculture, www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/
4. Optimizing Water Use to Sustain Food Systems, www.ogallalawater.org/
5. Irrigation: Drip or Microirrigation, U.S. Geological Survey, www.usgs.gov/special-topics/water-science-school/science/irrigation-drip-or-microirrigation#overview
6. Irrigation Drip, University of Massachusetts Amherst, ag.umass.edu/vegetable/fact-sheets/irrigation-drip
7. Surface Irrigation Systems, Oklahoma State University, extension.okstate.edu/fact-sheets/surface-irrigation-systems.html
8. Water-use efficiency powered by precision irrigation, Netafim, www.netafim.com/en/precision-Irrigation/water-use-efficiency/
9. On-Farm Water Recycling as an Adaptation Strategy for Drained Agricultural Land in the Western Lake Erie Basin, Great Lakes Integrated Sciences Assessments Program, glisa.umich.edu/media/files/projectreports/GLISA_ProjRep_Purdue.pdf
10. These Farmers Recharged Groundwater by Catching Atmospheric Rivers, Civil Eats, civileats.com/2023/04/17/these-farmers-recharged-groundwater-by-catching-atmospheric-rivers/
11. Economic Advantages of Soil Moisture Probes on the Texas Southern High Plains, Texas A&M AgriLife Extension Service, www.depts.ttu.edu/tawc/resources/researchuploads/soilprobes.pdf
12. Low Energy Precision Application (LEPA) and Low Elevation Spray Application (LESA) Trials in the Pacific Northwest, Bonneville Power Administration, http://irrigation.wsu.edu/Content/Fact-Sheets/LEPA-LESA.pdf
13. Rangeland management is key to sustaining the Ogallala Aquifer, Texas Water Resources Institute, twri.tamu.edu/news/2023/february/rangeland-management-is-key-to-sustaining-the-ogallala-aquifer
14. Solutions for Your Crops, Netafim, www.netafimusa.com/agriculture/solutions-for-your-crop/