

MANAGING THE LIFEBLOOD OF CALIFORNIA AGRICULTURE

**Mitigating Chronic Water and Labor Shortages
Through Use of Mechanized Irrigation**



A special white paper from Valley Irrigation, a worldwide leader in irrigation technology.

RETHINKING WATER MANAGEMENT IN THE GOLDEN STATE

California is not known as the Golden State simply because of its beaches, palm trees and entertainment industry. It also is recognized as a worldwide leader in diverse, efficient crop production. The state's 88,000 farms and ranches make agriculture a nearly \$32 billion industry that generates \$100 billion in related economic activity.¹ Although the state is best known for fruits, nuts and vegetables, it also is the leading dairy state in the nation, as well as a major producer of numerous traditional North American crops.

Value of Selected California Crops 2006

Vegetables	\$6.9 billion
Dairy (milk and cream)	\$4.49 billion
Alfalfa	\$828 million
Corn (field)	\$62.6 million

Source: National Agricultural Statistics Service

Growing high-value crops requires both high management and high use of inputs – including irrigation water – which is why agriculture accounts for 43 percent of all water used in the state.² The abundance of water and labor, along with innovative agronomic practices, have long been the key to California's success. However, two emerging trends may threaten that efficiency.

First is uncertainty about the continued availability of sufficient water to maintain current production levels. In an average year, the total water supply in the state is 194.7 million acre-feet.³ However, ongoing drought and environmental conditions can reduce this supply significantly.

"Last year (2007) was one of the driest in California history during the past 20 years," said Mike Wade, executive director of the California Farm Water Coalition. "Long-range weather forecasts predict another dry year in southern and central California, while a wet season is expected in northern California. But the flow of water from the north to the south must pass through the Delta, and court-ordered (environmental) restrictions will reduce those flows from February through June."⁴

Municipal and industrial demands also increase competition for available water, further forcing growers to seek workable solutions to reduced supplies.

“

Being a farmer in California means being ready to adapt to almost any circumstance. Our innovative attitude in agriculture urges us to constantly improve our drought-management strategies.”

– Al Montna
President
California State Board
of Food and Agriculture⁵

The second trend is reduced availability of workers for labor-intensive irrigation practices. "The labor shortage facing the agricultural community remains a concern for current and subsequent years," said Michael Proso, assistant secretary of the California Labor and Workforce Development Agency. "There is a great deal of competition in the ever-growing need for entry level, low- and mid-skilled workers that directly impacts agriculture, and this is also compounded by foreign competition."⁶

How can California growers address increasing concerns about water and labor availability? By managing both resources more efficiently. Mechanized irrigation, can help alleviate both concerns for California growers:

- When compared to various forms of surface irrigation, mechanized uses 25 percent to 50 percent less water and requires substantially less labor.⁷
- The efficiency of mechanized approaches that of sub-surface drip, but it requires far less labor.⁸
- Mechanized irrigation provides the most crop production flexibility of any irrigation method making it adaptable over time.

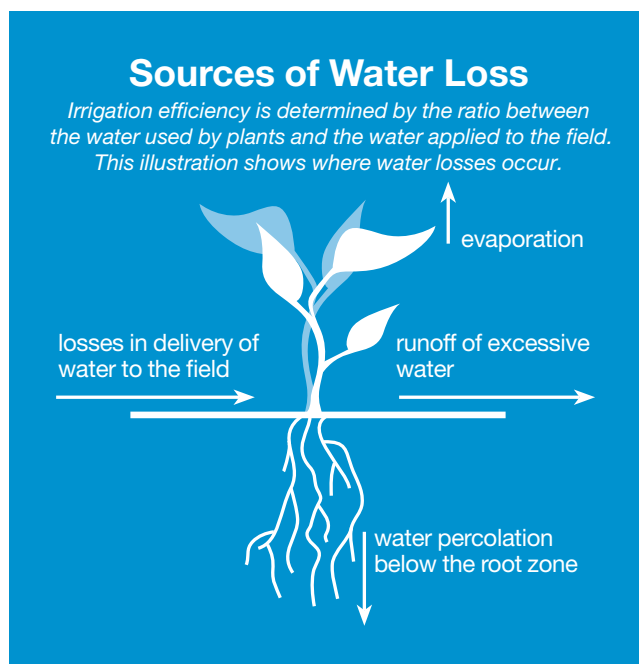
This special white paper will look at how mechanized addresses two of the most pressing challenges in California agriculture – water and labor availability.

INCREASED DEMAND FOR WATER CALLS FOR GREATER EFFICIENCY

Mark Twain was right – everyone talks about the weather, but no one does anything about it. That’s why any discussion of increasing the water supply in California misses a more salient point: How can growers make better use of the water supply that *is* available? Or to put it another way, how can they irrigate more efficiently?

The choice of irrigation type is critical to optimizing efficiency. What trends will shape the future of California agriculture, and how will they affect the demand for irrigation water? An estimated 695,000 additional acres of California farmland will be converted to urban uses by 2030. Growers likely will compensate by converting to more high-value crops and increasing inputs to enhance yields. Acreage is expected to shift from cotton, alfalfa and irrigated pasture toward vegetables, fruits and tree nuts – all crops that require substantial irrigation to be productive.⁹

Irrigation efficiency can be defined as the amount of water added to the root zone as a percentage of the amount taken from the source. The three most common factors that reduce efficiency are evaporation; deep percolation, where water seeps below a level where plants can use it; and runoff.



“

Irrigation is the primary consumer of water on earth.”

– Igor Shiklomanov¹⁰

Increased demand for irrigation water is on a collision course with availability. Clearly, California growers must find a way to do more with less. Mechanized technology is clearly a key to doing exactly that.

Defining Terms:

Common Types of California Irrigation

Drip – Water is applied on or below the soil surface as drops or small streams through emitters.

Flood – Water is applied to the soil surface without flow controls.

Furrow – Small ditches or furrows guide water across the field.

Center pivot – Automated system consisting of a sprinkler lateral rotating around a pivot point and supported by a number of self-propelled towers.

Linear – Automated system that moves in a straight path perpendicular to the lateral and irrigates a rectangular area or field.

Solid set – System of portable surface or permanently buried laterals that completely cover the irrigated area or field.

Source: Irrigation Association

MECHANIZED ON THE MOVE

Every type of irrigation used in California has both benefits and drawbacks. However, the superior efficiency of mechanized gives it a clear edge.

More water used by crop. The concept behind irrigation efficiency is simple – deliver the required water to plants, when they need it. By that standard, surface irrigation is the most wasteful method, with only 40 percent to 50 percent efficiency. Drip sets the standard at just below 100 percent, but mechanized is only slightly less efficient at 98 percent when using LEPA.¹¹ However, because water flow cannot be seen with drip, there may be a tendency to over water.

Reduced installation costs. Installation costs for subsurface drip systems generally are 50 percent to 100 percent greater than for mechanized on relatively large fields.¹² The efficiency of the system is highly dependent on the skill of the irrigation technician who designs and installs it. Mechanized systems, by contrast, can easily be moved among fields and installed for consistent performance.

Lower maintenance costs. The annual maintenance expenses for an mechanized system typically are less than 1 percent of the original purchase price. Maintenance costs for subsurface drip average between 3 percent and 10 percent of the purchase cost per year.¹³ If the system is not routinely maintained, efficiency can quickly deteriorate because of plugging, root intrusion and pest damage.

Automated controls. Computerized monitoring and control systems can ensure that mechanized systems operate at peak efficiency. Automated controls maintain the correct relationship among soil type, water-holding capacity, crop water demands, equipment speed and sprinkler package design.¹⁴

Energy savings. The rising cost of energy is a concern for every California grower. The low operating pressure of modern irrigation systems, such as mechanized, makes them far more energy-efficient than older technology, such as surface irrigation, which requires far more water. Mechanized also operates at lower pressures than solid set and wheel-line irrigation systems, which reduces energy costs.

Increased longevity and resale value. When properly maintained, mechanized systems can perform efficiently for up to 30 years, compared with an average of 10 years for drip systems. Because mechanized systems can be moved to another field, they hold at least 50 percent of their resale value for up to 15 years. By contrast, growers replacing a drip system must dispose of worthless used tape in an environmentally sound way.¹⁵

Reduced salinity. Water logging associated with surface irrigation increases soil salinity, which can reduce both yields and land value. The western part of the Central Valley, where 57 railroad cars of salt from irrigation water and other sources are added to the soil daily, is a major area of concern in the state.¹⁶ Although both mechanized and drip irrigation address this problem, salinity can build up where wet and dry soil meet in drip-irrigated fields. The capillary action of the upward movement of water in drip systems also can move salt into the root zone.

Greater agronomic flexibility. Growers who use mechanized can do more things on more crops than they can with surface or drip irrigation. The high clearance allows mechanized to be used on most commonly grown crops other than fruit trees, such as vegetables, alfalfa and corn. Mechanized is preferable on crops where surface water application is necessary to germinate seed and stabilize soils. Mechanized systems also can be used to apply foliar crop protection products and cool temperature-sensitive crops such as corn. Finally, because row spacing is not predetermined, it is easier to rotate to other crops when using mechanized.¹⁷

Affordability for lower-value crops. Because mechanized is cost-efficient, it also can be used on lower-value crops, such as field corn grown for dairy feed.

Surface drip irrigation, by contrast, has a number of inherent disadvantages that can contribute to reduced water and labor efficiency:

Common Disadvantages of Surface Drip Irrigation

- In many cases, the system has no resale value or minimal salvage value.
- Because applications usually are unseen, it is more difficult to apply water uniformly.
- The wetting pattern may be too small on coarse-textured soils, resulting in too small of a root zone.
- Initial investment cost is high compared to other systems.
- Emitter discharge rates can exceed the ability of some soils to redistribute the water.
- Some crops may not develop properly in certain soils and climates.
- Does not work as well on rolling terrain because of water pressure differentials.
- Life expectancy is unpredictable because of design, installation and maintenance variables.
- A steady water supply, not always available in California, is required for maximum efficiency.
- The load control of electric power can interrupt pumping.
- If growers get behind in low-capacity systems, it is difficult to catch up to the crop's water needs.
- Management time requirements are higher, especially in early years when the learning curve is steep.
- Special care and knowledge is necessary to apply fertilizer or crop protection products through the system.
- Installation is labor-intensive and requires specialized equipment.
- Fixed drip-line spacing can limit crop rotation and tillage options.
- Water quality testing before design is recommended to reduce emitter clogging problems.
- Fluids used to flush the system can damage the environment.
- Crop roots and rodents can damage drip lines.

Source: Various university bulletins

In summary, mechanized is much more efficient to install, maintain and operate than surface or drip irrigation, which means a substantial savings on valuable water. It also offers a number of benefits that address the other major concern in California fields – labor availability.

LABOR CRUNCH REQUIRES DOING MORE WITH LESS

Just as water is essential to producing crops in California, an abundant supply of affordable labor also is indispensable. An estimated 36 percent of the nation's farm workers are employed in the state, and more than 80 percent of those work on vegetable, fruit and nut crops.¹⁸

The rancorous debate over comprehensive immigration reform in 2007 underscored the challenges that California growers face. Not only is the continued flow of seasonal workers uncertain but agriculture faces stiff competition from construction and other industries to attract documented workers. No wonder Western Growers Association estimates the labor shortfall to be as high as 30 percent in recent years.

Several state regulatory trends are likely to affect the labor situation in coming years:

Workers' compensation. Recent legislation reduced the rate charged to employers by 40 percent.

Minimum wage. Gov. Arnold Schwarzenegger has proposed phasing in a \$1 per hour increase – in coming years. The average wage for California agricultural workers currently is \$9 an hour.

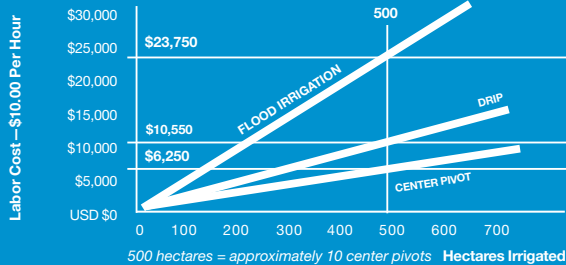
Regulations. Other proposed legislation would place further requirements on farm labor contracts and the grower who use them.¹⁹

Immigration Issues. Federal and state governments continue to wrestle with this ongoing situation, with obvious impact on growers.

Although there are no simple solutions to the farm labor shortage, a good strategy for growers would be the same one they use to mitigate water shortages: Do more with less.

Labor Cost Comparison

As the size of the irrigated field increases, the labor cost using flood irrigation also dramatically increases. The labor cost of center pivot equipment, on the other hand, increases only slightly with field size, since one person can run multiple pivots, covering thousands of hectares.



The data is based on a University of Nebraska study, "Comparison of Irrigation Distribution Systems."

Because mechanized is much less labor-intensive than either surface or drip, it can free up workers – as well as managers – for other critical tasks.

Easier installation. Unlike surface irrigation, there is no need for the labor-intensive work of building and maintaining trenches. Mechanized can be installed in much less time than it takes to design and install a drip system. Plus, mechanized can easily be redeployed to another field as necessary.

Less maintenance time. The efficiency of drip irrigation depends on regular, frequent maintenance, which means a major commitment of time. Maintaining a mechanized system is less time-consuming and labor-intensive.

Remote monitoring and control. Sophisticated telemetry systems enable one person at a computer to manage the irrigation needs of as many as 10 fields. Automated systems also simplify reporting by tracking irrigation totals, status change, current status and configuration.

Reducing labor expenses, combined with greater irrigation efficiency, means a better return on investment with mechanized.

Comparative Return on Investment

	Pivot	Drip
Crop Revenue	\$ 66,525	\$ 63,786
Crop Cost	51,025	54,429
Net Returns	15,500	9,357

Source: An Economic Comparison of Subsurface Drip and Center Pivot Sprinkler Irrigation Systems.

COUNTING THE COSTS IN CALIFORNIA FIELDS

Irrigation has been practiced for thousands of years, yet only since the mid 20th century has technology provided the necessary breakthroughs to feed a fast-growing world population.

Mechanized holds the promise of enabling California producers to address their two greatest challenges – water and labor availability – to continue leading the world in productivity. By any measure, mechanized is the solution to the efficiency puzzle.²⁰

Comparing Mechanized and Surface Irrigation

Water Efficiency

- Mechanized uses 25 percent to 50 percent less water.

Labor Efficiency

- Mechanized requires substantially less labor.

Availability is not the only labor issue in California. Even when an adequate supply is available, the cost of hourly labor can add up quickly. Mechanized irrigation, in addition to reducing the amount of labor required, can help producers hold the line on the cost of labor.

Moving irrigation pipes by hand is labor-intensive, and therefore costly. A San Joaquin Valley grower estimates his annual labor cost for hand-moving pipes for 150 acres of alfalfa at \$26,000 – and that doesn't include the cost of supervision. By contrast, his labor expense for pivot irrigation is \$3,000 – an annual savings of \$23,000. Those costs often are compounded by rental fees for lateral pipe, as a dairy farmer in the Valley points out.

The more growers do the math on labor costs, the more mechanized irrigation makes economic sense.

Comparing Mechanized and Drip Irrigation

Water Efficiency

- Surface Drip Irrigation has slightly higher efficiency than low-energy precision application (95 percent vs. 90 percent to 95 percent) in research installations.
- No known studies yet compare actual on-farm efficiency.

Crop Yields

- Uniformity of drip systems appear to degrade over time, favoring mechanized.
- Design of drip systems is critical to good water uniformity.
- Mechanized systems have an edge where salinity is a problem.

Cost

- Center pivots and linear are less expensive to install on large plots and have higher resale values.
- Drip systems become more cost-competitive in small fields and irregularly shaped fields.
- Mechanized may last 30 years vs. 10 to 15 for drip, if properly maintained.
- Ongoing maintenance costs for drip are three to five times higher than for mechanized.
- Operating costs for energy are similar, but mechanized typically requires much less labor.

Crop-Specific

- Drip often is favored on tall, permanent crops, especially when the field is not laid out to use mechanized systems.
- Mechanized systems are preferred in sandy soils, where surface application is necessary for germination.
- Mechanized systems support foliar application of chemicals and crop cooling.
- Mechanized systems are preferred where frequent crop rotations are used.

Farm Management

- Drip systems are less adaptive and forgiving to poor management practices.
- Drip is more flexible for some existing infrastructure.

LEADING THE WAY FORWARD

As a growing world population looks to California for its food supply, producers must continue to find ways to do more with less. Moving from surface and drip irrigation to mechanized will help growers get the most from two of their most precious resources, water and labor.

The ability to develop innovative solutions to emerging problems has helped make California agriculture the envy of the world. Efficient irrigation technology will help growers meet the conservation and economic challenges of the 21st century.

NOTES

1 California Department of Food and Agriculture (CDFA) Web site 2 California Farm Water Coalition 3 The Water Fact Book, California Farm Water Coalition 4 California Farm Water Coalition Web site 5 CDFA news release, Feb. 21, 2007 6 CDFA hearing, April 26, 2006 7 Circles of Life 8 Water Scarcity and Modern Irrigation 9 California Water Plan Update 2005 10 Water in Crisis: A Guide to the World's Fresh Water Resources 11 Water Scarcity and Modern Irrigation 12 An Economic Comparison of Subsurface Drip and Center Pivot Sprinkler Irrigation Systems, as quoted in Water Scarcity and Modern Irrigation 13 Water Scarcity and Modern Irrigation 14 Water Scarcity and Modern Irrigation 15 Water Scarcity and Modern Irrigation 16 *California Agriculture*, Volume 54, No. 1 17 Water Scarcity and Modern Irrigation 18 The California Farm Labor Force: Overview and Trends from the National Agricultural Workers Survey 19 CDFA hearing, April 26, 2006 20 Water Scarcity and Modern Irrigation



A valmont COMPANY
Conserving Resources. Improving Life.

For more information on water reuse, contact CES at 1-800-728-8322.



Valmont Irrigation
7002 N. 288th St. P.O. Box 358 Valley, NE 68064-0358
(402) 349-6014 www.valleyirrigationcalifornia.com