Innovation and Implications of Water Use Efficiency in Agriculture

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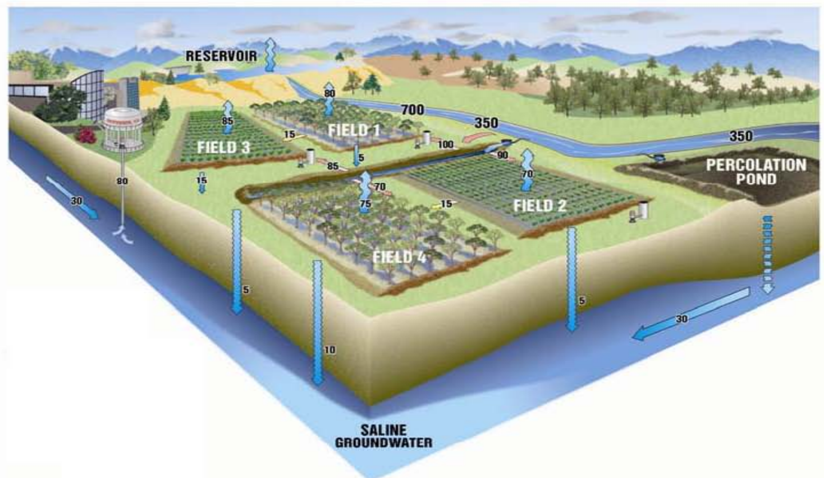
Agricultural Water Use in California:

A 2011 Update



Staff Report
The Center for Irrigation Technology
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Table 8 – Typical range of application efficiencies presented for the major irrigation system types

	WATER APPLICATION EFFICIENCY					
SYSTEM TYPE	Tanji & Hanson[1] (S1)	SJVDP (S1b)	ATTRA[2] (S2)	KSUIE[3] (S3)	Howell (S4)	Hanson et al (S5)
Surface Irrigation						
Furrow	60-90	70-85	60-80	50-90	50-80	70-85
Furrow w/Tailwater					60-90	
Border	65-80	70-85	55-75	60-90	50-80	70-85
Basin	75-90			60-95	80-95	
Sprinkler						
Periodic Move	65-80	70-80	60-75	65-80	60-85	70-80
Continuous Move	75-85	80-90		70-95	70-98	80-95
Center Pivot			65-90[4]		75-98[5]	
Linear Move w/ spray heads			75-90		70-95	
Solid Set	85-90	70-80	70-85	70-85		70-80
Drip/Trickle	75-90	80-90				80-90
Trickle (point source)			85-95	75-95	70-95	
Subsurface Drip			85-95	70-95	75-95	
Microspray			85-90		70-95	

Table 7 – Reported acreages of various irrigation system types in California, 1994 – 2008

YEAR REPORTED	TOTAL REPORTED	GRAVITY	SPRINKLER	DRIP	SUB
1994	8,023,965	5,185,677	1,848,697	933,696	55,895
1998	8,424,207	5,819,660	1,528,038	1,021,720	54,789
2003	8,749,684	5,261,073	1,723,040	1,706,916	58,655
2008	7,959,443	4,189,852	1,367,179	2,336,130	66,282
% Change 1994 - 2008		**-19.2%**	**-26.0%**	**+150.2%**	**+18.6%**

SOURCES:

1. "Land Irrigated by Method of Water Distribution", Table 4, Volume 2, Subject Series, Part 3, 1994 Farm and Ranch Irrigation Summary, 1992 Census of Agriculture, National Agricultural Statistics Service, U.S. Department of Agriculture
2. "Land Irrigated by Method of Water Distribution", Table 4, 1997 Census of Agriculture, 1998 Farm and Ranch Irrigation Summary, National Agricultural Statistics Service, U.S. Department of Agriculture
3. "Land Irrigated by Method of Water Distribution", Table 4, Farm and Ranch Irrigation Survey (2003), 2002 Census of Agriculture, Volume 3, Special Studies, part 1, doc AC-02-SS-1, National Agricultural Statistics Service, U.S. Department of Agriculture, November, 2004
4. "Land Irrigated by Method of Water Distribution", Table 4, Farm and Ranch Irrigation Survey (2008), 2007 Census of Agriculture, Volume 3, Special Studies, part 1, doc AC-07-SS-1, National Agricultural Statistics Service, U.S. Department of Agriculture, November, 2009

Drip/Micro Irrigation Technology in Agriculture

- Drip/micro irrigation has long held the promise of significant water savings
  - Do plants use less water with drip irrigation?
  - Are field level water savings achieved at the basin level?
  - Without over-irrigation at the field level, how do we achieve sustainable recharge to the groundwater?

Drip/Micro Irrigation: Value Proposition

- What it offers
  - Improved water management
  - Improved yields
  - Improved chemical/fertilizer use
  - Reduced groundwater degradation
  - Potential for better TOU/PD energy pricing

Adoption of Drip Irrigation has Increased the Production of Processing Tomatoes

- 1981 24.0 tons/acre (mainly furrow)
- 1991 31.7 tons/acre
- 2001 34.0 tons/acre
- 2011 46.3 tons/acre (mainly drip)

*yields from California Tomato Growers Association

Box D – Unintended groundwater exchanges

A 2003 model of the Friant Water Management and Groundwater revealed approximately 65,000 - 70,000 AF/yr of unintended groundwater exchange occurs annually between adjacent water districts receiving surface water supplies and the Pixley Irrigation District (PID) which is largely dependent on local groundwater. The continued augmentation to PID's groundwater supply from outside the district appears to hold true over the approximate 30-year modeling period spanning 1971 through 1999.

This is a prime example where improving on-farm efficiency and/or lining irrigation canals in one district would directly affect the supply of a nearby district. As shown in this case, recoverable losses are picked up somewhere else and reused. Over time, local agricultural communities have become depend on these recoverable losses as part of their long-term water supply source. In this case, reducing or limiting groundwater recharge would have a negative effect on the operations within the Pixley Irrigation District.

Sources:

1. Rund, NC, T.Harter, GF Marques, NW Jenkins, JR Lund, 2003. Modeling of Friant Water Management and Groundwater, Final Report, US Bureau of Reclamation, 294pp.
2. http://groundwater.ucdavis.edu/Publications/Harter-Lund-USBR2003-Final%20Report%20for%20print.pdf

Box H – Drip paradox

In conjunctive use districts such as Consolidated Irrigation District (CID), the benefits of agricultural water conservation measures are realized in a reduction in the use of both surface water supplies and groundwater. However, the reduction in surface water use presents other issues that must be addressed in the long-term water management strategy of the District. While applicable to all agricultural water conservation measures, this is particularly true in regard to the replacement of furrow/flood irrigation methods by drip irrigation systems.

In most cases, land converted to drip irrigation foregoes use of surface water and becomes strictly groundwater dependent due mainly to the high frequency requirements. In drier years, the forgone surface water is delivered elsewhere within the District resulting in minimal impact to District operations and area groundwater supplies. However, in wetter years, the reduced acreage utilizing surface water means reduced acreage providing the incidental recharge that invariably results when surface water is applied through normal irrigation practices. A situation is created resulting in greater groundwater pumping coupled with less recharge in years when surface water is plentiful or even in excess (It is noteworthy that ag to urban land conversion associated with expanding cities has a similar impact).

CID has a longstanding groundwater recharge program that relies on incidental recharge along with 1,300 acres of dedicated ponds to offset most of the groundwater pumping that occurs within the District. The District is underlain almost entirely by coarse-grained soils that allow for significant incidental recharge within the District boundaries for future use. In recent years, the number of acres within CID that use drip irrigation has increased significantly while demand for surface water has fallen.

The loss of incidental recharge via surface irrigation causes lower water tables and higher pumping costs. In order to maintain a sustainable conjunctive use water supply, the change to large acres of drip irrigation will necessitate the District to add additional recharge basins, at significant cost, if the area groundwater resource is to be maintained.

Source: Personal correspondence. Phil Desatoff, P.G., C.E.G. General Manager. Consolidated Irrigation District

Drip/Micro Irrigation: Value Proposition

- What it <u>doesn't</u> offer
  - Produce significant "new water"
  - Lower energy demand (depends on water source)
  - Reduced labor requirements vs. other methods
    - E.g. Row crop production irrigated w/pivots vs. drip

Future of Drip/Micro

- Significant acreage in California will continue to be converted to drip/micro irrigation
- Groundwater degradation is emerging as a critical issue-drip /micro is an effective mgt tool
- More emphasis on drip/micro system evaluations (maintenance and performance)
- Accommodates "Peak Day" pricing for small and medium customers better than other methods

Future of Drip/Micro (con't)

- Expect more automation, real time data collection, and system reporting
- Planning for significant increases drip/micro acreage cannot be limited to the field level
- Regional planning must include third-party impacts and groundwater recharge
- Ultimate goal should be sustainable water supplies

Questions?



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