



A Central Valley Grower Group's Effort to Protect Groundwater Quality

*2020 Southwest Idaho
Ground Water Quality
Forum*

*John Dickey
February, 2020*



*Southern San Joaquin
Valley Management
Practices Evaluation
Program Committee*



Context of this Presentation

- Discussing a CA regulatory program as implemented in the Central Valley, 1 of CA's 9 water quality regulatory regions. Programs in other regions differ somewhat.
- Not focused on policy decisions or judgements. Rather, explaining how growers have responded to requirements, and why.
- A pro-active, thorough response to regulatory requirements does not imply that the requirements are popular, but rather reflects an informed choice under the circumstances.
- There are few templates for regulating and managing agricultural, non-point pollution, and the Central Valley's agricultural industry is arguably one of the largest, most productive, and diverse on earth. Therefore, it is very important for these growers to succeed.
- While the environmental and regulatory characteristics of the Central Valley are particular, we have nevertheless found a lot of technical common ground with regions grappling with similar problems.
- This presentation represents my own understanding and experience. Others may see things differently.

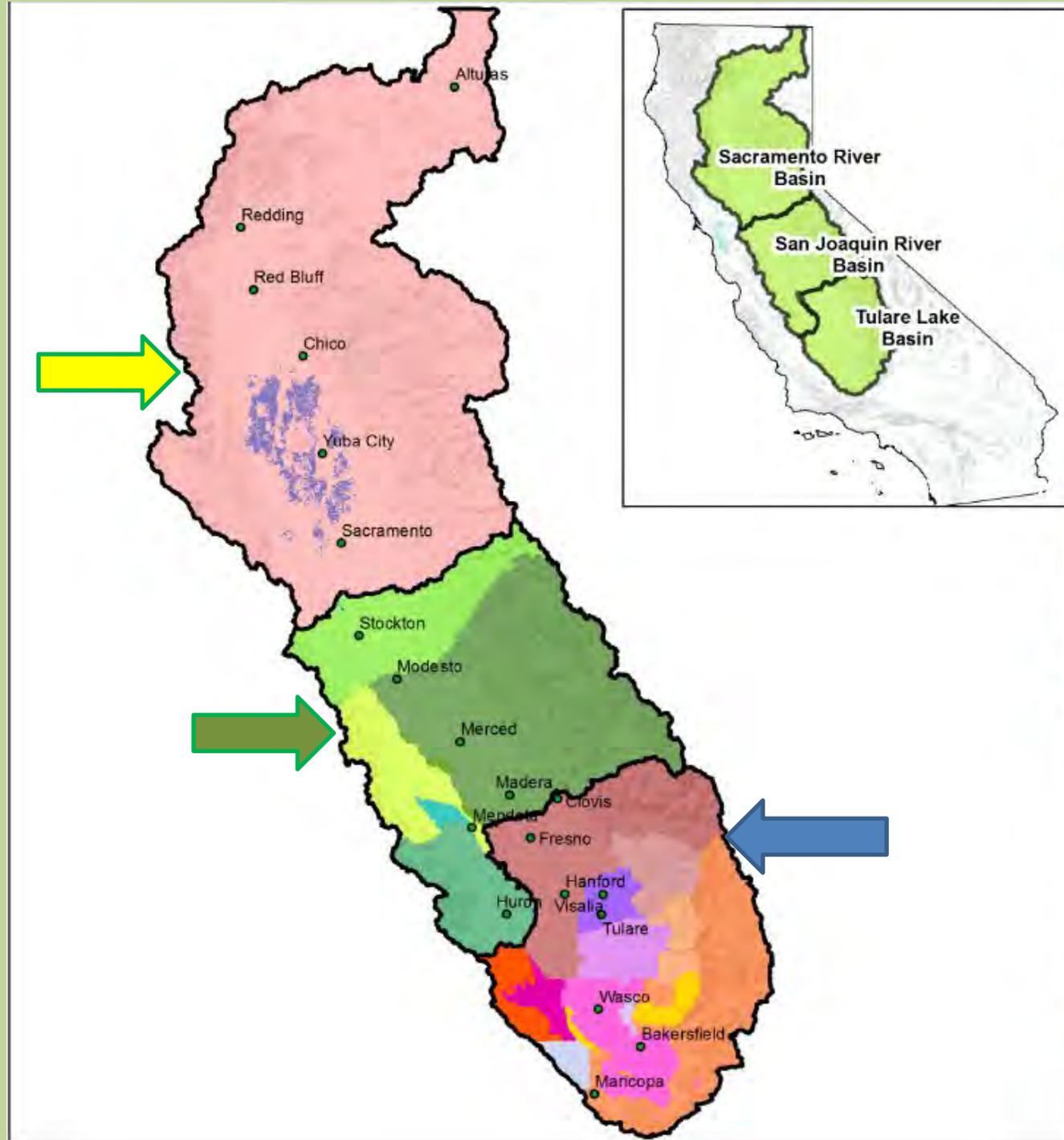
SSJV Management Practices Evaluation Program

- Who are we?
- MPEP strategy to expand and accelerate grower adoption of protective practices
- Work and timeline in historical context
- Background regarding nitrate in the Central Valley
- Factors driving nitrate leaching
- How the MPEP Leads to Better Recovery of Applied N into Crops
 - Performance goals and metrics
 - How N and water management are evolving
 - Outreach – newly available tools
 - Assessment with a calibrated, highly detailed, landscape-level model
- Questions & discussion

Who we are, what we do

- In 2015, 7 grower coalitions formed the Committee to respond to irrigated lands orders.
- 9000 members farm ~2 million acres, mostly S of Fresno.
- Purpose: Evaluate effects of our farming on water quality, with an initial/current focus on *nitrate leaching to groundwater*.
- Funded by grower/members & grants obtained from agencies with common interests.
- Work with collaborators on **assessment, studies, outreach, & regulatory compliance**.

Central Valley Model Domains and Water Quality Coalitions



- ### Legend
- Sacramento Valley Water Coalition
 - California Rice Commission
 - San Joaquin County & Delta Coalition
 - Westside San Joaquin River Watershed
 - East San Joaquin Water Quality Coalition
 - Westlands Water Quality Coalition
 - Grassland Drainage Area
 - Cawelo Water District Coalition
 - Cawelo Coalition Supplementary
 - Buena Vista Coalition
 - Buena Vista Coalition Supplementary
 - Kaweah Basin Water Quality Association
 - Kaweah Association Supplementary
 - Kern River Watershed Coalition Authority
 - Kern Coalition Supplementary
 - Kings River Watershed Coalition Authority
 - Tule Basin Water Quality Coalition
 - Tule Coalition Supplementary
 - Westside Coalition Supplementary
 - Westside Water Quality Coalition

REGION 5 COALITION BOUNDARIES

SOUTHERN SAN JOAQUIN VALLEY (SSJV) MANAGEMENT PRACTICES EVALUATION PROGRAM (MPEP) COMMITTEE

FUNDING FROM AND COLLABORATION WITH USDA-NRCS THROUGH CONSERVATION INNOVATION GRANT

Study of grower practice adoption

- Rate of practice adoption varies among commodities; very broad changes in irrigation systems in permanent crops; changes in soil/nutrition related practices ongoing.
- Benefits sought by growers: crop **yield & quality**
- Barriers to practice adoption by growers: **cost, technical knowledge, and uncertainty** (lack of site-specific information?)

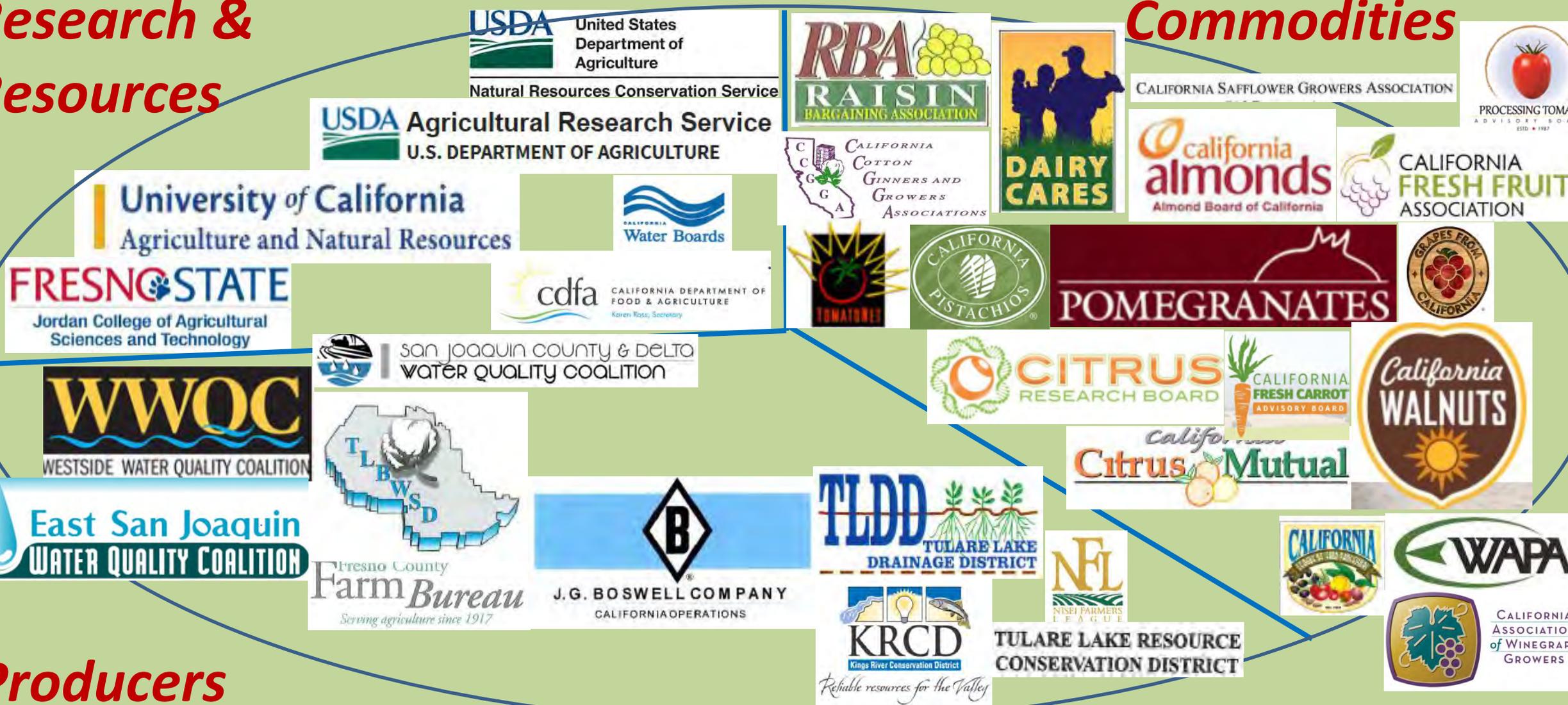
Key take-homes for MPEP: A grower-oriented outreach program will be more successful if environmental and regulatory compliance benefits are co-equal with improvements in crop yield and quality. Free tools that facilitate informed decisions in a convenient way can reduce uncertainty that prevents adoption of better N and irrigation practices.

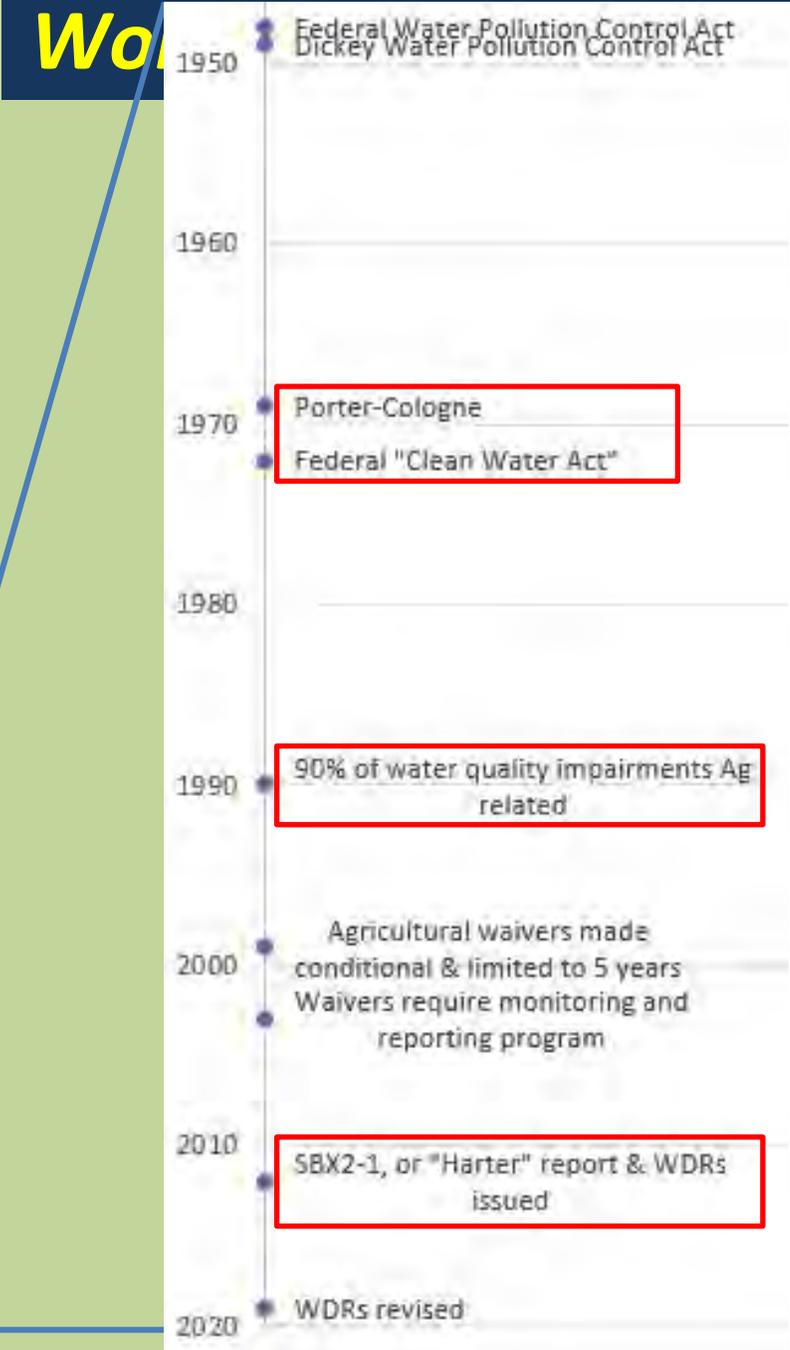
Committee Collaborates to Focus Resources on Maximizing Capture of Applied N by Crops

Research & Resources

Commodities

Producers





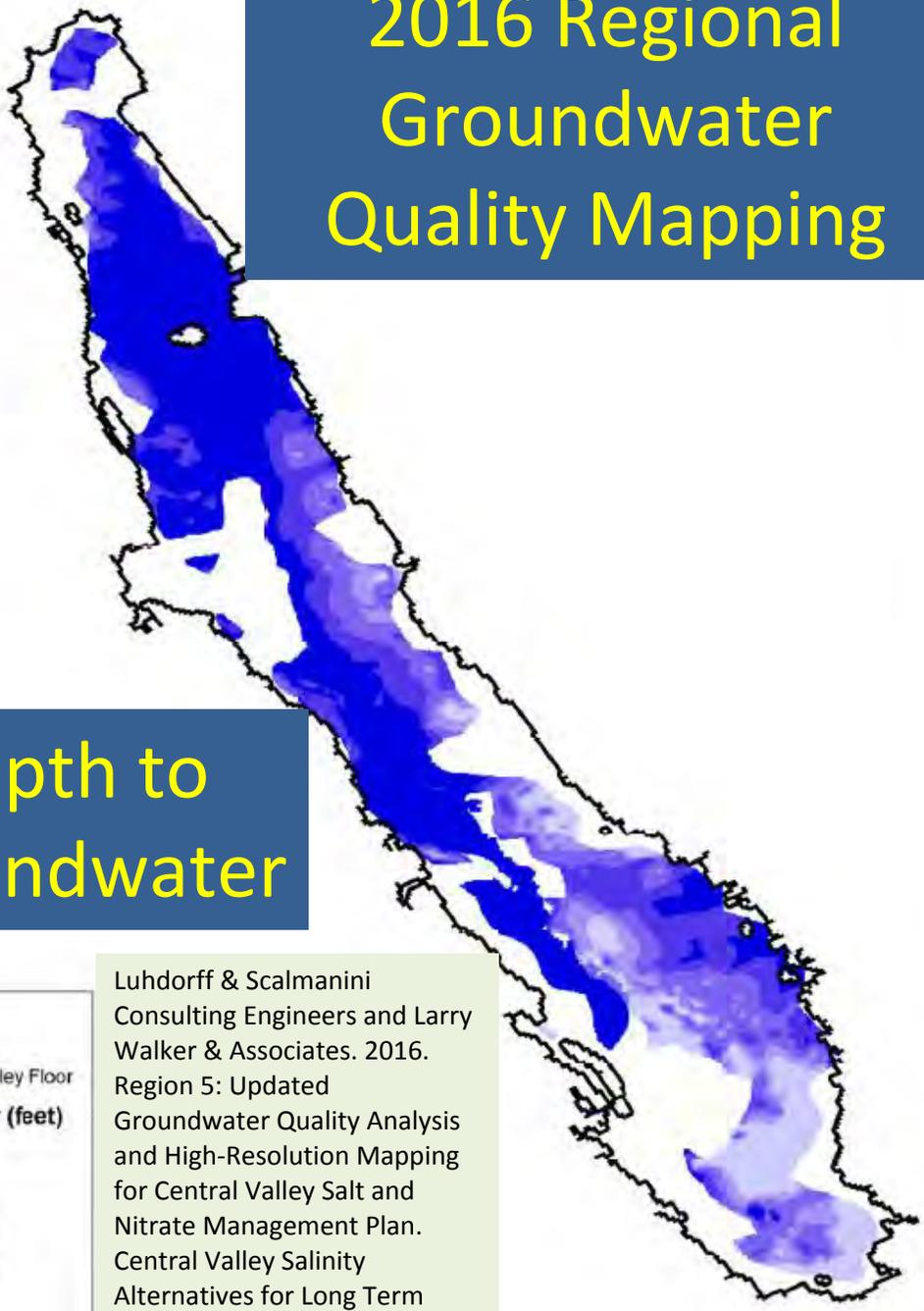
2017 Snapshot of Central Valley Irrigated Lands

- ***Irrigated Lands Regulatory Program (includes crops not irrigated with dairy effluent):***
 - ***~6.2 M acres, 17% of US and 75% of CA irrigated land.^a***
 - ***>250 crops, \$17 B/year.^a***
- ***Dairy Program (includes forages irrigated with dairy effluent):^b***
 - ***CA produces 20% of US milk (Wisconsin: 14%), \$6.3 B/year for milk, 1.7 M milking cows plus support stock (heifers, calves).***
 - ***Approximately 91% of CA dairy cows and more than 80% of dairies are in the Central Valley.***
 - ***Central Valley dairies are concentrated in the SSJV.***

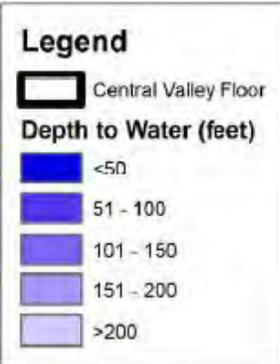
^aIncluding Dairy Program forage.

^bDairy info from: Flaherty, R., and J.P. Cativiela. 2017. California Dairy 101. Dairy and Livestock Working Group.

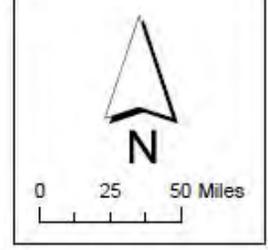
2016 Regional Groundwater Quality Mapping



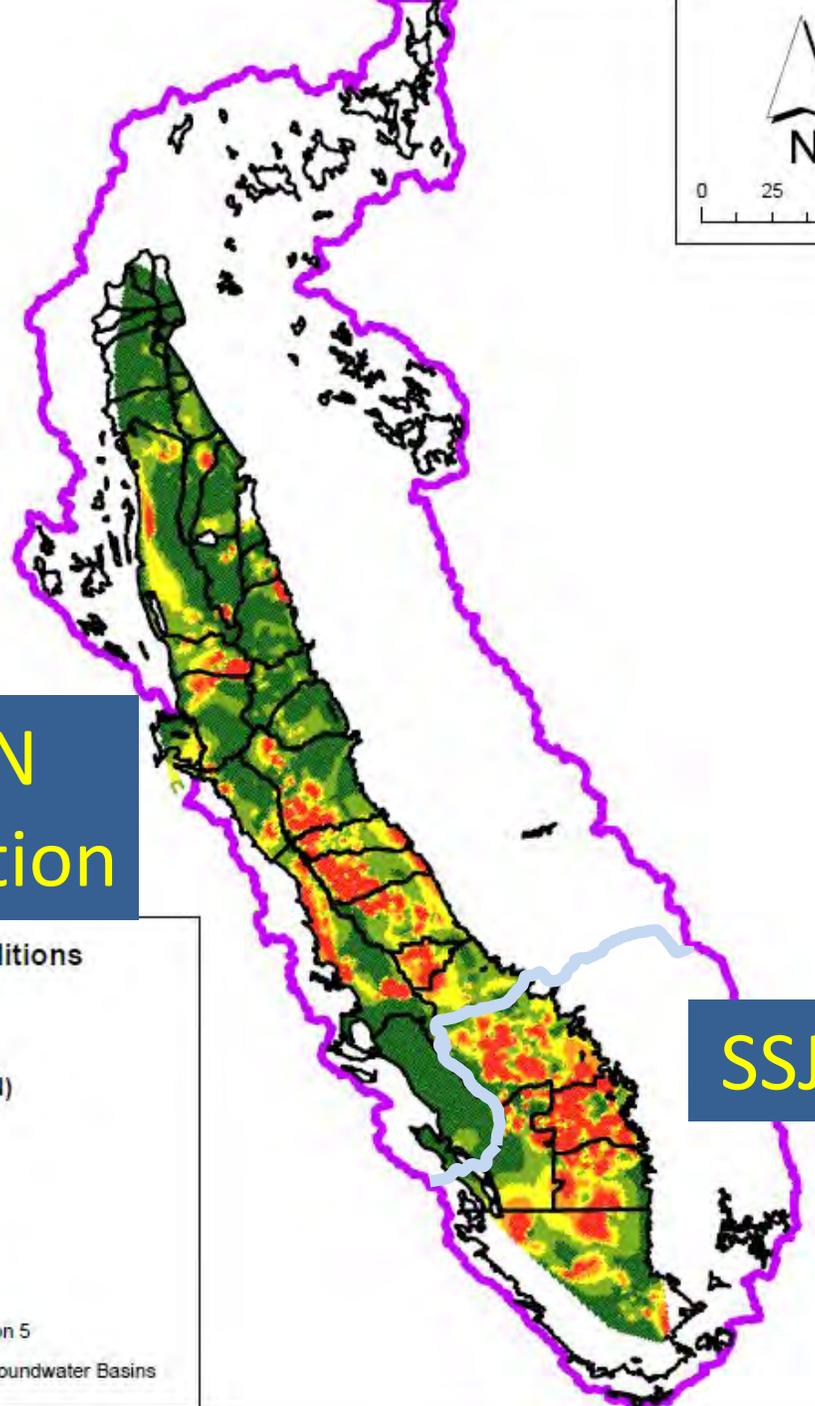
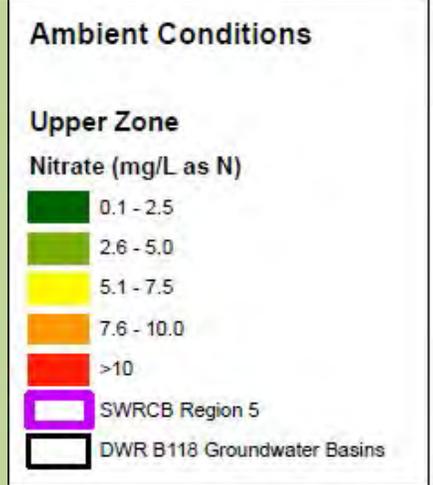
Depth to Groundwater



Luhdorff & Scalmanini Consulting Engineers and Larry Walker & Associates. 2016. Region 5: Updated Groundwater Quality Analysis and High-Resolution Mapping for Central Valley Salt and Nitrate Management Plan. Central Valley Salinity Alternatives for Long Term Sustainability (CV-SALTS).



Nitrate-N concentration



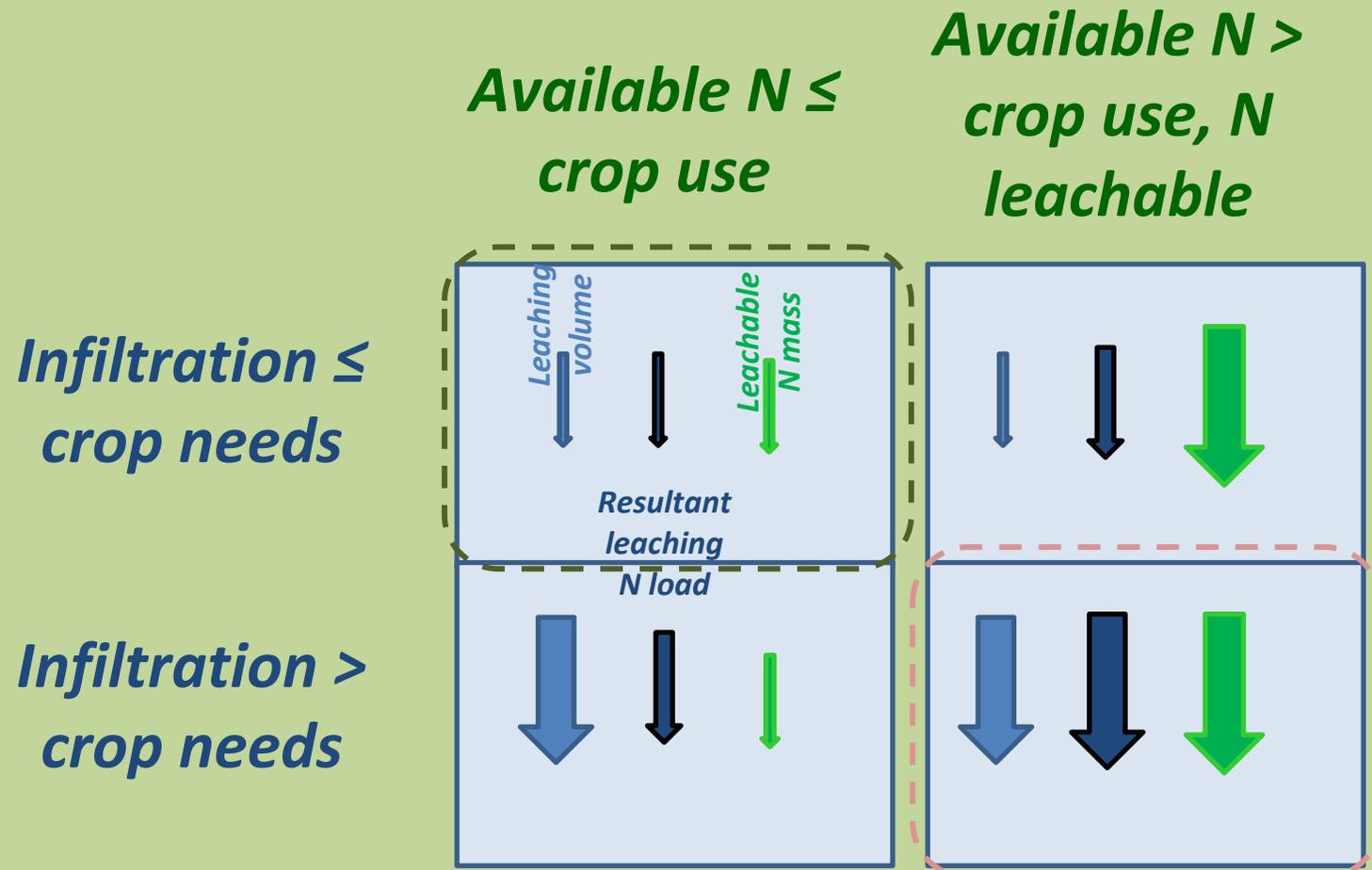
SSJV

Summary of Background

- Nitrogen and other resources were harnessed to generate epic levels of agricultural production and value.
- Groundwater nitrate levels appear to have been affected.
- N consumed by crops and animals is not the problem. Rather, it is the N *not* consumed by crops that can be lost to the atmosphere & groundwater.

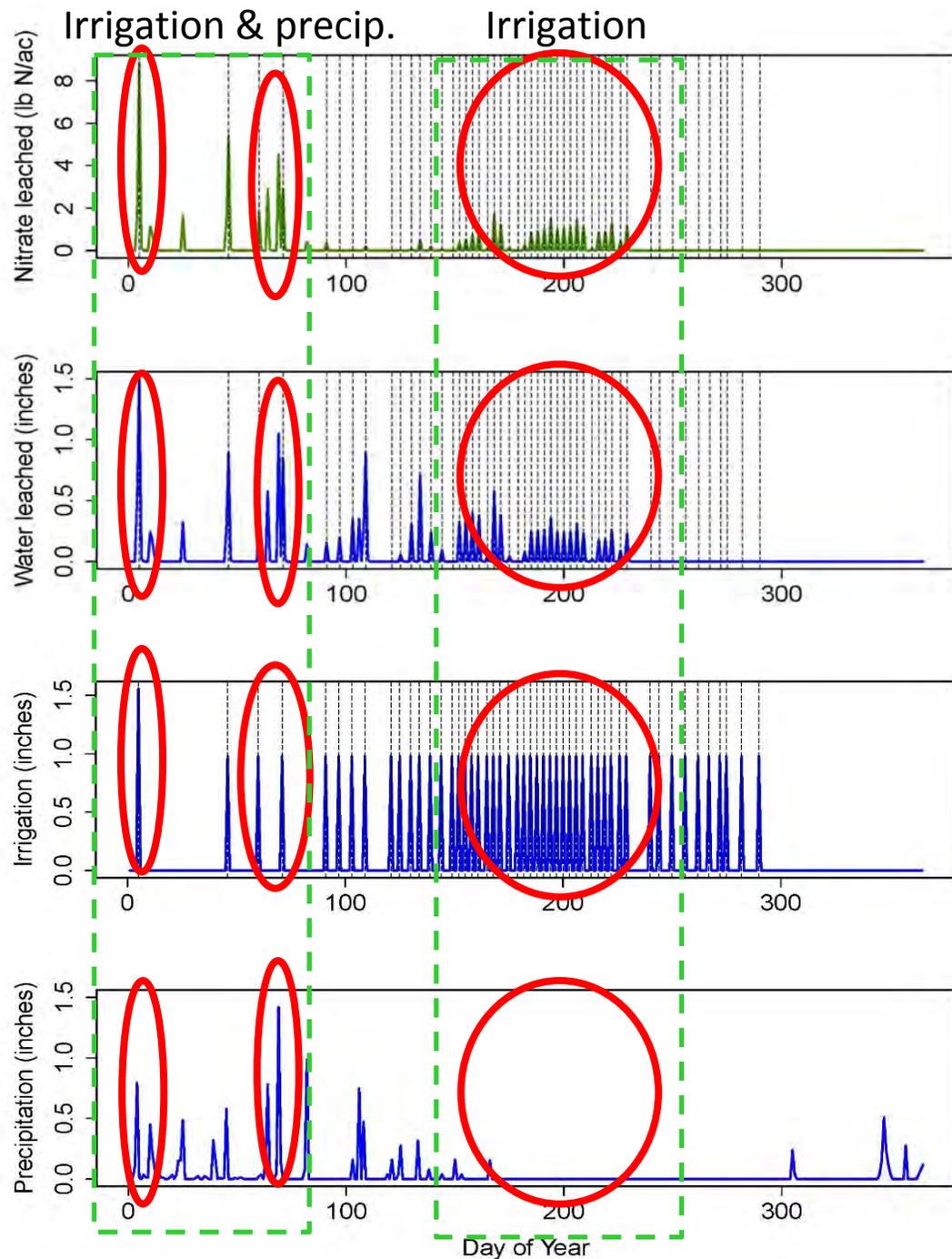
Factors driving nitrate leaching from root systems ?

Opportunities to reduce the rate of nitrate leaching



How to know where and when leaching events occur?
Identify periodic imbalances between irrigation+precip & ET,
especially when residual soil nitrate concentrations are high.

Modeled daily nitrate leaching



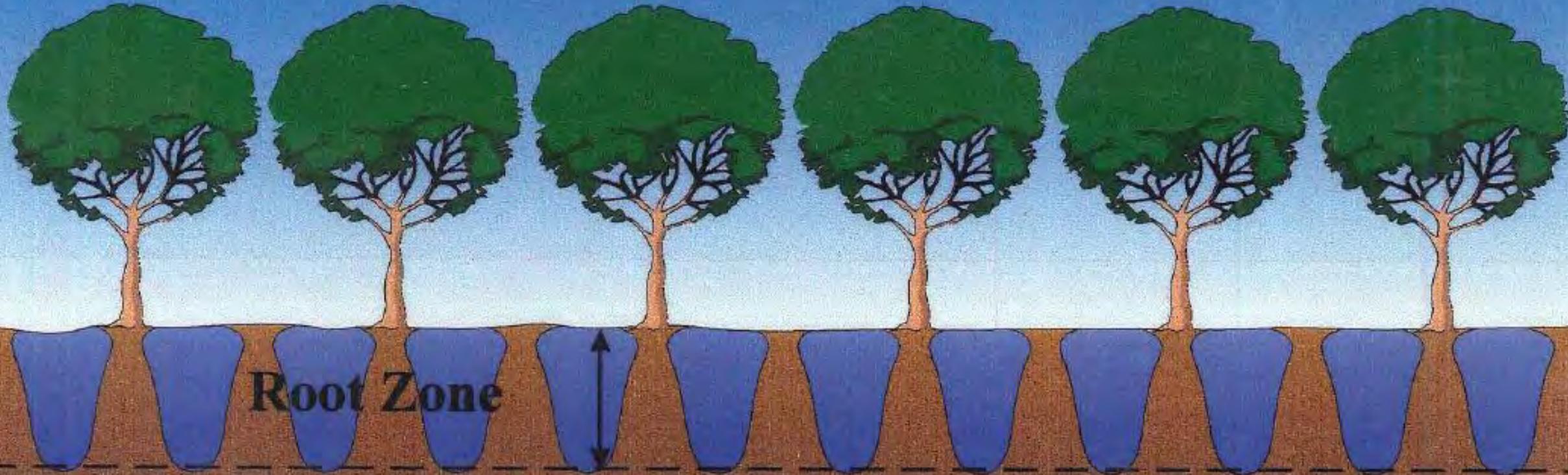
Key Points:

- Leaching depends on hydrology and the presence of nitrogen.
- Nitrate leaching by irrigation controlled by fertilization, scheduling, and uniformity.
- Leaching by precipitation driven by fertilization.

Drip Irrigation -- *Low uniformity*

Drip Irrigation -- *Over-application*

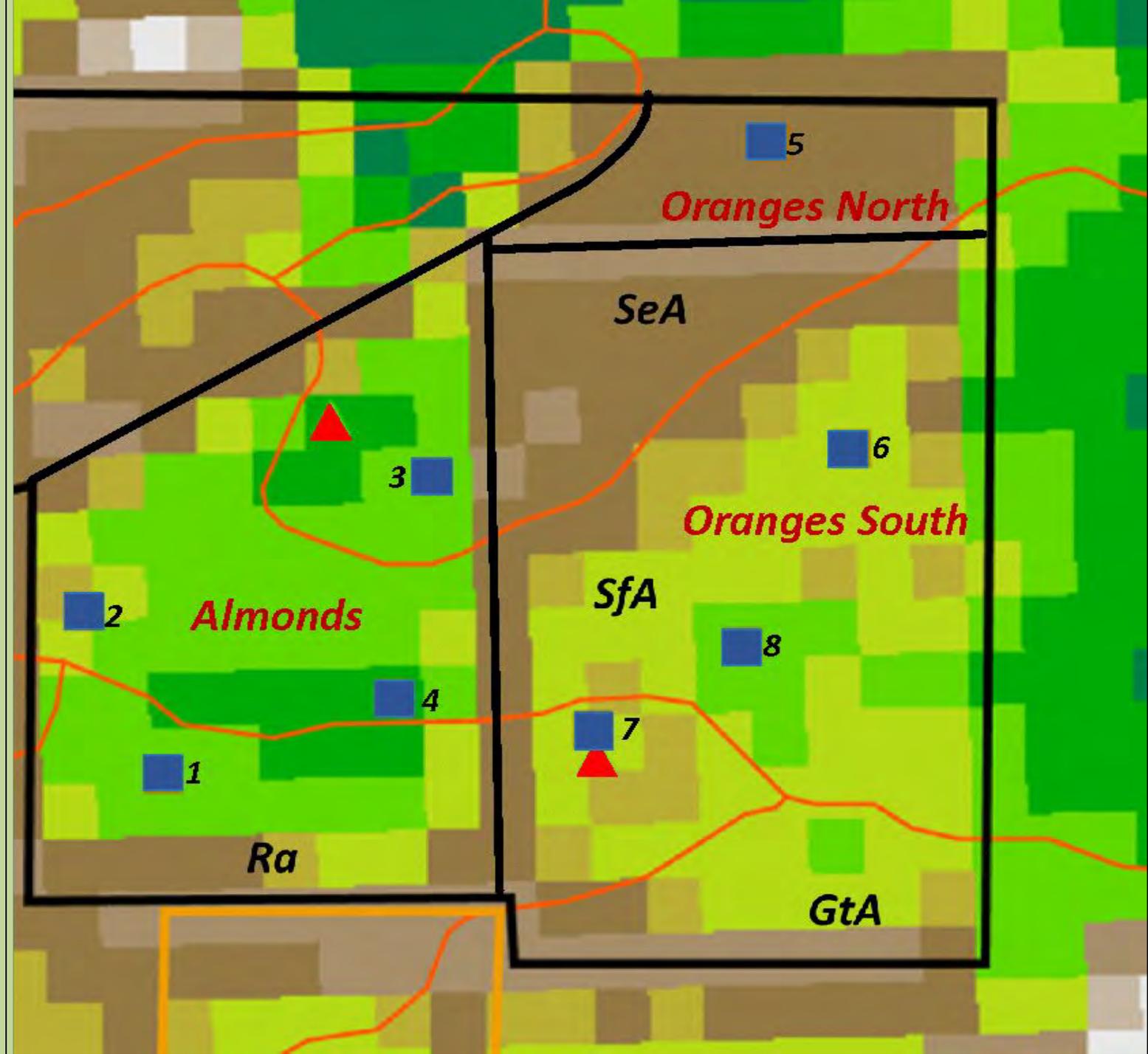
Drip Irrigation -- *High uniformity, well scheduled*



Leaching strategically timed and purposeful.

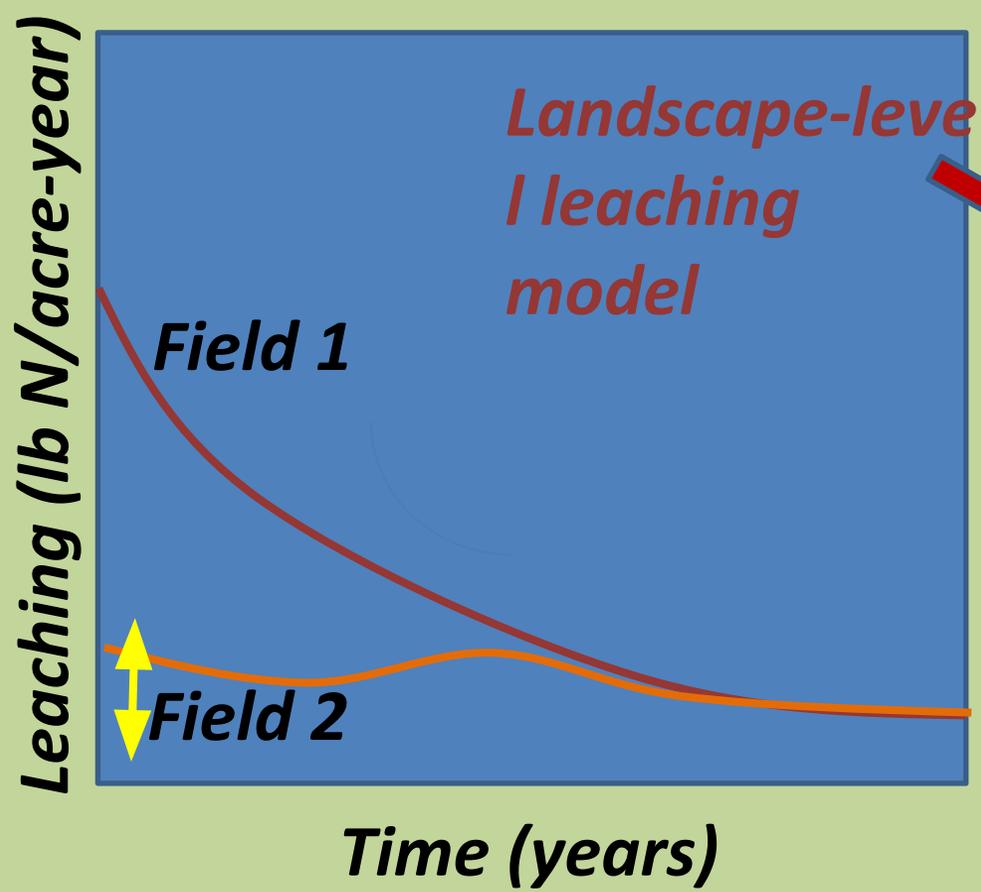
ETa 2014 May-Oct Summary

ETa201405to10cv

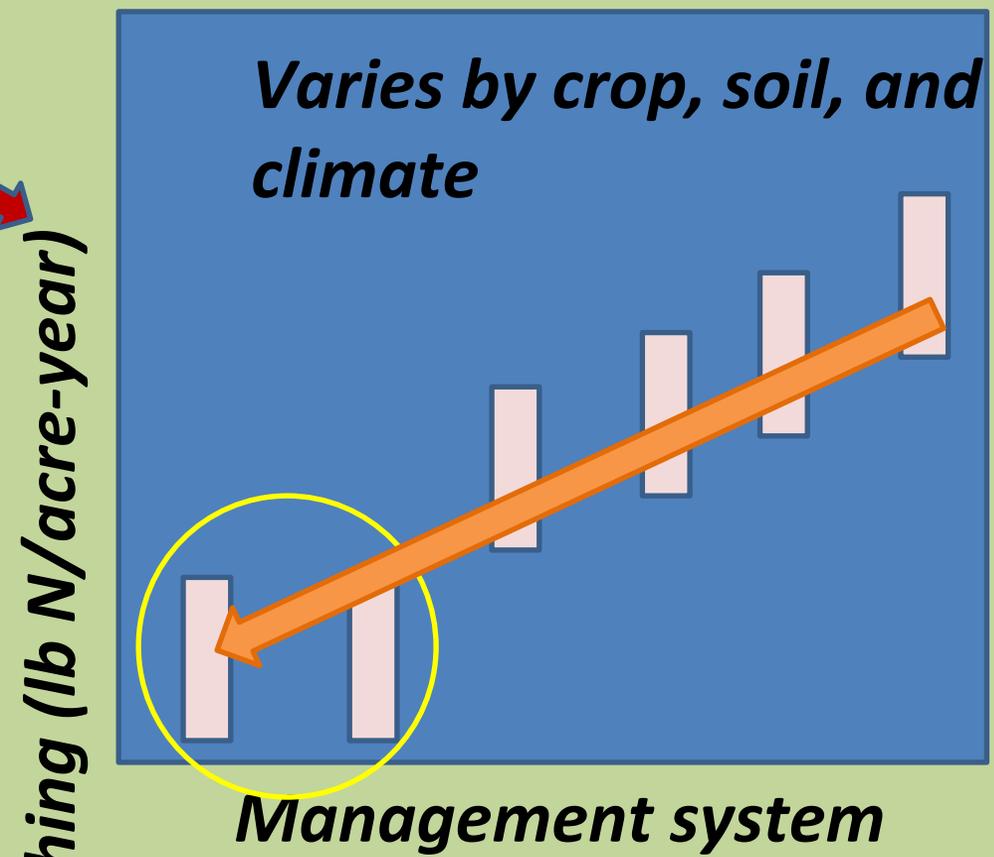


How the MPEP Leads to Better Recovery of N into Crops

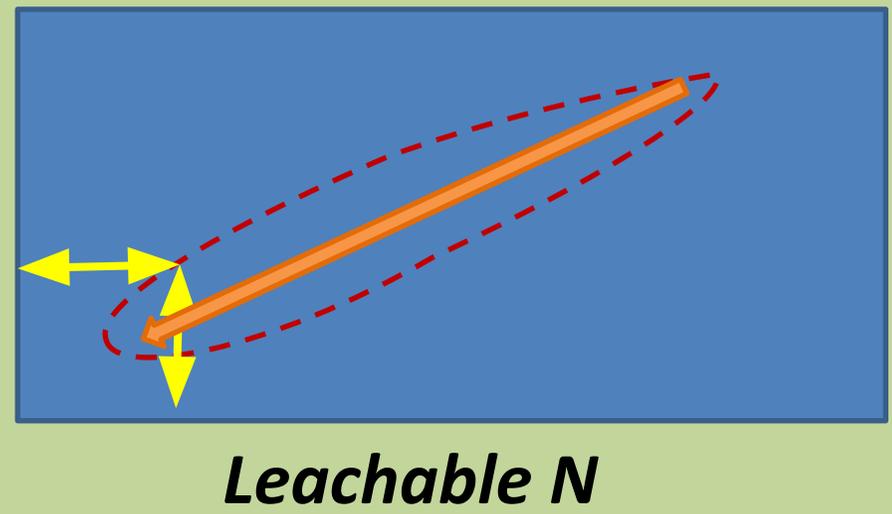
- Performance goals and metrics
- How N and water management are evolving
- Outreach – newly available tools
- Assessment with a calibrated, highly detailed, landscape-level model



*How to enable and incentivize transitions?
 Maintain or Increase
 Yield & Quality*



*Management information from growers ?
 Practice adoption rates*

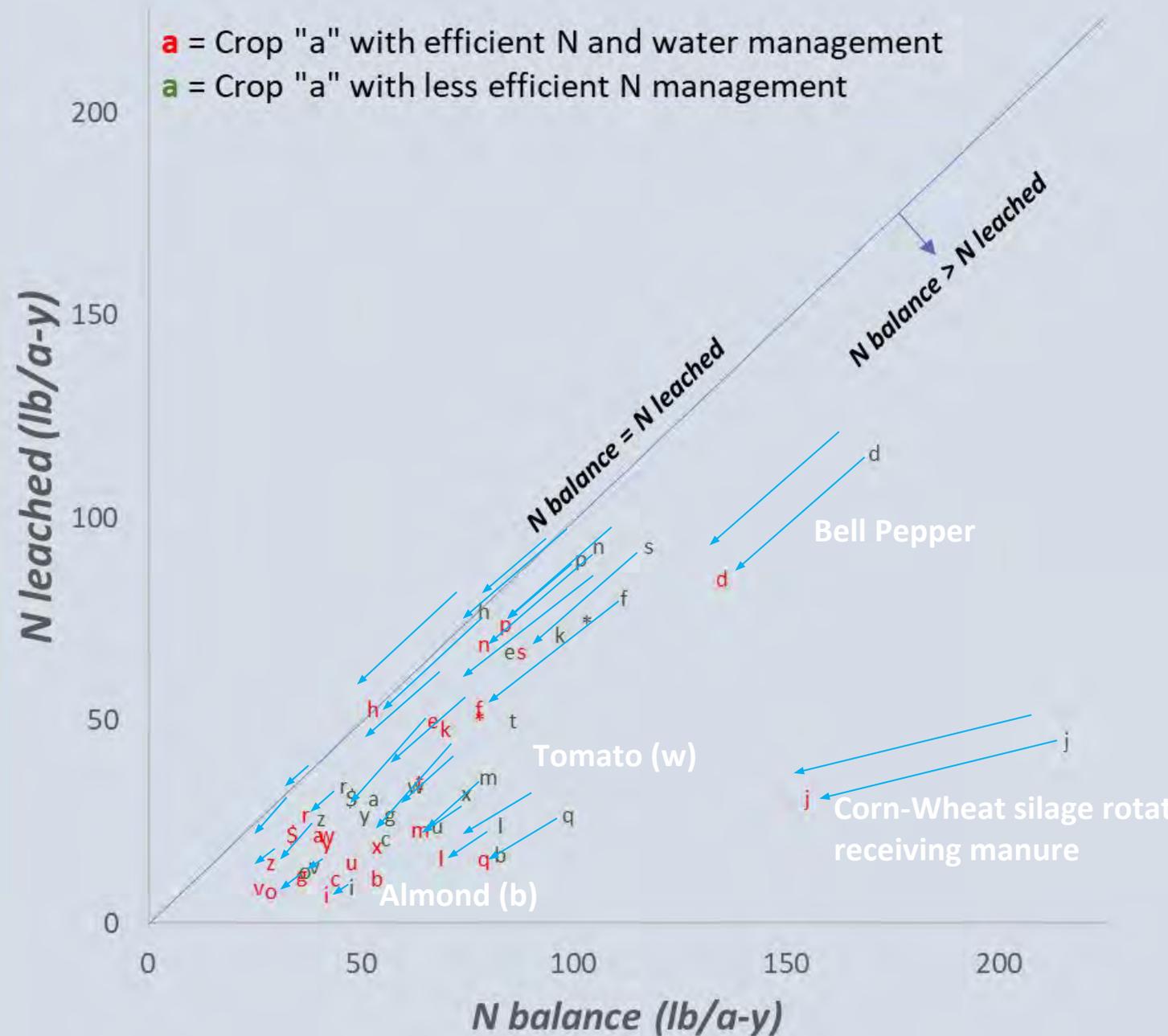


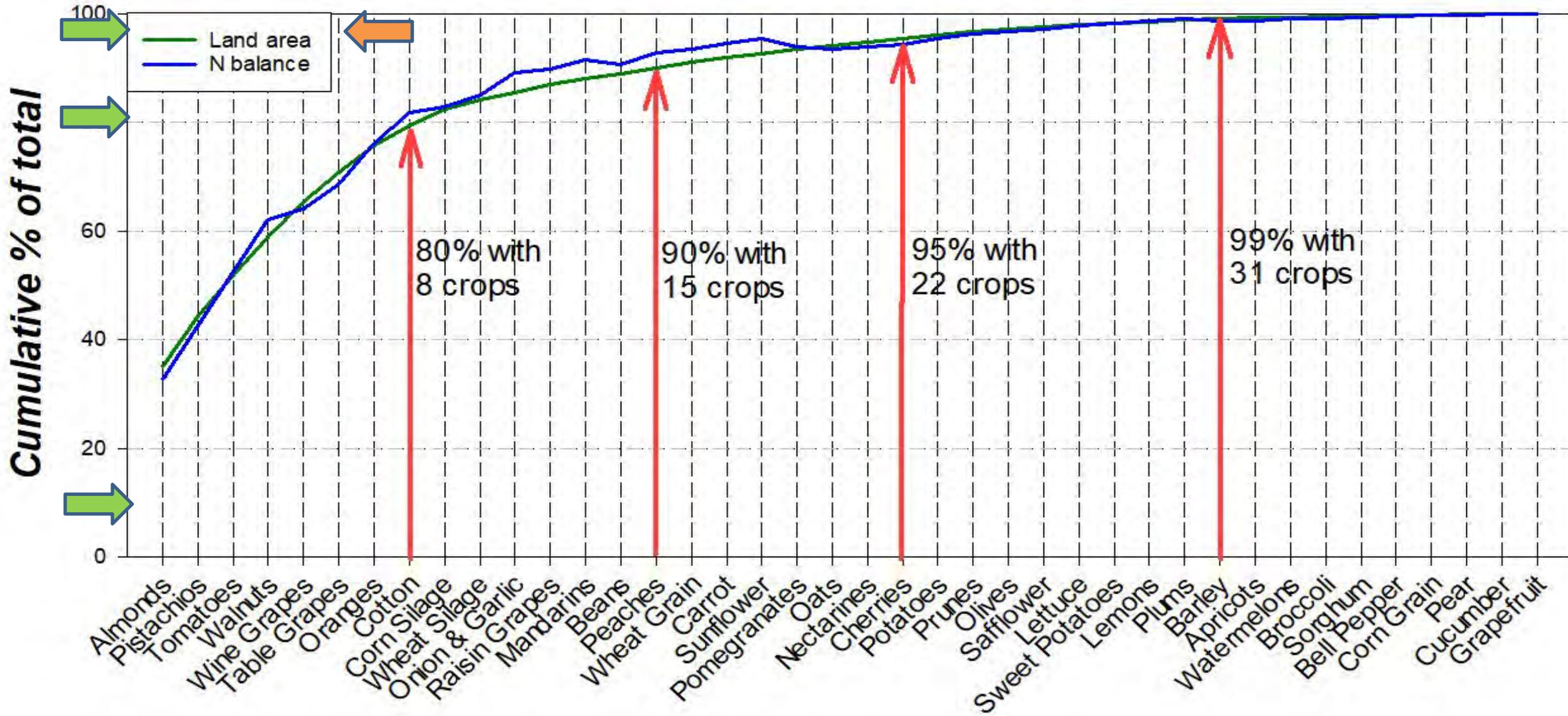
Performance metrics

Performance goals, assessment framework

$$N \text{ Balance} = N \text{ applied} - N \text{ removed (yield)}$$
A Leachable N Metric for Central Valley Crops

- Modeled N leached for 2 levels of N management in 28 crops
- For each crop:
 - N balance and leaching were lower when managing N more efficiently.
 - Higher N balance was related to higher rates of N leaching.



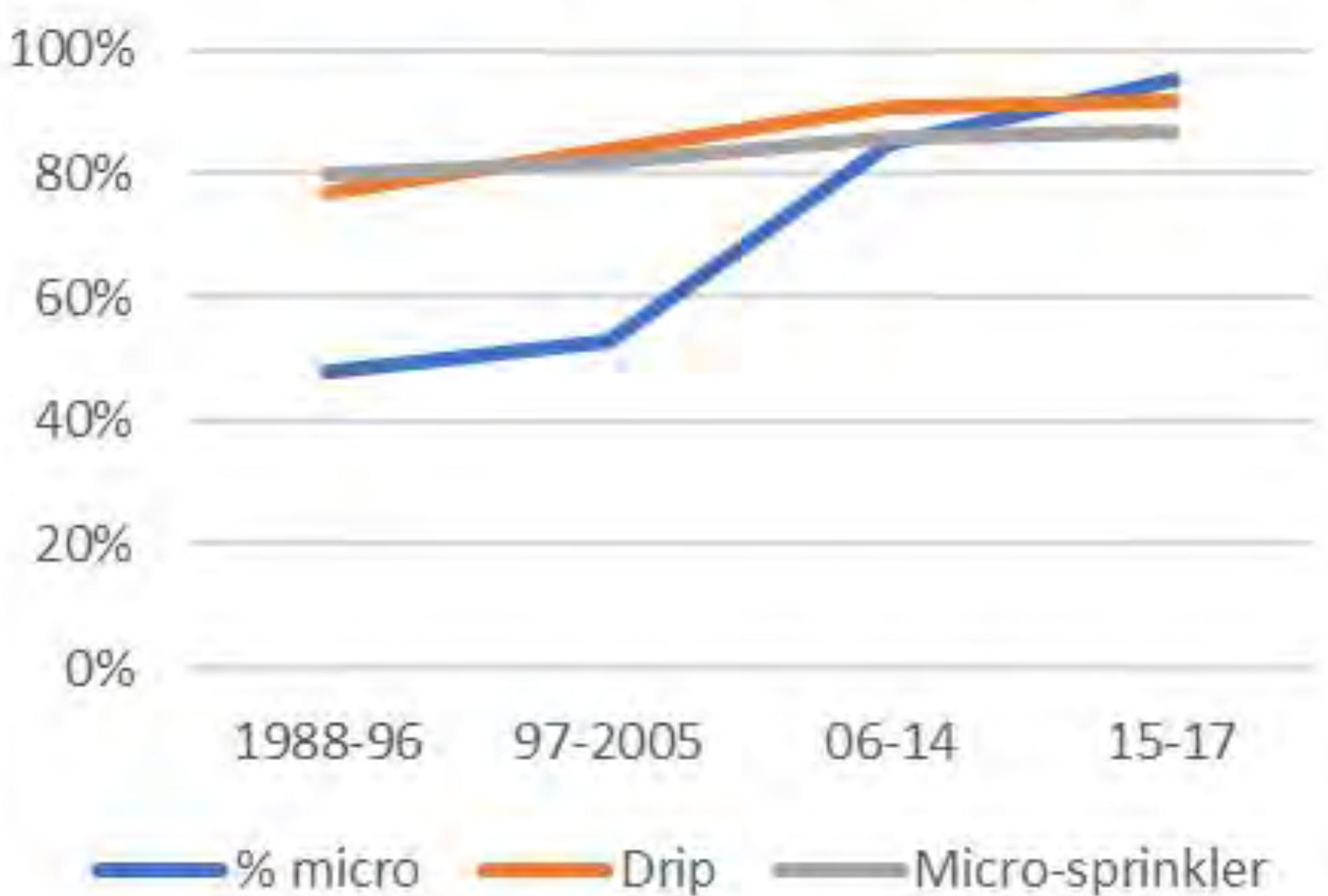


Provisional crop N removal rates established for 98% of acreage in 2016, but only 12% had a firm, contemporary sampling foundation. Collaborative sampling with commodity groups has boosted this to 82% of acreage. A second phase would take this to 99%.





**Trends in
micro-irrigation
frequency
and
performance
in DU tests,
NW Kern RCD**

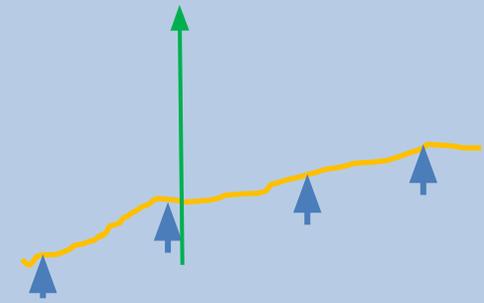


Data from Hockett,
B. 2019. Kern
Coalition CEU
Meeting.

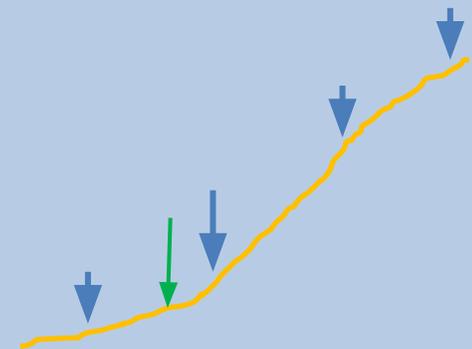
Individual and broad-based shifts in N and water management

- 2016 relationship of yield and N balance to N applied to oranges in the Central Valley (red lines)
- One grower's yield and N balances from 2016-19 (numbers).
- Grower's 2018 shift in 4 crucial irrigation and fertigation practices resulted in a >60% decline in the 2019 N balance due to a nearly doubling of yield without applying more N.
- Broad-based shifts of this nature move the yield curve up, and the N balance curve downward (= less risk per pound of N applied).

Yield (cartons/a)



N balance (lb/a)



How are N and water management evolving now?

- N balance can serve as a broad-based metric for N fate.
- For many crops, there is some acreage with elevated N rates that on average produce no more crop than fields with lower rates. There may thus be opportunities for lower N rates without sacrificing yield. This shift appears to be occurring.
 - There is greater consensus among growers about how to fertilize some crops than others.
 - Reports generally reflect agronomic rates far lower than those assumed in the historically-oriented SBX2-1 work.

How are N and water management evolving now?

- On other acreage, improved timing and uniformity of irrigation and fertigation should enable larger harvests, lower N rates, or both.
 - Capturing more N into a bigger crop reduces leachable N just as well as eliminating N applications that do not contribute to crop yield.
 - Better yield and quality are effective supplementary incentives to meet environmental performance goals and regulatory obligations.

Tools for Growers

- Website: 1-stop shopping for priority pollutants
<https://agmpep.com/>
- Learning event calendar <https://agmpep.com/events/>
- Handouts/fliers
 - Wellhead protection
<https://agmpep.com/urgent-practices/>
 - Well abandonment
<https://agmpep.com/urgent-practices/well-destructionabandonment-practices/>
- Adding Spanish & other translations

Tools for Growers

• Tools & calculators

– Actual ET & ET uniformity viewer

<https://agmpep.com/landcover-et/app.php>

<https://agmpep.com/variability/app.php>

– N removed in 72 crops <https://agmpep.com/calc-y2r/>

– Applied water calculator (applied water by depth, volume, or pump run time) <https://agmpep.com/calc-appw/>

– N in irrigation water (4 versions, multiple water sources, N forms)

<https://agmpep.com/calc-irrn/>

– SWAT results viewer <https://agmpep.com/swat-viewer>

– Integration with **CropManage** to inform growers' irrigation/fertigation decisions

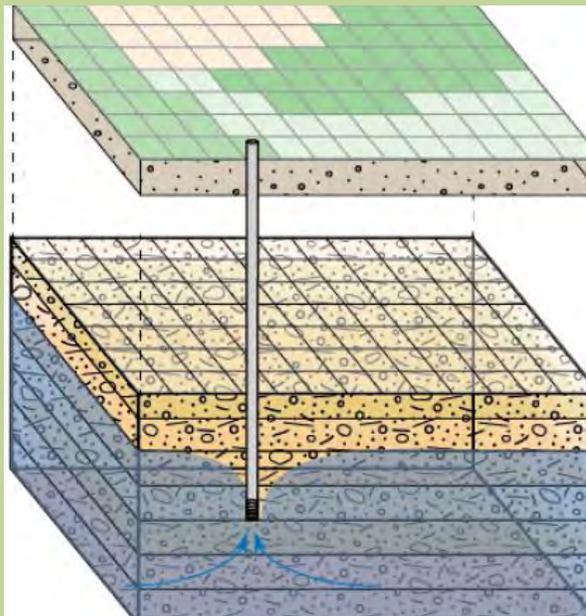
CropManage: A tool that integrates your management information with research-based irrigation and fertility recommendations

- CropManage:
 - Is free
 - Allows you to set up a ranch with multiple, independent fields
 - Integrates your management info with publicly available agroclimatic and soils info (accommodates ETcrop & Soil Moisture Monitoring information)
 - Provides research-based, daily recommendations for irrigation and fertility management
 - Currently handles **almonds, alfalfa, tomatoes**, many veg crops, with **pistachio, walnuts** & more to come!

Assessment Options in the Order

- Groundwater monitoring;
- Modeling;
- Vadose zone sampling; and/or
- Other scientifically sound and technically justifiable methods for meeting the defined objectives.

Workplan proposed a linked root-zone (SWAT) groundwater modeling approach with the most detailed, readily available crop, soil, climate, and management data



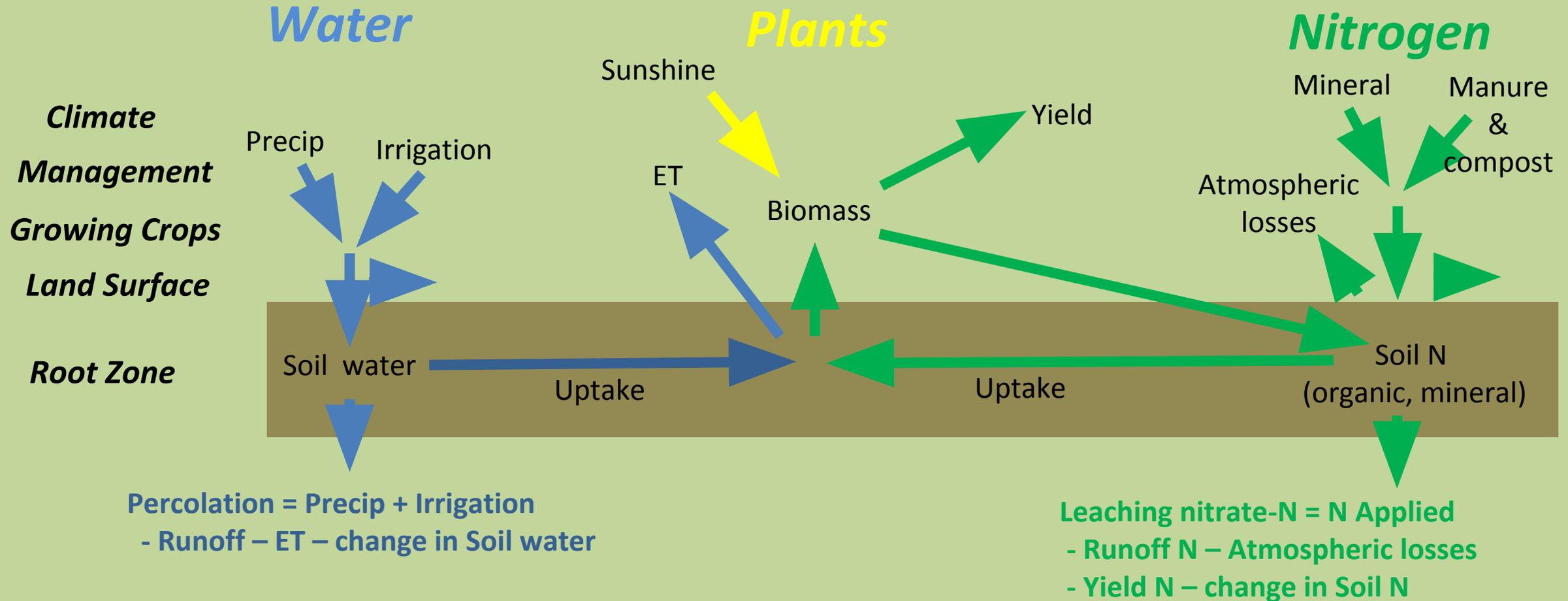
(sketch from S.R. Maples, 2016)

Surface loading as a function of climate, soil, & crop/management

Sub-root-zone, vadose processes initially not emphasized

Steady-state groundwater model characterizing how the underlying aquifers respond to surface loading that results from alternative management regimes

How Root-zone Balances Work



SWAT models growing plant demands and calculates water & N balances

- Daily for a long time, each day beginning where the previous left off
- Separately for many unique climate x management x crop x soil combinations
- Applies results to geographic units in the watershed

Scale of SWAT Modeling

- **Central Valley Watershed:**

- **30 Years**
- **3 Domains**
- **38M acres**
- **681 Sub-basins**
- **> 9k Soils**
- **126k Hydrologic Response Units (HRUs = Crop x soil x climate x watershed combinations)**

- **Irrigated lands:**

- **> 40 modeled crops represent >200 crops grown**
- **25k irrigators**
- **67k irrigated HRUs (representing over 205k fields)**
- **>6.2M acres**

Each SWAT Model Run Reflect Specific Management for each Crop

...crop rotations, cover crops, elimination of fall N applications, etc.

Management		SWAT Run #							
Quality	Parameter	1	2	3	4	5	6	7	8
Standard "good"	Irrigation practices	x	x			x	x		
	Nitrogen management	x		x		x		x	
Less efficient (More Inputs)	Irrigation practices			x	x			x	x
	Nitrogen management		x		x		x		x
Reduce 10 lb/a (Tomato)	Nitrogen management					x	x	x	x
Add early- season event (Almond)	Irrigation practices					x	x	x	x

Questions, comments?

SSJV MPEP

Urgent Practices ▾ NMP ▾ Events Resources ▾ Projects ▾ About ▾

Welcome to the Southern San Joaquin Valley
MANAGEMENT PRACTICES EVALUATION PROGRAM

The SSJV MPEP Committee includes seven irrigated agricultural water quality coalitions located in California's Central Valley, generally between Fresno and Bakersfield, representing members/growers who irrigate agricultural crops to grow food, feed, fiber, and fuel in one of the most productive areas of the planet.

Coalitions:
Buena Vista Coalition | Cawelo Water District Coalition | Kaweah Basin Water Quality Association | Kern River Watershed Coalition Authority | Kings River Water Quality Coalition | Tule Basin Water Quality Coalition | Westside Water Quality Coalition

Events for week of November 26, 2018

« Previous Next »

Mon 26th	Tue 27th	Wed 28th	Thu 29th	Fri 30th	Sat 1st	Sun 2nd
No Events Today	2018 Alfalfa and Forage Symposium November 27 - November 29 Grand Sierra Hotel	2018 Alfalfa and Forage Symposium November 27 - November 29 Grand Sierra Hotel Kern County Ag Day November 28 @ 7:00 am - 1:30 pm Kern County Fairgrounds	2018 Alfalfa and Forage Symposium November 27 - November 29 Grand Sierra Hotel Measurement & Management of Water & Nitrates November 29 @ 9:00 am - 11:30 am Dixon Resource	No Events Today	No Events Today	No Events Today

Visit & use the MPEP Website: Agmpep.com