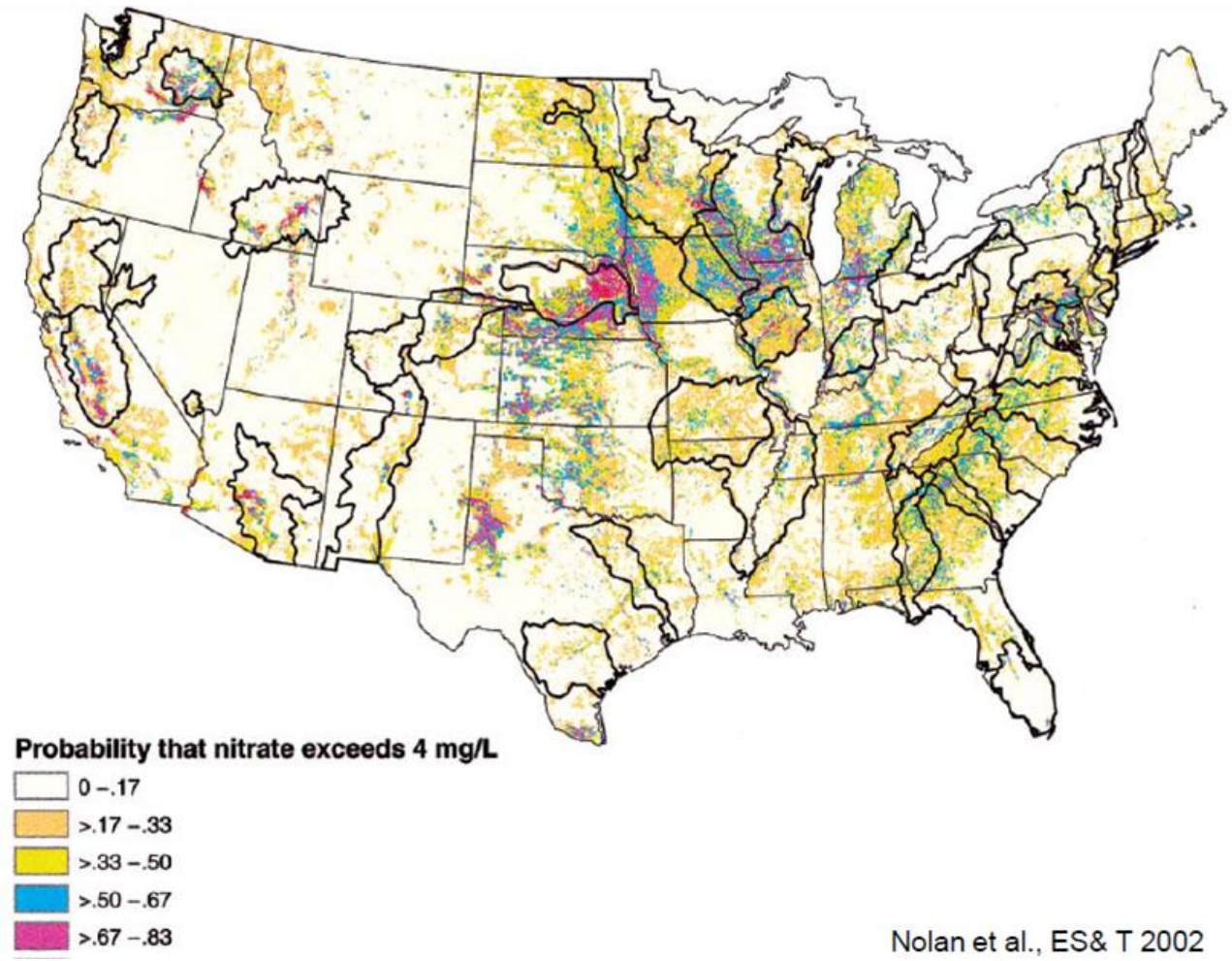
Nitrogen management and water quality in irrigated crop production

Is California alone in having a nitrate problem ?



Intensive ag production is often associated with environmental water quality problems

Why is it particularly problematic in California?

- Special climatic advantages encourage intensive production of high value crops
- Long growing season allows multiple crops per year in many places
- Semi-arid climate provides little dilution of NO_3-N lost in field runoff or leaching

Nitrogen requirements for crop production:

- all crops require a significant amount of nitrogen to attain good yield and quality

	Approximate crop N uptake (lb/acre) for high yield / high quality production	
	in the whole crop	in the harvested portion
Cotton	250	140
Corn for grain	240	120
Processing tomato	240	160
Lettuce	140	80
Spinach	100	70

Water quality protection requires *reasonable* proportionality between N application and N removal in harvested product

So, how much N fertilizer is required ?

Using a strict N balance approach:

Crop N uptake requirement
- **soil N contribution**
- **N contribution of prior crop residues**
- **irrigation water N contribution**

= **fertilizer N requirement**

What is a realistic yield goal for the field ?

So, how much N fertilizer is required ?

Using a strict N balance approach:

Crop N uptake requirement
- soil N contribution
- N contribution of prior crop residues
- irrigation water N contribution

= fertilizer N requirement

How accurately can these values be estimated ?

So, how much N fertilizer is required ?

Using a strict N balance approach:

Crop N uptake requirement
- soil N contribution
- N contribution of prior crop residues
- irrigation water N contribution

= fertilizer N requirement

How efficient will the irrigation be ?

So, how much N fertilizer is required ?

Using a strict N balance approach:

Crop N uptake requirement
- soil N contribution
- N contribution of prior crop residues
- irrigation water N contribution

= fertilizer N requirement

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How efficiently can the crop utilize the fertilizer ?
How large will gaseous losses (volatilization, denitrification) be ?
To what extent will rain or inefficient irrigation leach N before crop uptake ?

Bottom line, uncertainties can result in 'insurance' N application

The path to greater fertilizer efficiency / reduced water quality impacts :

- **Improve irrigation**

The path to greater fertilizer efficiency / reduced water quality impacts :

- **Accurately credit residual soil NO_3-N**

The path to greater fertilizer efficiency / reduced water quality impacts :

- **Improve monitoring techniques (both plant and soil)**

The path to greater fertilizer efficiency / reduced water quality impacts :

- Expand use of N 'trap' crops

In summary :

- **Significant improvements in N fertilizer efficiency can be made**
- **Meeting environmental water quality targets will be a daunting task**

10 pounds of NO_3-N escaping a field requires approximately 4 acre·inches of pure water to dilute it 10 PPM