Alternatives and Costs of Reducing Agricultural Nutrient Losses to Surface Water

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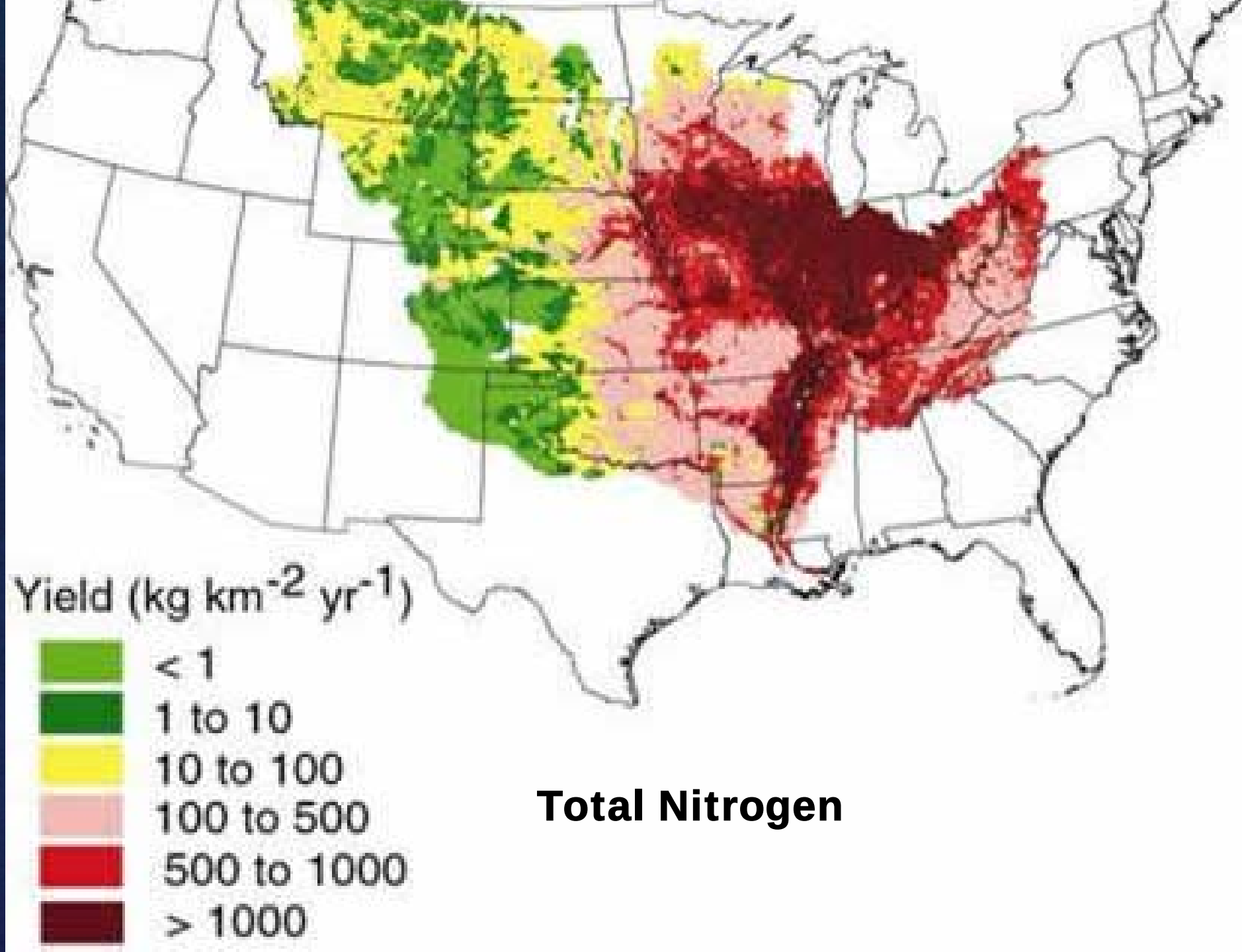
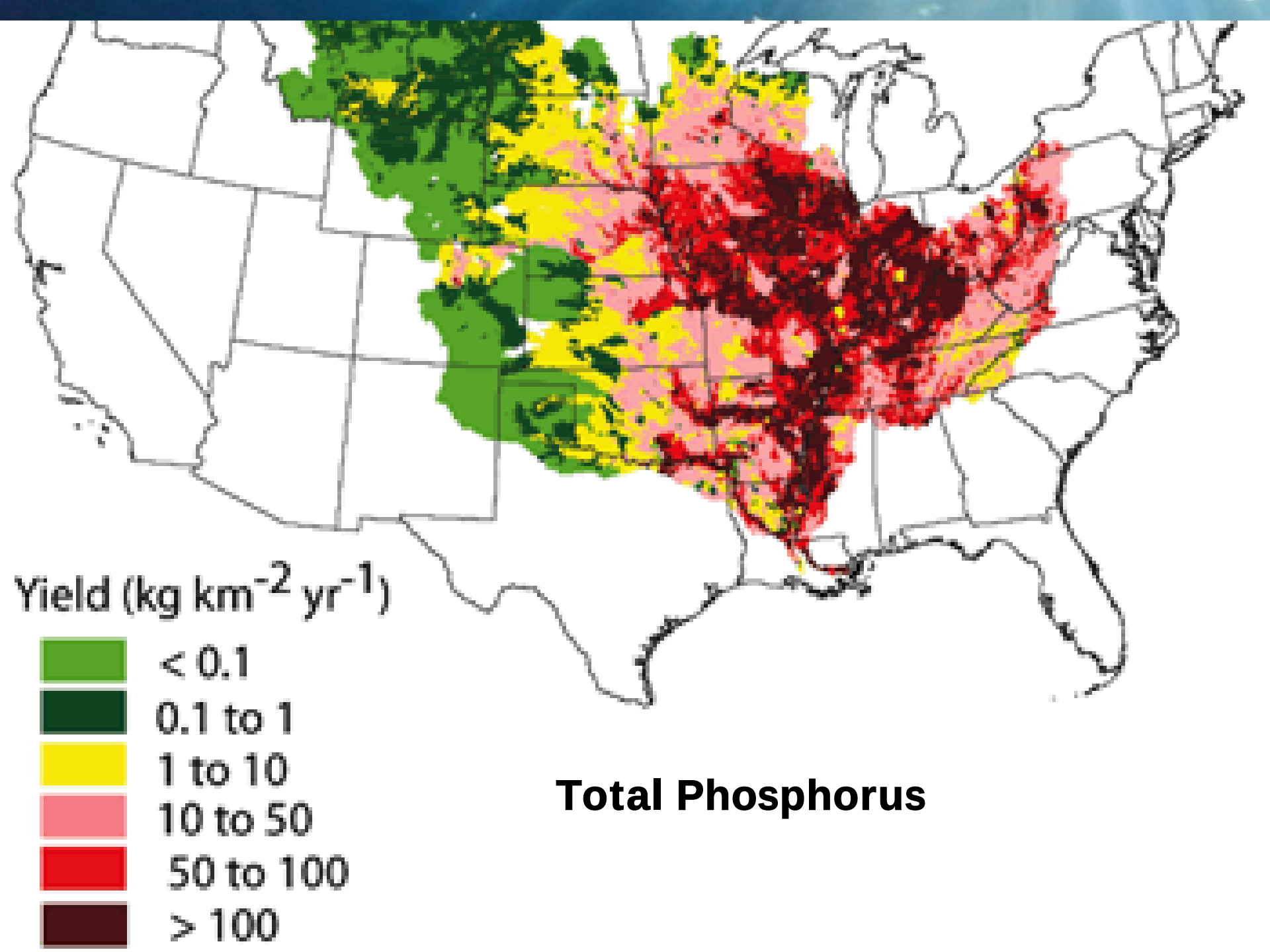
Illinois

- 13 million people
- 28 million acres of agricultural land
- 10 million acres tile drained

USGS says Illinois #1 source of nitrogen and phosphorus to the Gulf of Mexico



Total Nitrogen



Total Phosphorus

- **USEPA SAB says 45% reduction in both N and P needed to reduce size of hypoxic zone to 5,000 sq km**

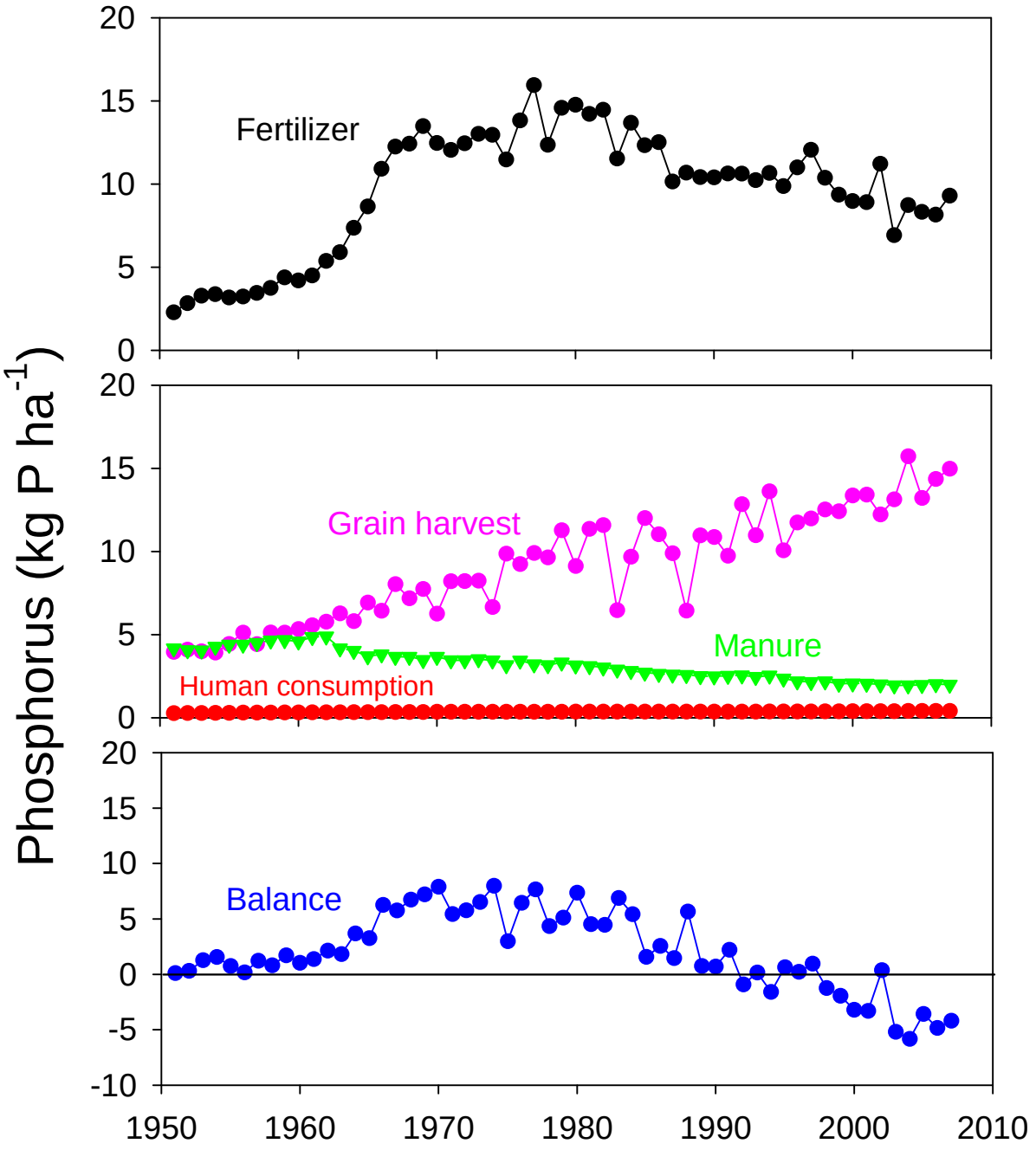
What can we do in agriculture?

- given,
  - it is not typically over-fertilization based on current rates and yields
  - may be zero or negative N & P balances in some tile drained areas

Nutrients in Illinois

- Mass-balance analysis for Illinois shows negative balance for P and declining balance for N

Illinois P Budget



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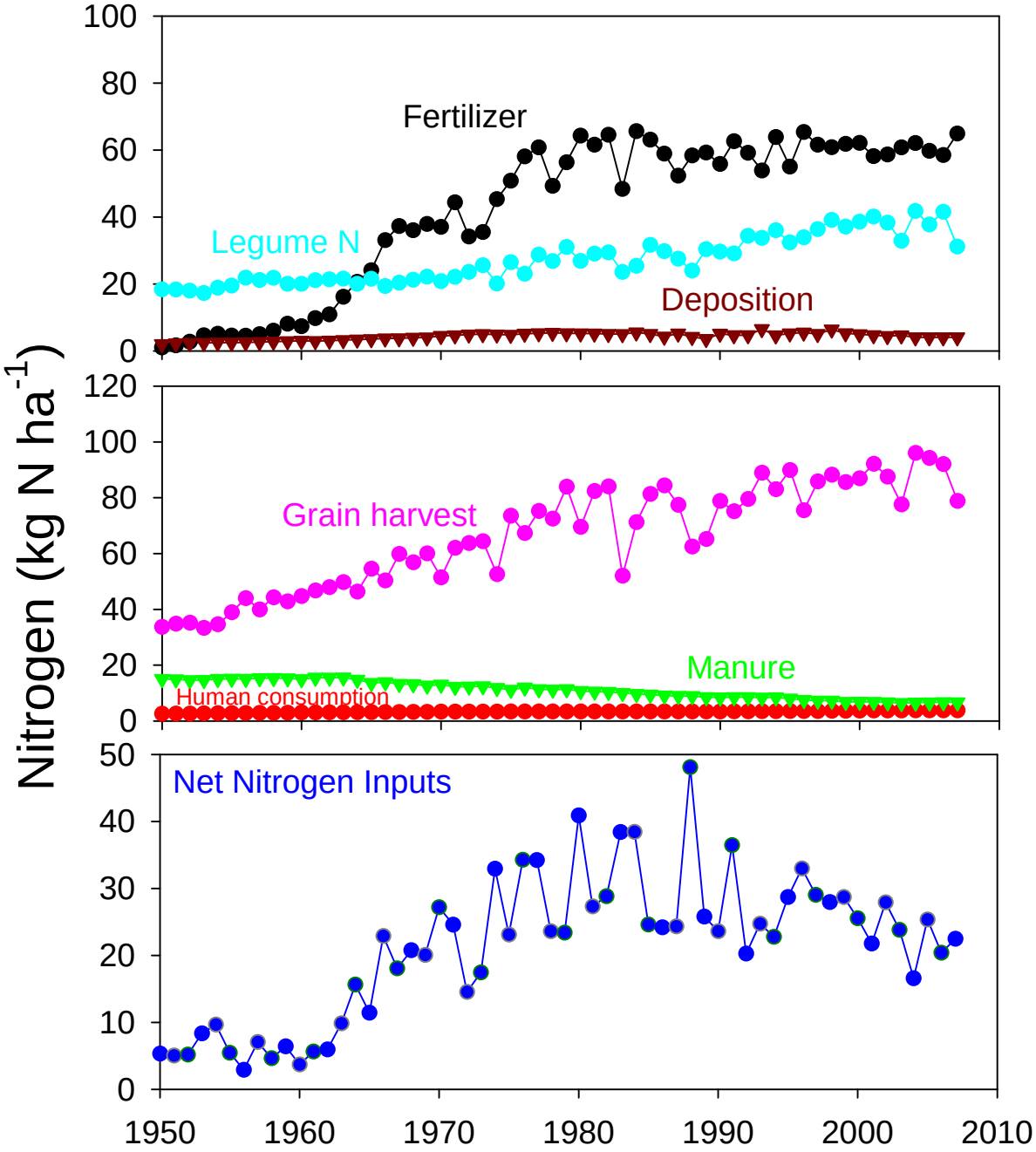
Illinois N Budget



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What can we do in agriculture?

three types of conservation practices could help

- nutrient-use efficiency
- in-field management
- off-site measures

Spring nitrate loss from tile drained fields

- improved N fertilizer management
- cover crops, wetlands, drainage management
- alternative and more complex cropping systems (including perennials)
  - cellulosic biofuels (switchgrass, Miscanthus)

Phosphorus loss reduction

- improved P fertilizer and manure management
  - incorporate P fertilizers, manure
  - soil tests, follow recommendations
- riparian buffer strips
- cover crops
- again, alternative and more complex cropping systems (including perennials)

Costs

Practice effectiveness

Cost effectiveness

Cost per pound and

Total cost

Lake Bloomington Watershed

Mark David, Gregory McIsaac and Corey Mitchell

University of Illinois-NRES

Baseline conditions

44,764 acres
93% cropland
Low erosion rates
More than 50% tile-drained
Well-buffered

Estimated Lake Bloomington Loadings

Total P loading – 14,100 lbs P yr-1 (0.31 lb/ac)

Total N loading – 917,000 lbs N yr-1 (21 lb/ac)

Nitrogen reduction practices (tile drainage)

Practice	% reduction
nitrification inhibitors	10
spring vs. fall fertilization	20
recommended rate vs. above	0
no-till vs. conventional	0
cover crops	25
water table management	40
shallow or wide tiles	25
conversion to CRP	95
conversion to perennial crops	80
constructed wetlands (20:1)	50
bioreactors	No data

Phosphorus reduction practices

Practice	% reduction	
	Tiled	Runoff
recommended rate vs. above		5
inject phosphorus fertilizer		20
cover crops	5	25
shallow or wide tiles	+	-
conversion to CRP	50	75
conversion to perennial crops	50	95
WASCOBs		75
sedimentation basin		95
riparian buffers		50
constructed wetlands (20:1)		20

Practice	Cost
Fall to spring fertilizer N	$25/ac
Recommended P rate vs. above	$12/ac/4 yrs
Inject P fertilizer	$14/ac/2yrs
Wetlands	$6,000/ac + $300/ac rent
Drainage mgt	$250/ac
Cover Crops	$50/ac
CRP/perennials	$300/ac/yr

50% reduction TN

	Non-targeted	Targeted
Practice	Annual cost/lb	Annual cost/lb
CRP	$15.60	
Fall to spring fertilizer	$3.59	$2.85
Cover Crops	$15.79	$13.06
Wetlands	$4.03	$2.16
Drainage mgt	$3.17	$1.80

To achieve a 45% reduction in TP

Practice	Annual cost/lb
No P fertilizer > 70	$193.01
Inject P	$114.62
Perennial crops	$1,013.00

Dual nutrient scenarios

	Percent reductions		Total cost (30 years)	Annual cost per acre
	TN	TP		
Targeted N	50%	52%	$70,509,163	$56.32
Non-targeted	50%	52%	$117,671,310	$93.99
TMDL	79%	93%	$384,503,500	$307.13


10 million acres of tile-drained cropland in Illinois x $56 to $94/acre = $560 million to $940 million per year

Conclusions

- current recommendations and BMP's won't fix problem
- there are methods that can help, both on- and off-field
  - costs and risk
- no "one size fits all" method
- other benefits (local water quality) may not always be clear

No magic bullets

Practice	Erosion/ runoff	Phosphorus	Nitrate
No till	↓↓	↓↑	↑↔
Drainage management	↑	↑	↓
Tile drainage	↓	↓	↑
Cellulosic crops	↓	↓	↓