

# Legacy phosphorus drawdown at decadal to centennial scales in the U.S. Maize Belt

Perspectives for reducing “legacy phosphorus” in agricultural soils

2 February 2022

ESPP

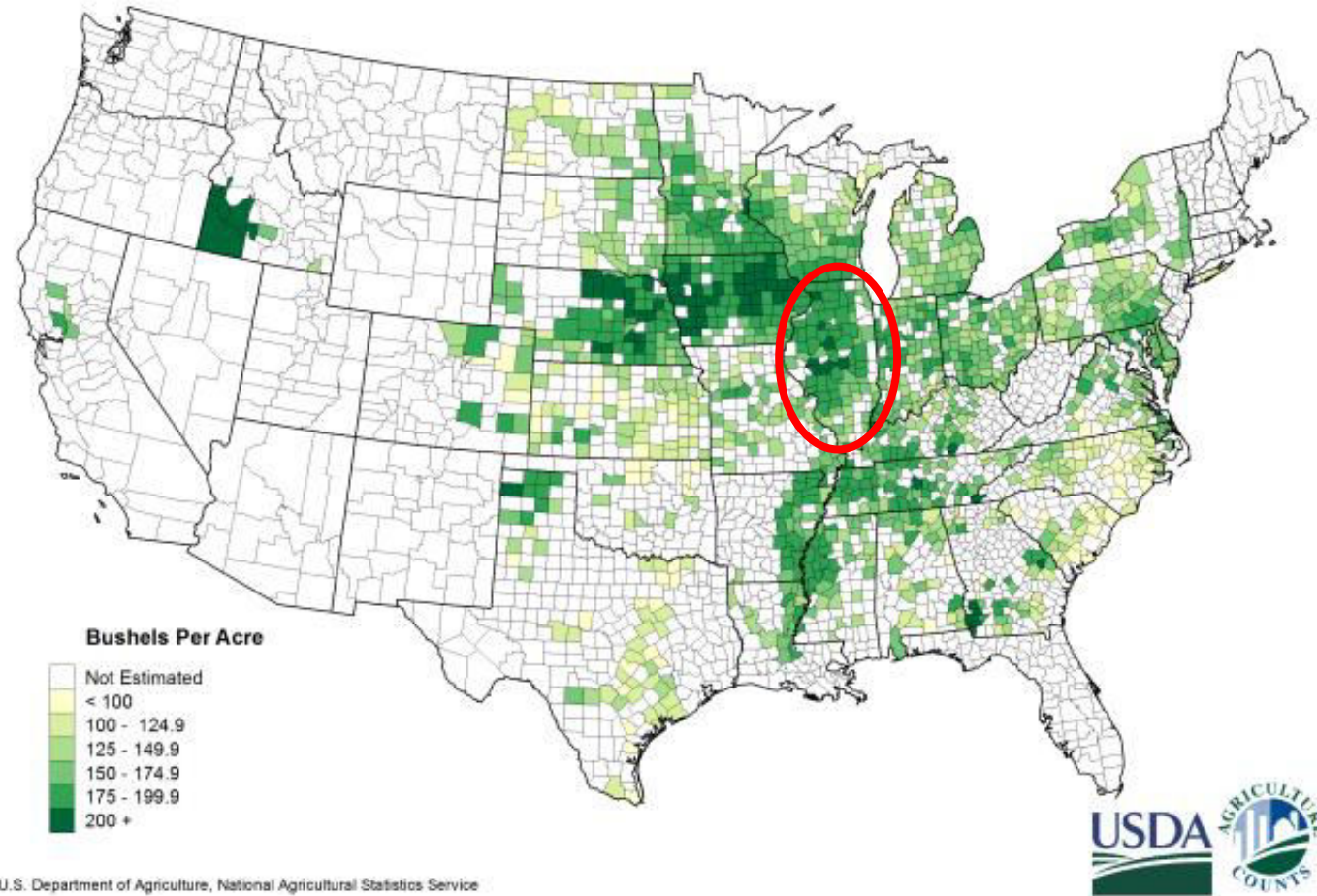
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# Illinois: heart of the U.S. Corn Belt

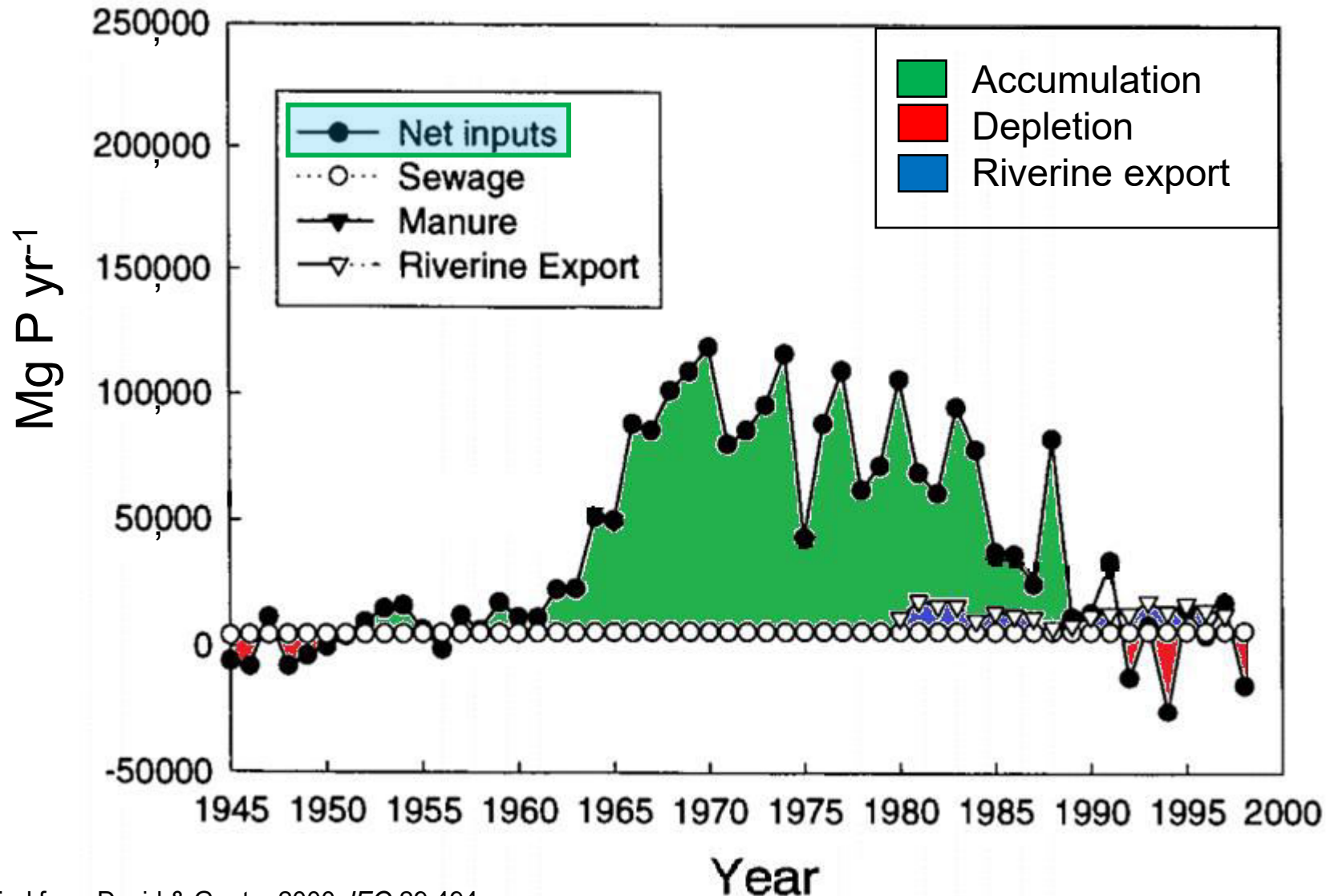
- One of the most productive regions of maize and soybean production
- Radical transformations in <200 years: prairie and forest to ~75% intensive agricultural land use



*Typical central Illinois landscape, Champaign Co.*



# Legacy P in Illinois: how much?



**≈ 2 million Mg P  
positive balance**

How much of a *relative*  
enrichment is this?

## Soil P stocks

9.34 million ha of cropland  
5,200 kg P/ha to 100 cm depth  
=48.6 million Mg P

**Estimated ~4% of soil P stocks**

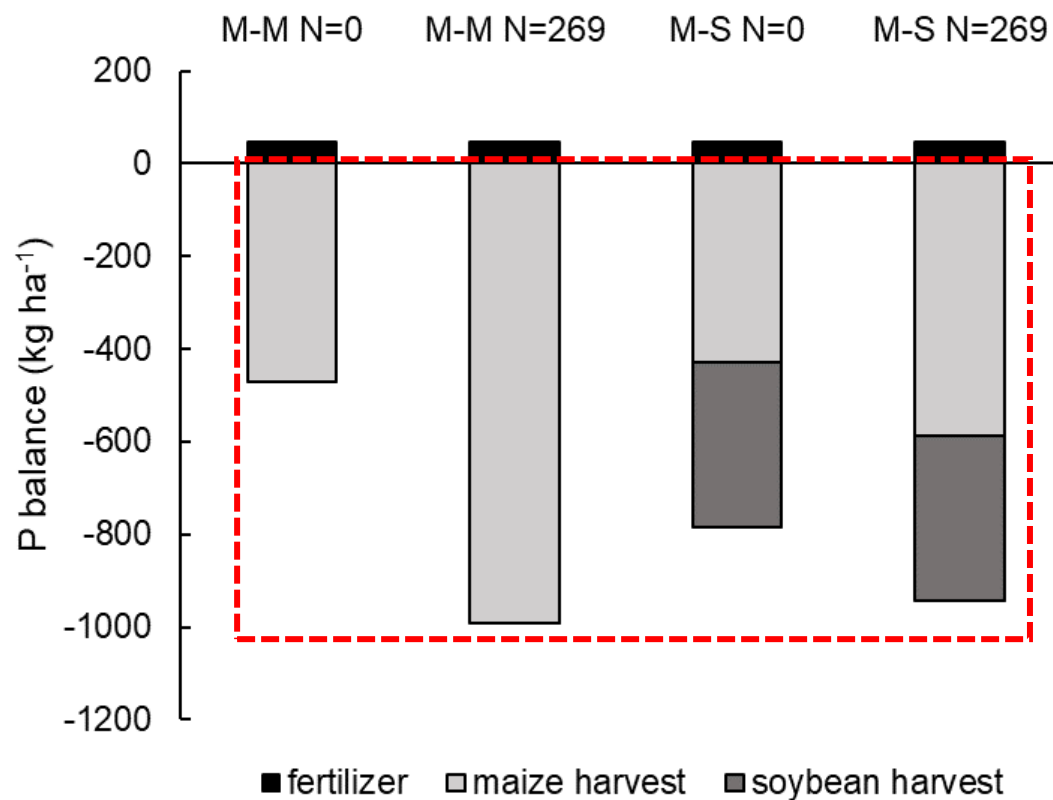
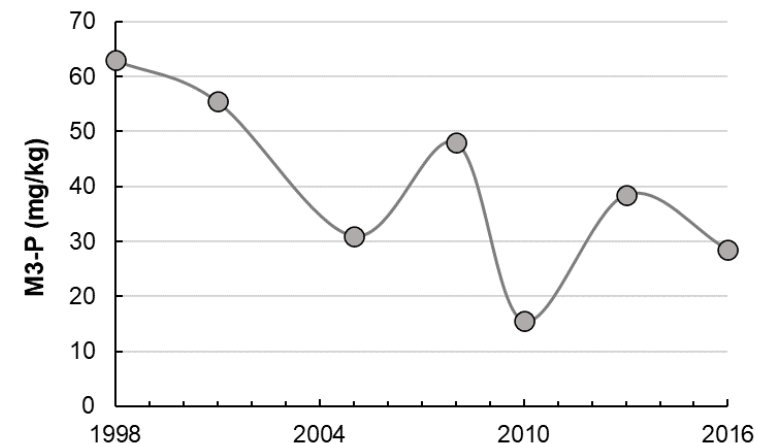
**→ Drawdown possible**

# Case Study #1: 37 years of drawdown

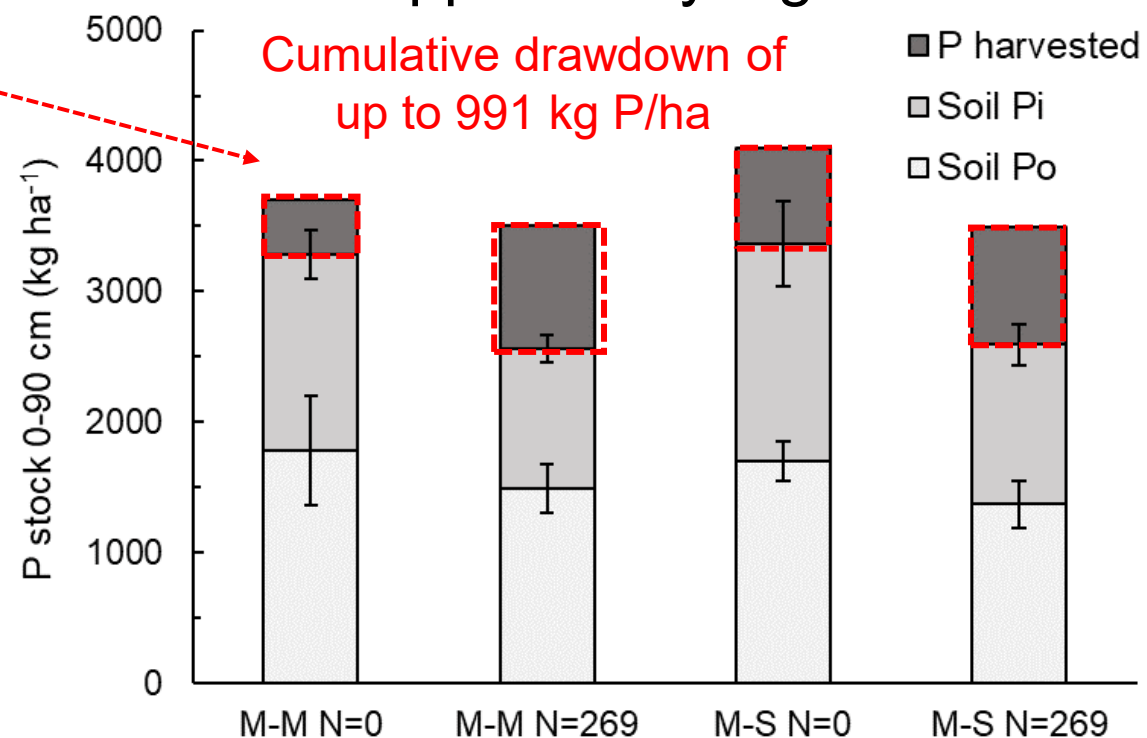
(Northwestern Illinois Agricultural Research & Demonstration Center in Monmouth, IL)

- Former swine manure application
- 1980-2017 balance reveals large magnitude of drawdown....

## M3-P decreased erratically



## ...supported by high P stocks

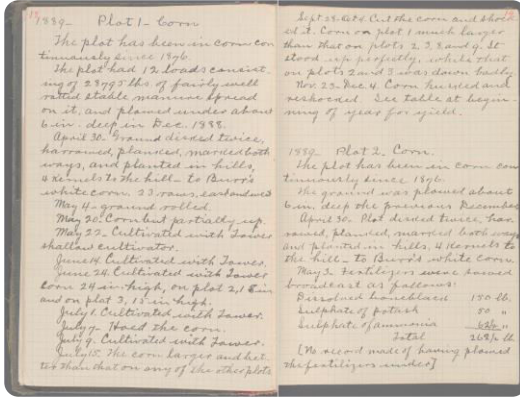


# Case Study #2: 145 years Morrow Plots, est. 1876 (University of Illinois, Urbana, IL)

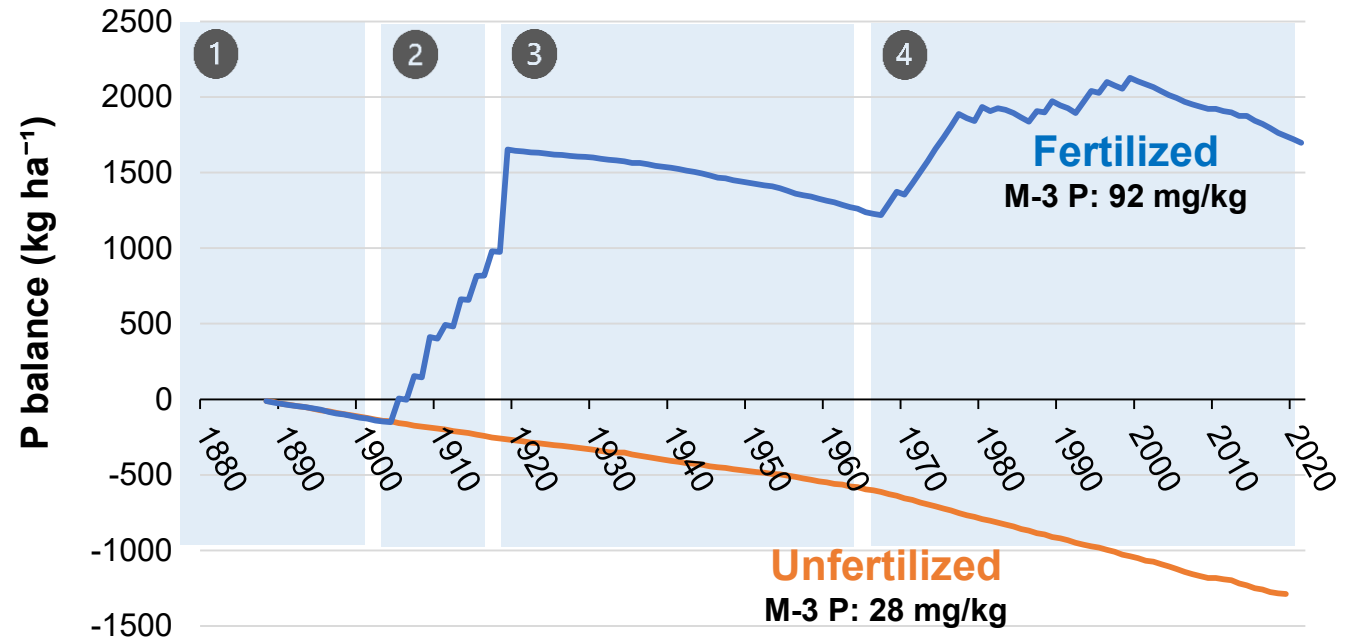
Records on inputs/outputs

+

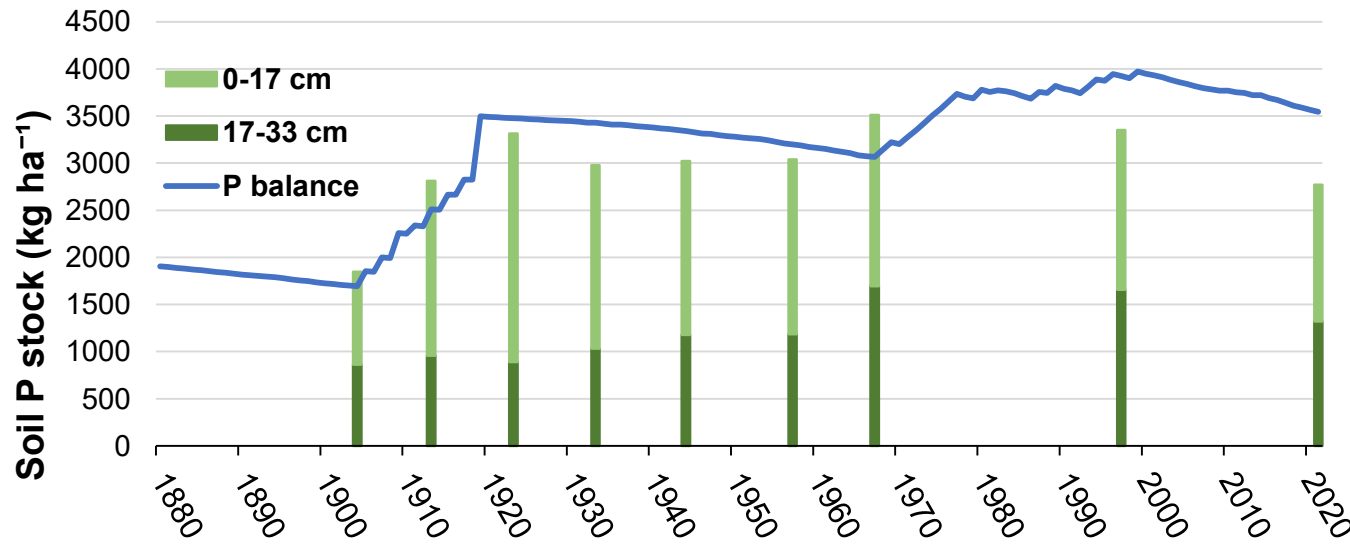
soil archive



P Balances of fertilized and unfertilized subplots



Corroborating P budgets based by soil (surface) stocks



## Fast accumulation...

- > Majority of legacy P accrued in 15 years
- > Soil P stock increased by 80% in Phase 2

## ...but slow drawdown

- > 150+ years of additional drawdown needed to restore to 1876 levels

## Extent of P enrichment not captured by soil test values

- > 92 mg kg<sup>-1</sup> ≈ 206 kg ha<sup>-1</sup> Mehlich-3 P