

# Phosphorus Management



WEAO Biosolids Workshop

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# Phosphorus

- ↪ Phosphorus Cycle
- ↪ Soil Phosphorus Pools
- ↪ Environmental Concerns
- ↪ Importance in Plants
- ↪ Importance in Livestock / Animals
- ↪ Phosphorus Availability

# Phosphorus Cycle

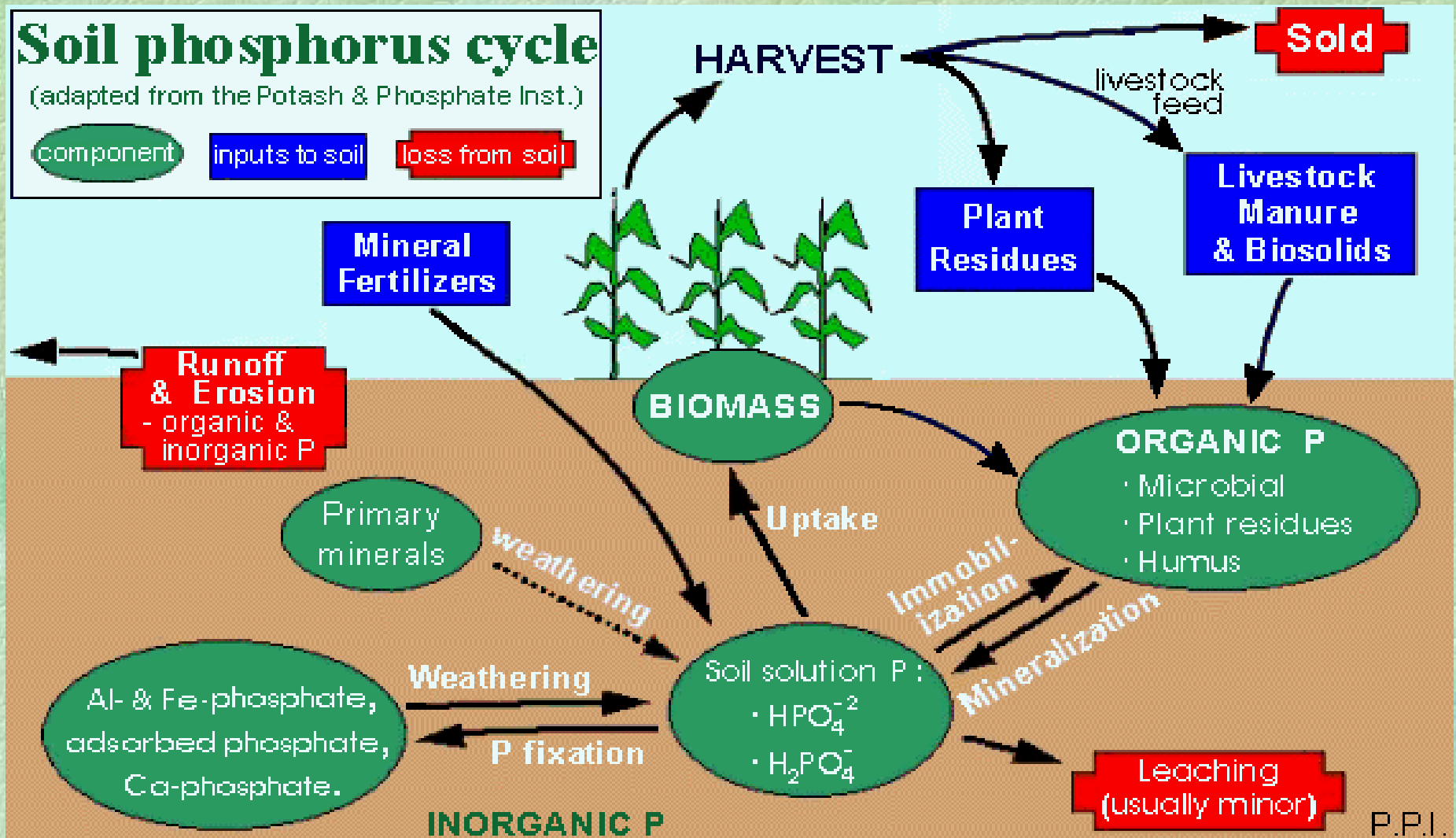
## Soil phosphorus cycle

(adapted from the Potash & Phosphate Inst.)

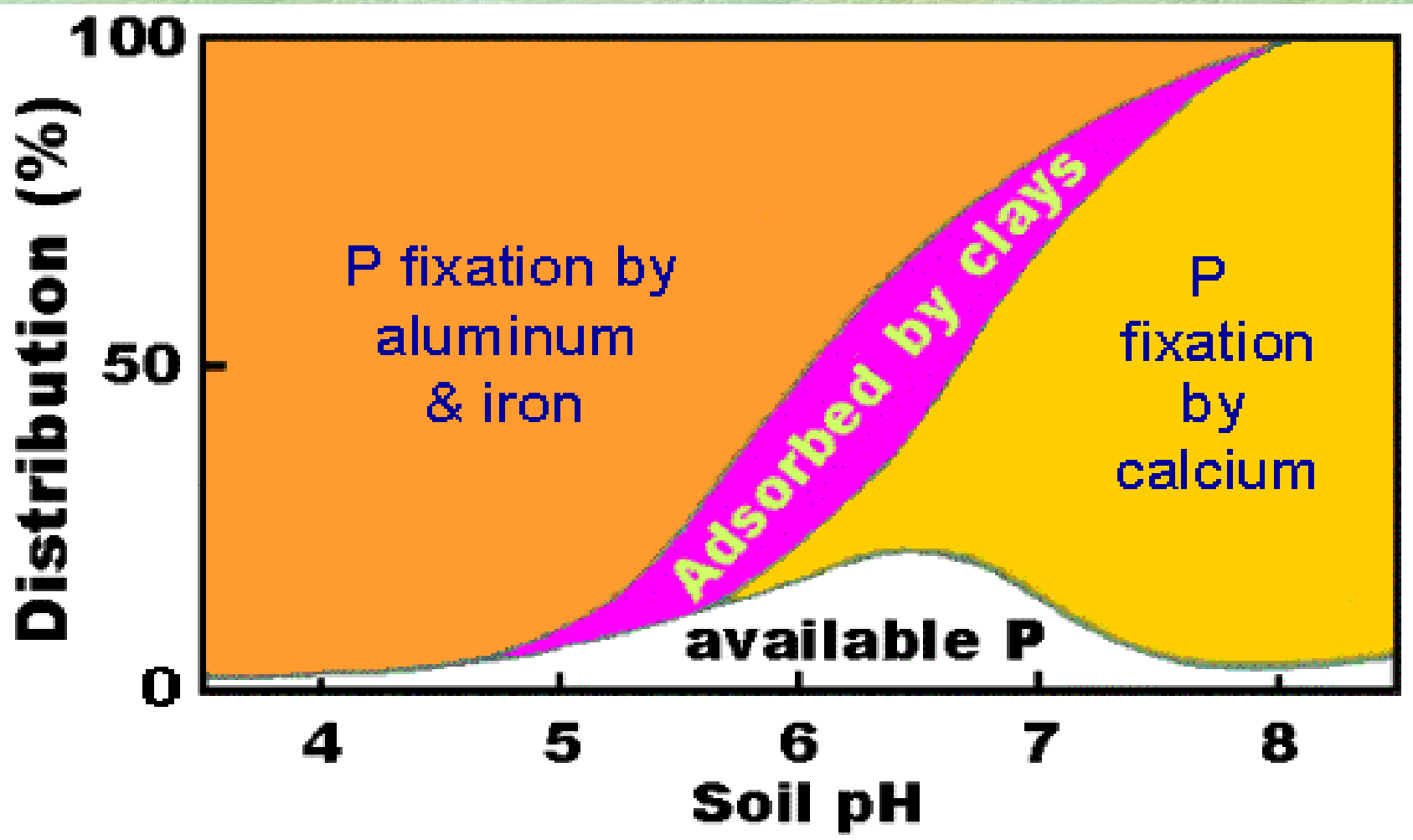
component

inputs to soil

loss from soil



# Effect of Soil pH on Forms of Soil P



# Phosphorus - Environmental Concerns

- A concern when it enters surface water
  - encourages excessive growth of aquatic vegetation, leading to oxygen depletion.
  - affects surface water quality and fish and wildlife habitat.
- Phosphorous binds tightly to soil particles - therefore erodible soils that are high in phosphorous are most likely to contribute to surface water contamination.
- Leaching of soluble phosphorous to tile drains and/or groundwater can be of concern if soils are “saturated” with phosphorus.

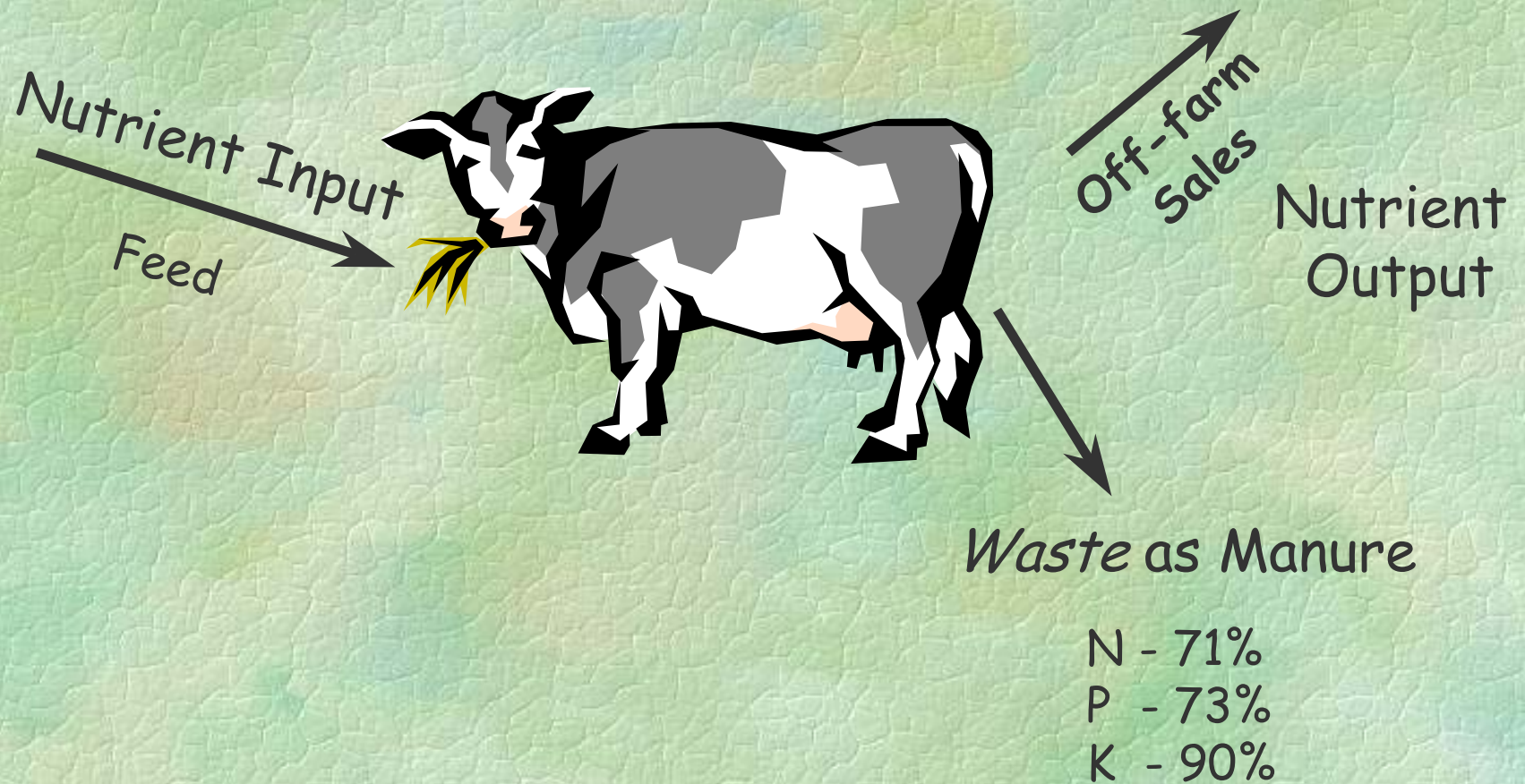
# Importance to Plants

- ↪ Uptake through root hairs ( mycorrhizal fungi) as primary orthophosphate ion ( $\text{H}_2\text{PO}_4^-$ ) or secondary orthophosphate ( $\text{HPO}_4^{=}$ )
- ↪ Integral role in many of the chemical reactions (photosynthesis, various energy reactions) & organic compounds (DNA, RNA, phospholipids)

# Importance in Animals

- ↪ Many of the same reasons as in plants .....  
energy based reactions, organic compound  
building, etc
- ↪ utilization efficiency?

# Manure Composition



# Phosphorous (P) Availability

- 40% of the phosphorous is available to a crop during year of application for *CROP PRODUCTION REQUIREMENTS*.

$$\text{Total P}_2\text{O}_5 \times 40\% = \% \text{ Available P}_2\text{O}_5$$

- **But.....when phosphorus is available above crop production requirements .....phosphorous does build-up in the soil.**
- An availability of **80%** is used to account for over-application above crop needs.

$$\text{Total P}_2\text{O}_5 \times 80\% = \% \text{ Available P}_2\text{O}_5 \text{ over time}$$

# Phosphorous Availability

## An analogy



Water from a saturated dripping cloth

40 % immediately available



Wringing water from wet cloth

40 % available later



Wet cloth, but it won't put more water in the bowl

# Biosolids Source Phosphorus

- ↪ Typically treat with Al or Fe compounds to precipitate P
- ↪ Results in highly insoluble precipitates & organically bound P
- ↪ Ontario approach has been to use 40/80 rule
  - based on livestock manure &
  - research work from other jurisdictions

# Biosolids Source Phosphorus

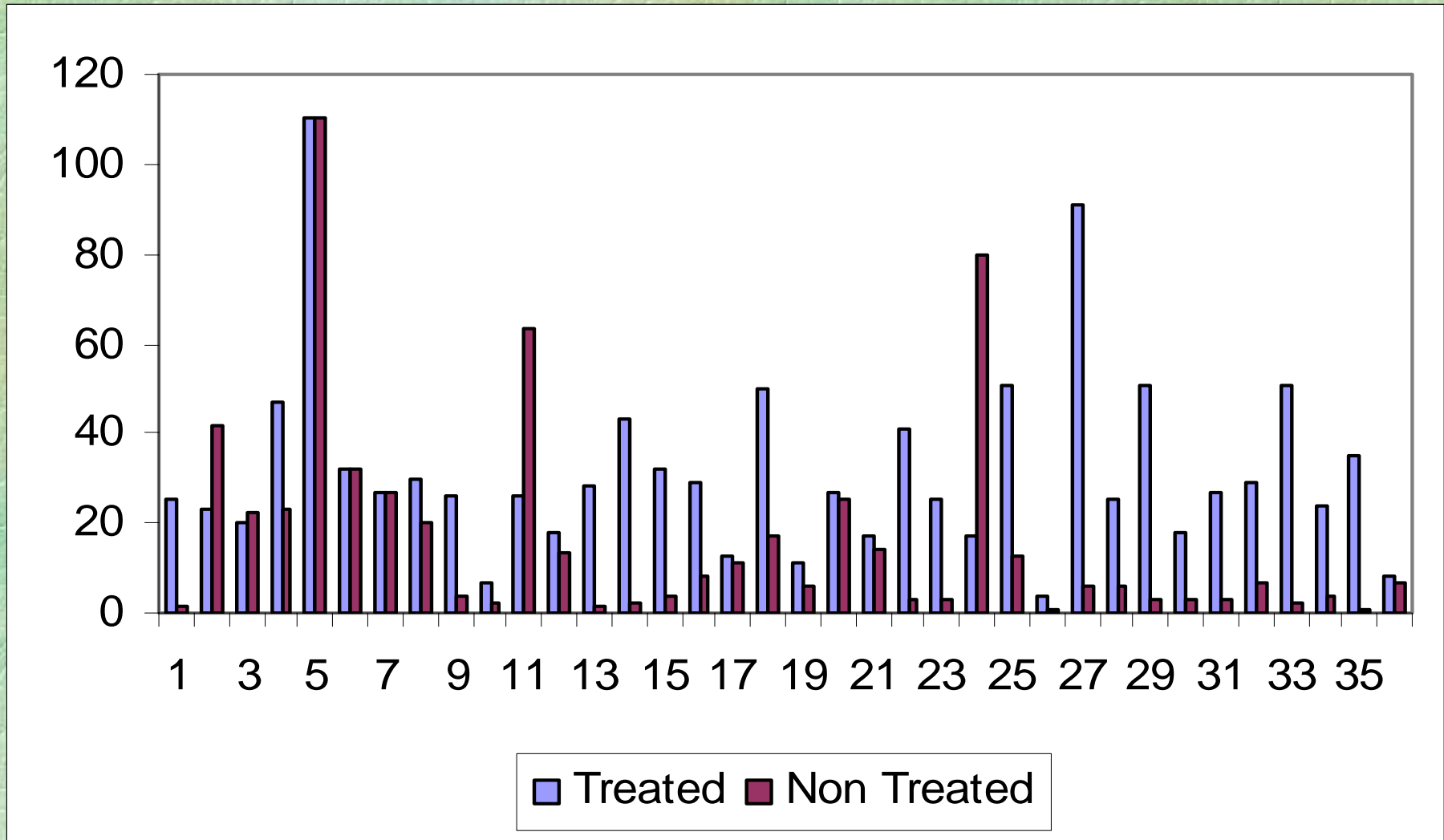
## ↳ Ontario based trials

### ↳ 1995 OMAFRA Regulated Metals study

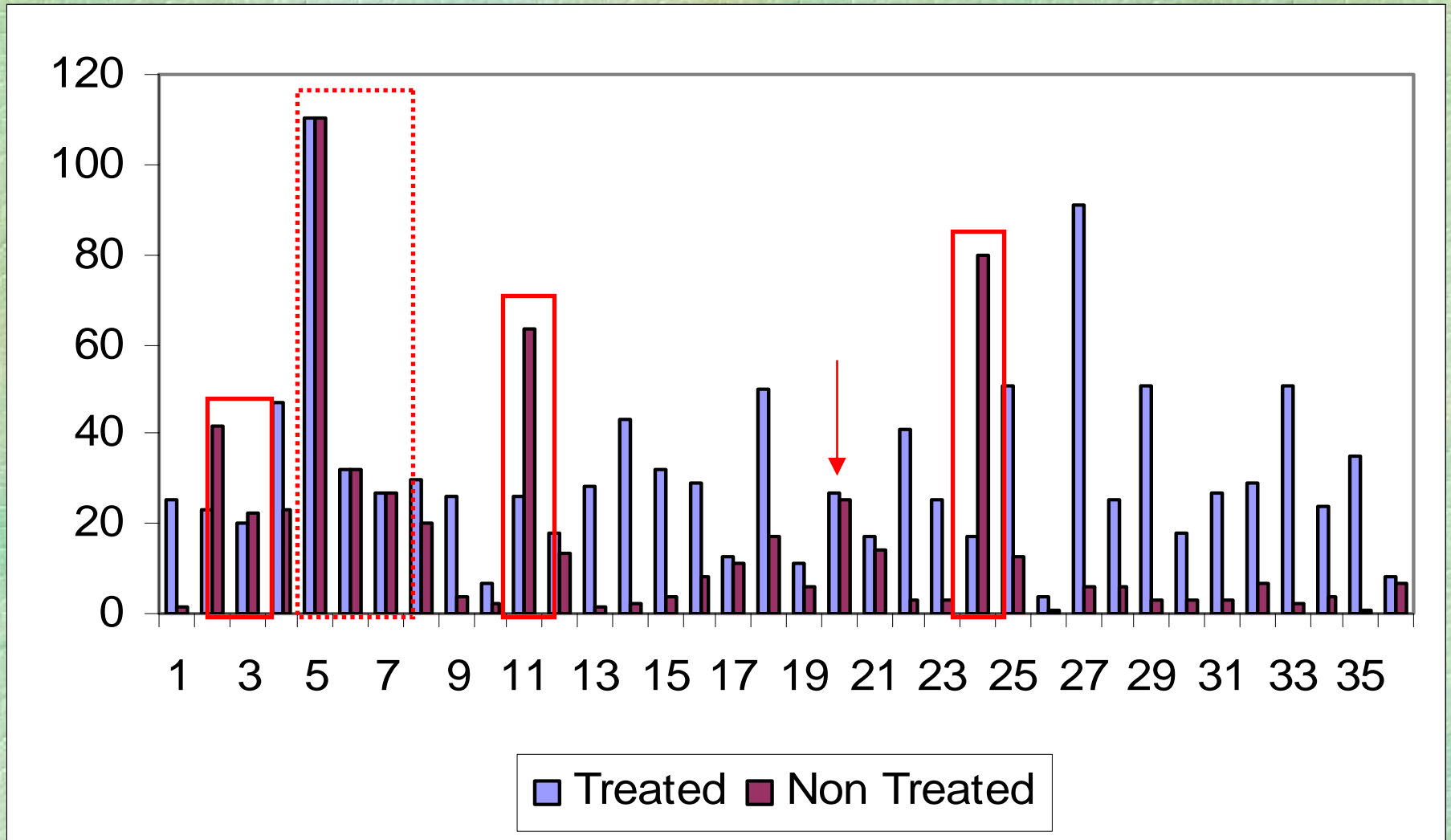
↳ 36 paired sites across Ontario

↳ at least 2 MSB applications

# OMAFRA 1995 Study P Data



# OMAFRA 1995 Study P Data

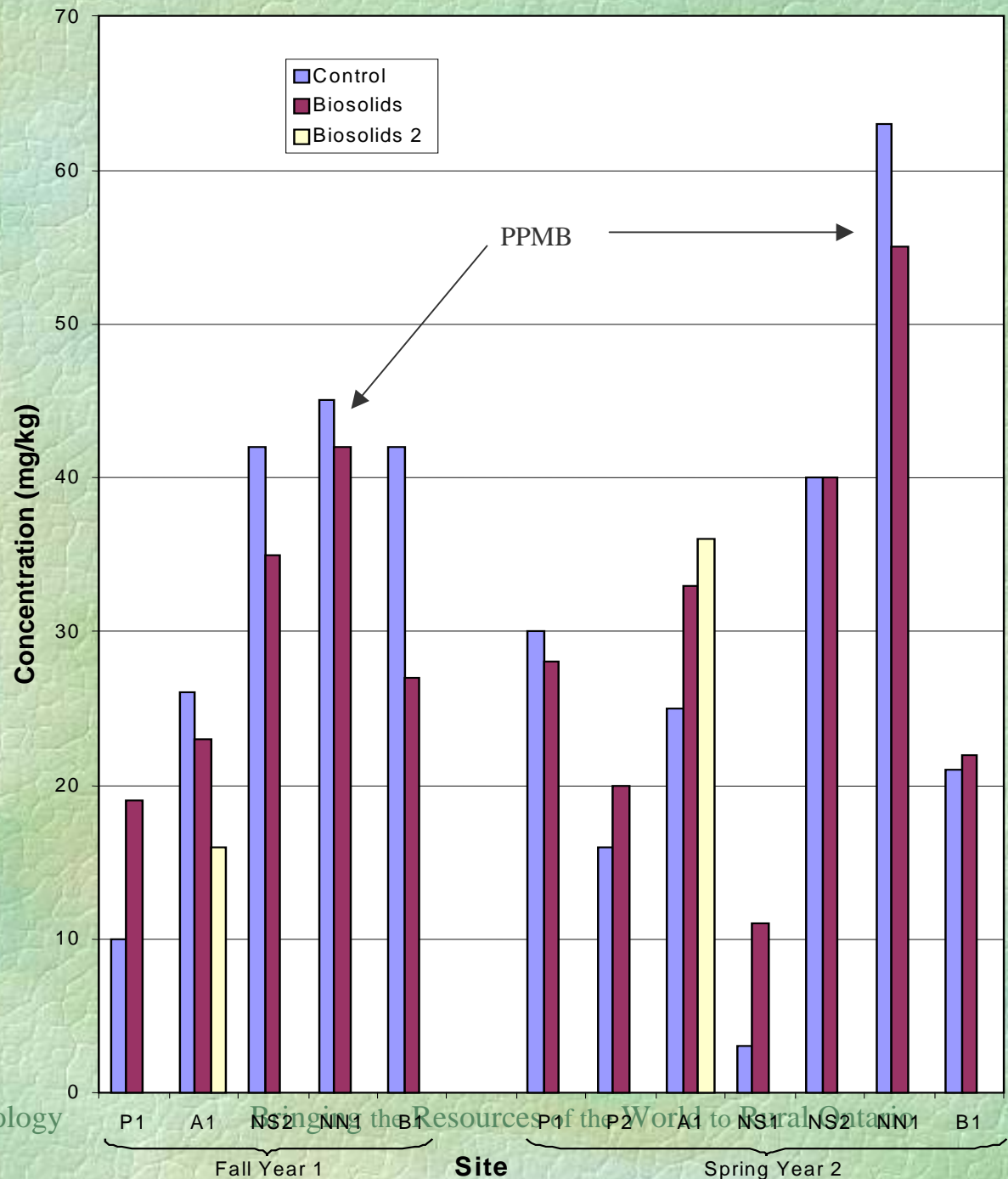


# Biosolids Source Phosphorus

## ↳ Ontario based trials

- ↳ 1995 OMAFRA Heavy Metals study
- ↳ Eastern Ontario biosolids P availability trial
- ↳ Golden Horseshoe Biosolids Utilization study
  - ↳ 7 MSB sites with replicated plots
  - ↳ soil parameters tracked prior to & for two years after application

# Golden Horseshoe SCIA Biosolids Utilization Study

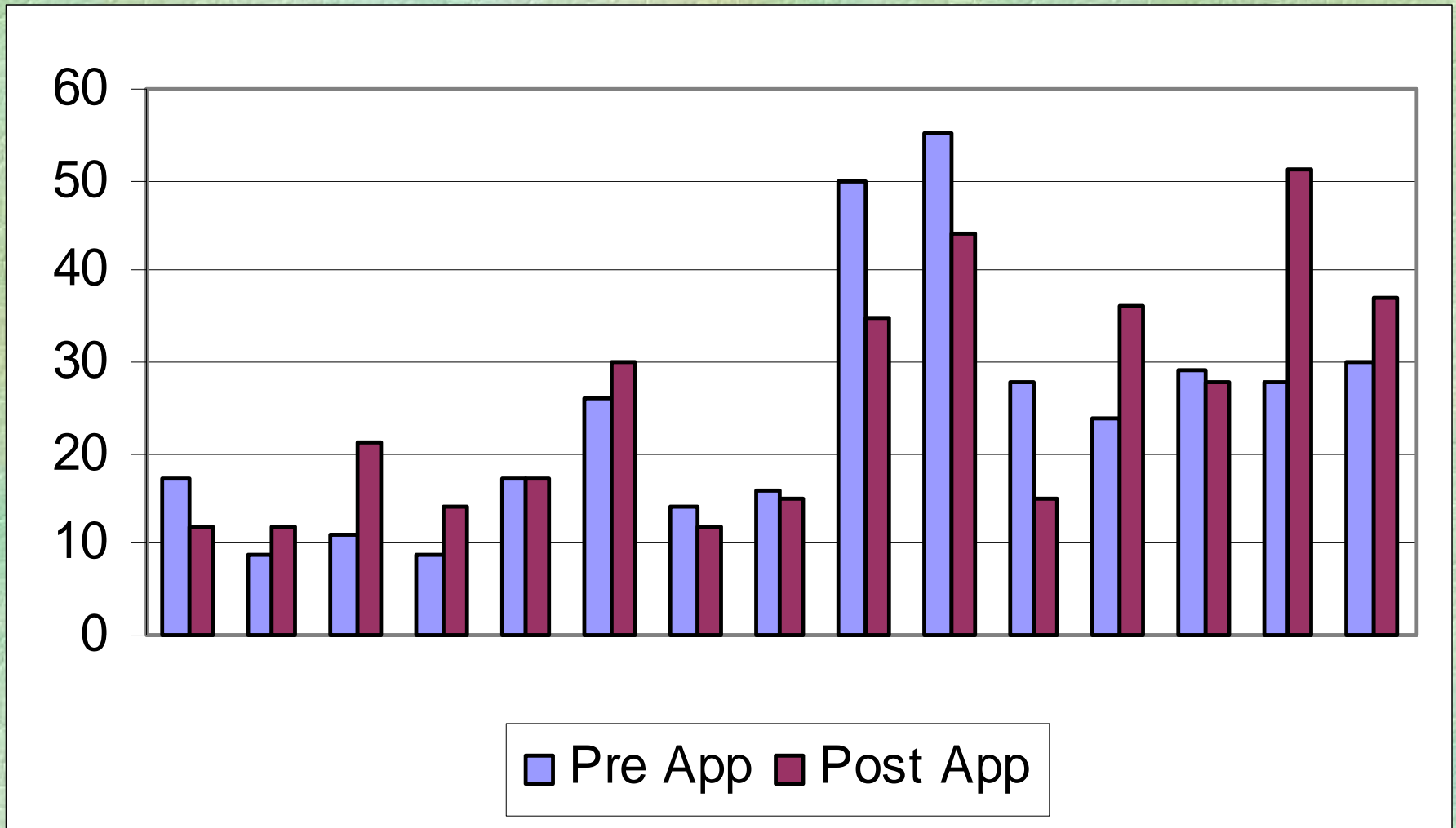


# Biosolids Source Phosphorus

## ↳ Ontario based trials

- ↳ 1995 OMAFRA Heavy Metals study
- ↳ Eastern Ontario biosolids P availability trial
- ↳ Golden Horseshoe Biosolids Utilization study
- ↳ GTA / GH Phosphorus Availability study
  - ↳ MSB applied Fall 02 / Spring 03
  - ↳ Soil samples July/August 03

# GTA / GH Phos Availability Study



# Phosphorus Dilemma

- ↪ Ontario manure research & research from other jurisdictions support 40% P availability in the year of application
- ↪ Manure is not treated & other jurisdictional work not with calcareous soils
- ↪ Field trial data is variable ..... Next steps
- ↪ Further research

# Questions ?



# Thank You