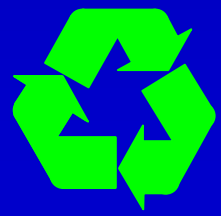
Nutrient Management in Crop Production

Dr. John E. Sawyer

Associate Professor

Soil Fertility Extension Specialist

IOWA STATE UNIVERSITY
University Extension



Focus On Agriculture

- Water Quality
  - Hypoxia
  - Pfiesteria piscicida
  - Nitrate
  - Tile Flow
  - Sediment
  - TMDL
  - Community Water Systems Monitoring & Reporting
- Farm Focus
  - Source Water Protection
  - Upstream Partners
  - Watersheds
  - Wetlands
  - Buffer Strips
  - Manure Regulations
  - CAFO
  - Nutrient Management

Focus On Agriculture

- Nutrient Issues Related to Water Quality
  - Surface Water
    - Sediment, Nitrate, Phosphorus
  - Groundwater
    - Nitrate

Focus On Agriculture

Crossroads, T - Junction, or Straightaway

Focus On Agriculture

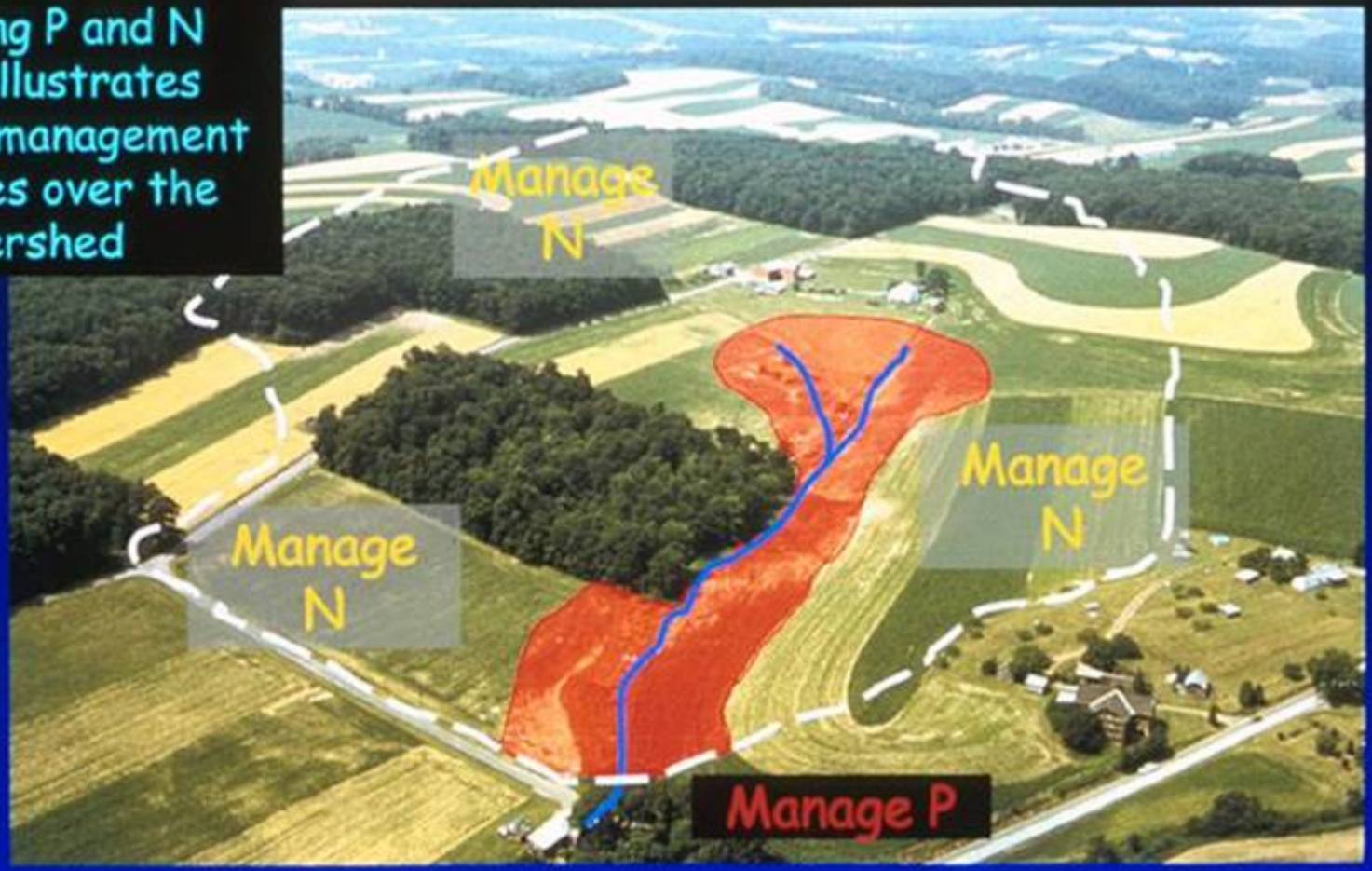
- Opportunities
  - CCA and MOU
  - Assist Farmers
  - Improve Water Quality
  - Management of Expensive / Limited Resources
    - Nitrogen
    - Phosphorus
    - Soil

Focus On Agriculture

- Challenges
  - Nutrient Management Planning
    - What's new?
      - CAFO
      - Manure Management Plans
      - Soil Conservation Requirements
    - The Key Focus
      - Crop Nutrient Needs
      - Nutrient Distribution / Allocation
        - Long-Term Input / Output Balance
        - Country - Region - Watershed - Field

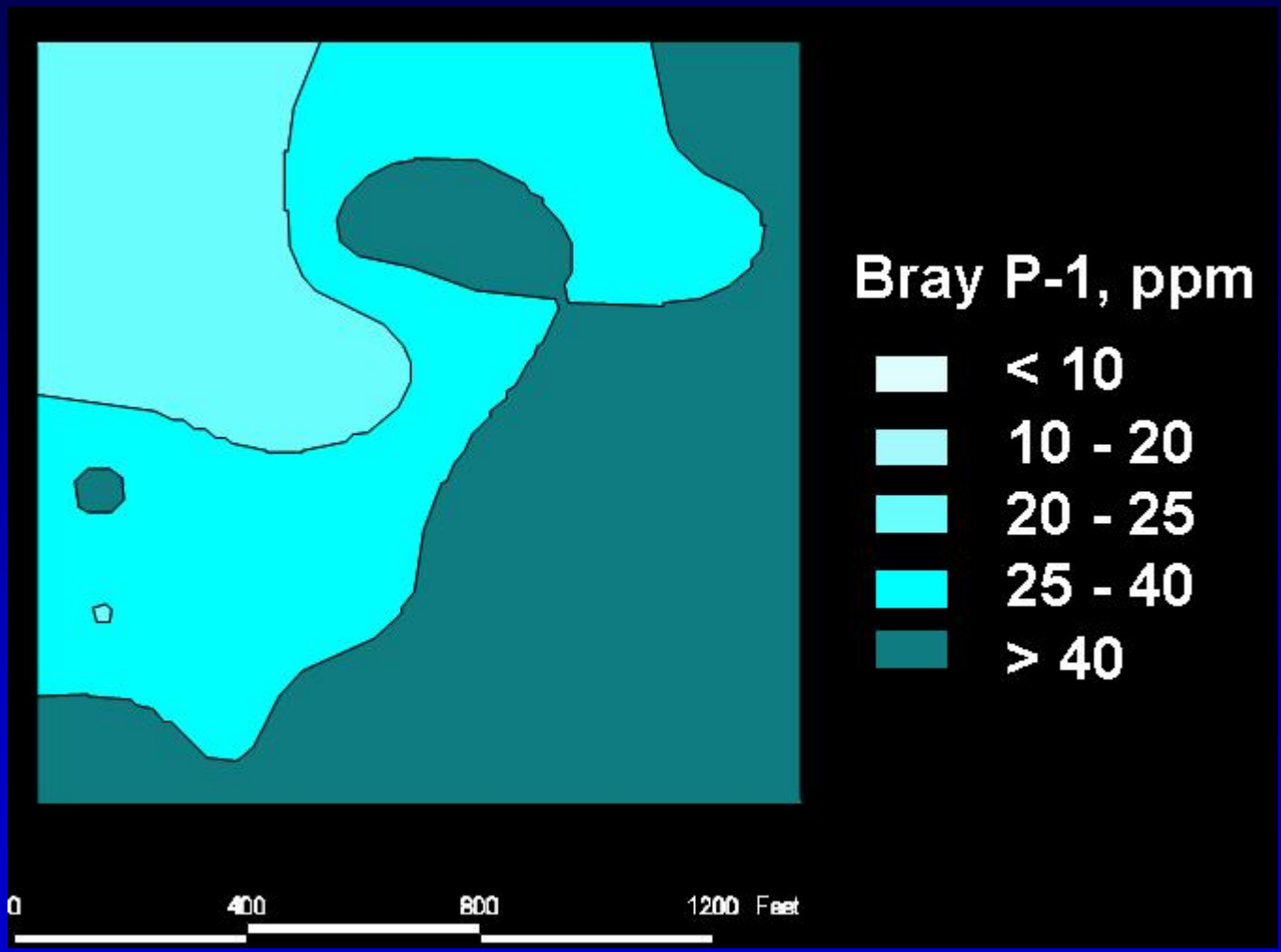
Integrated P & N Management

Combining P and N indices illustrates different management objectives over the watershed

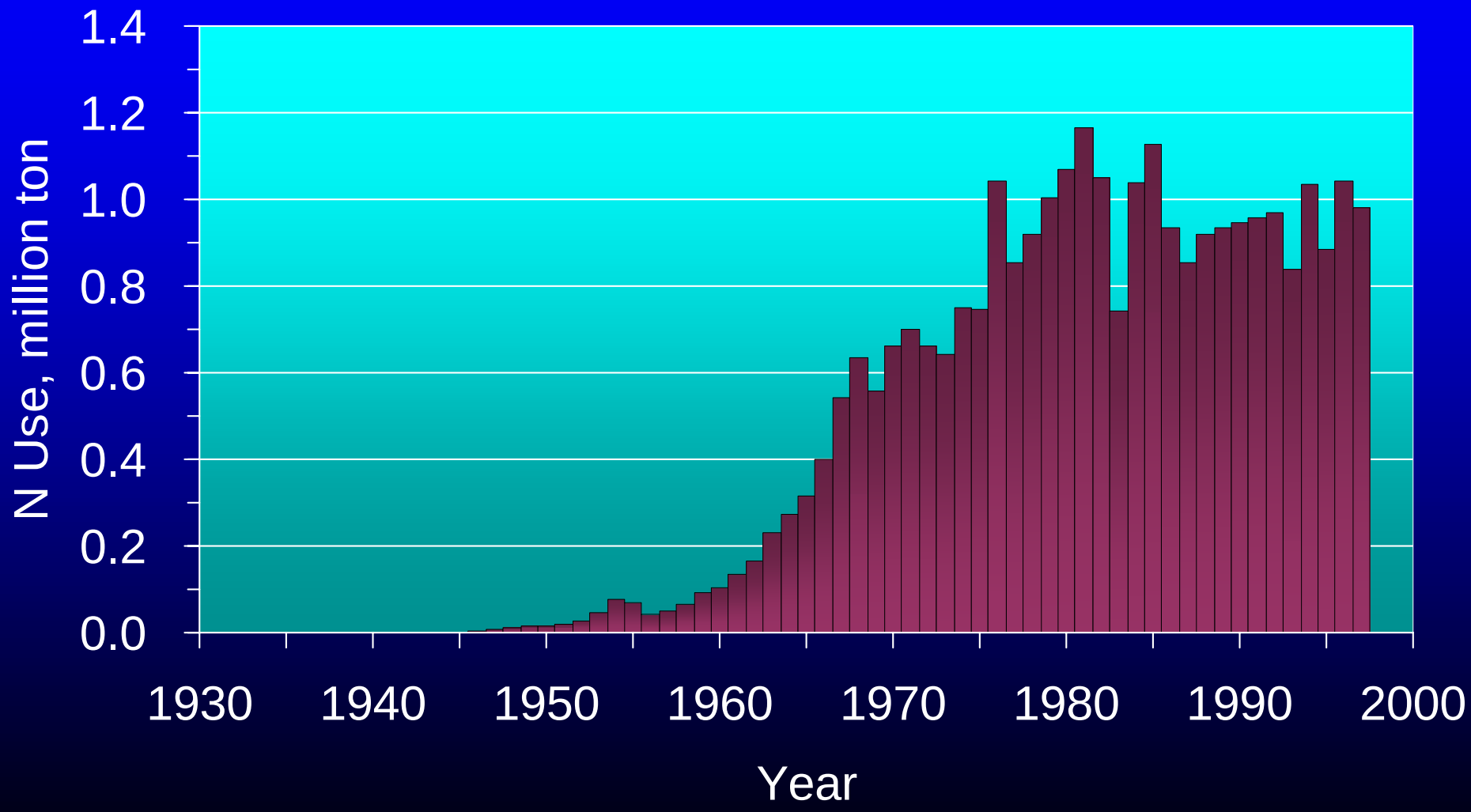


Sharpley, Gburek, USDA-ARS, Beegle, Penn State, University Park, PA

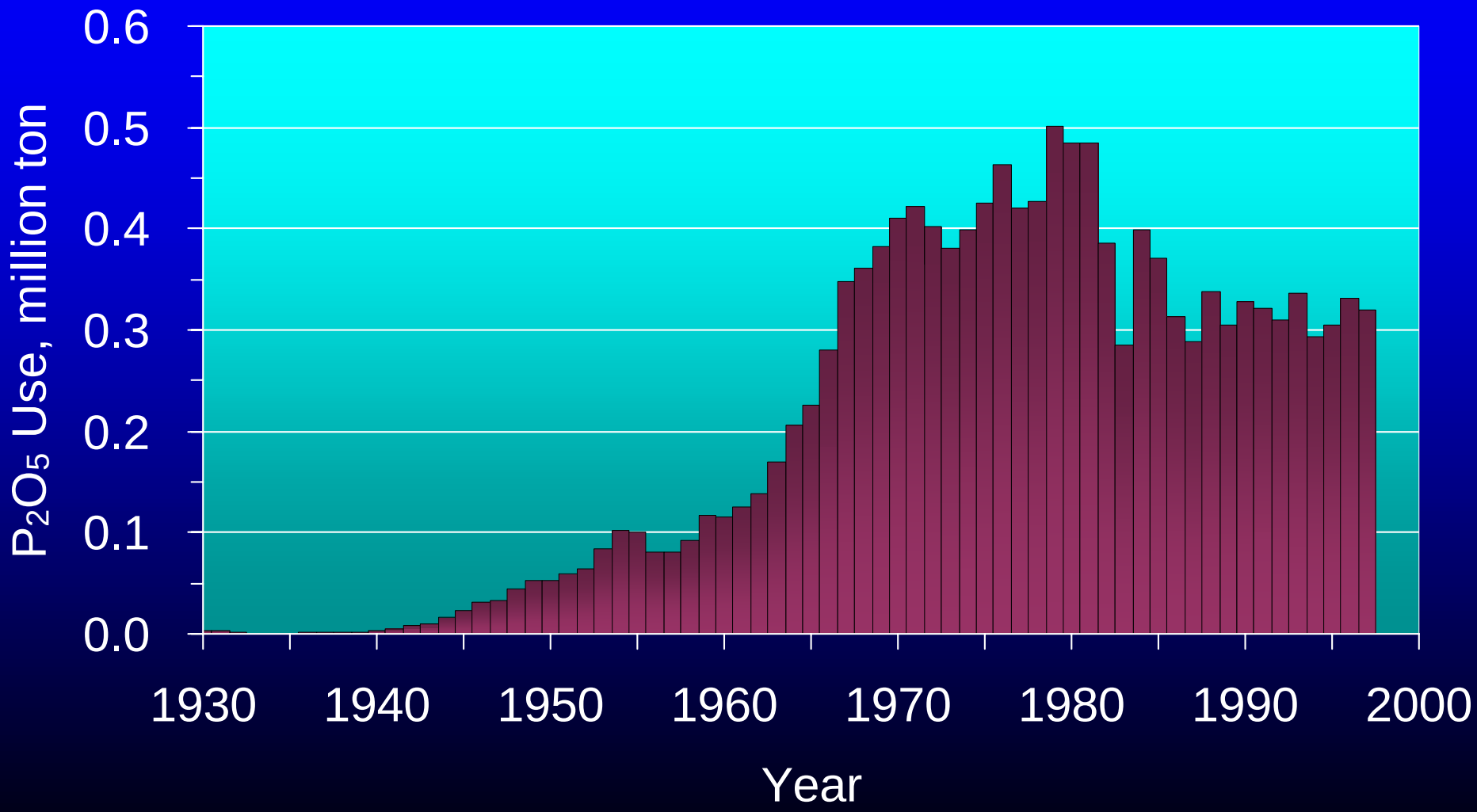
Example Field - Soil Test P



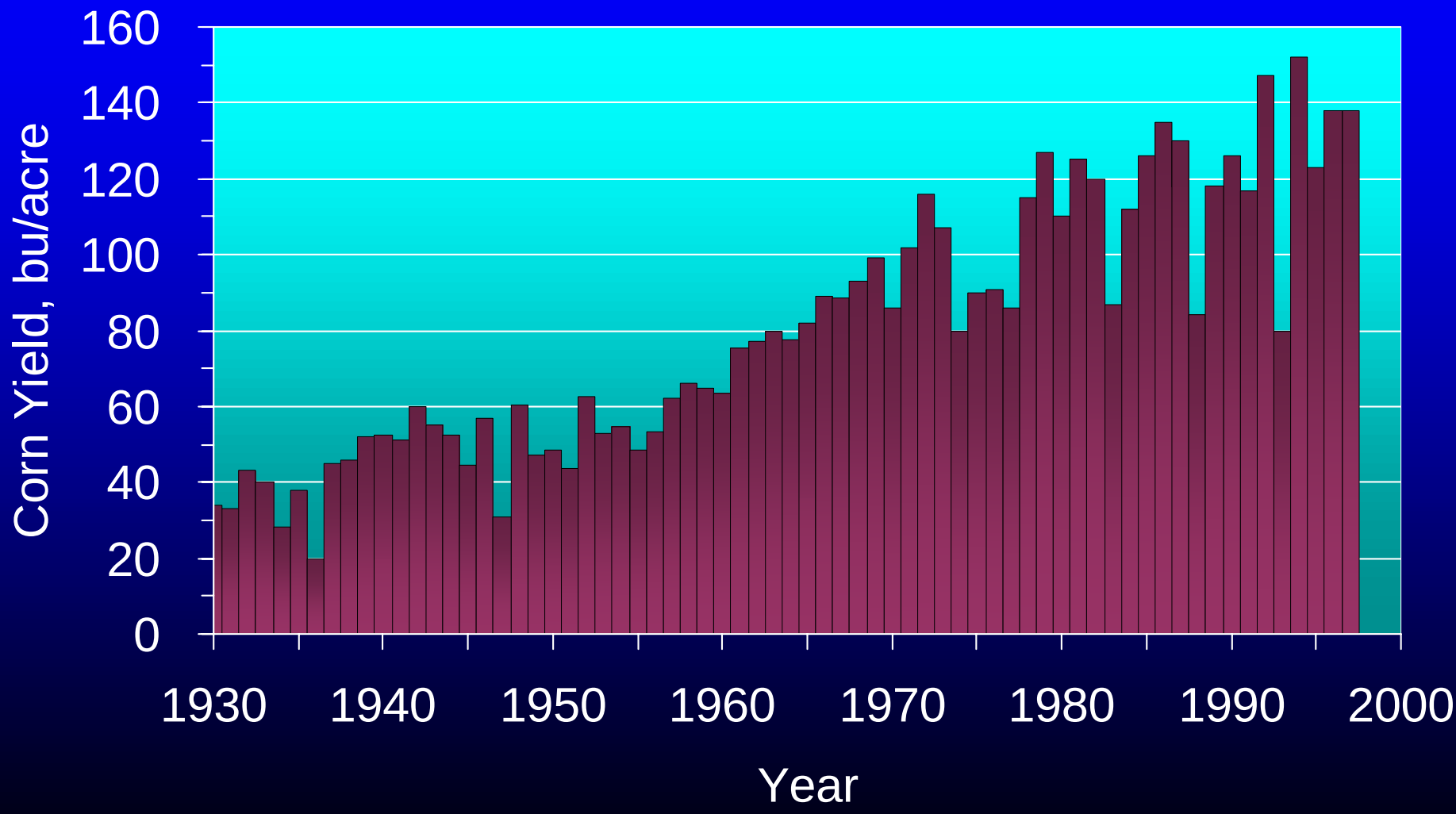
Annual Nitrogen Usage In Iowa



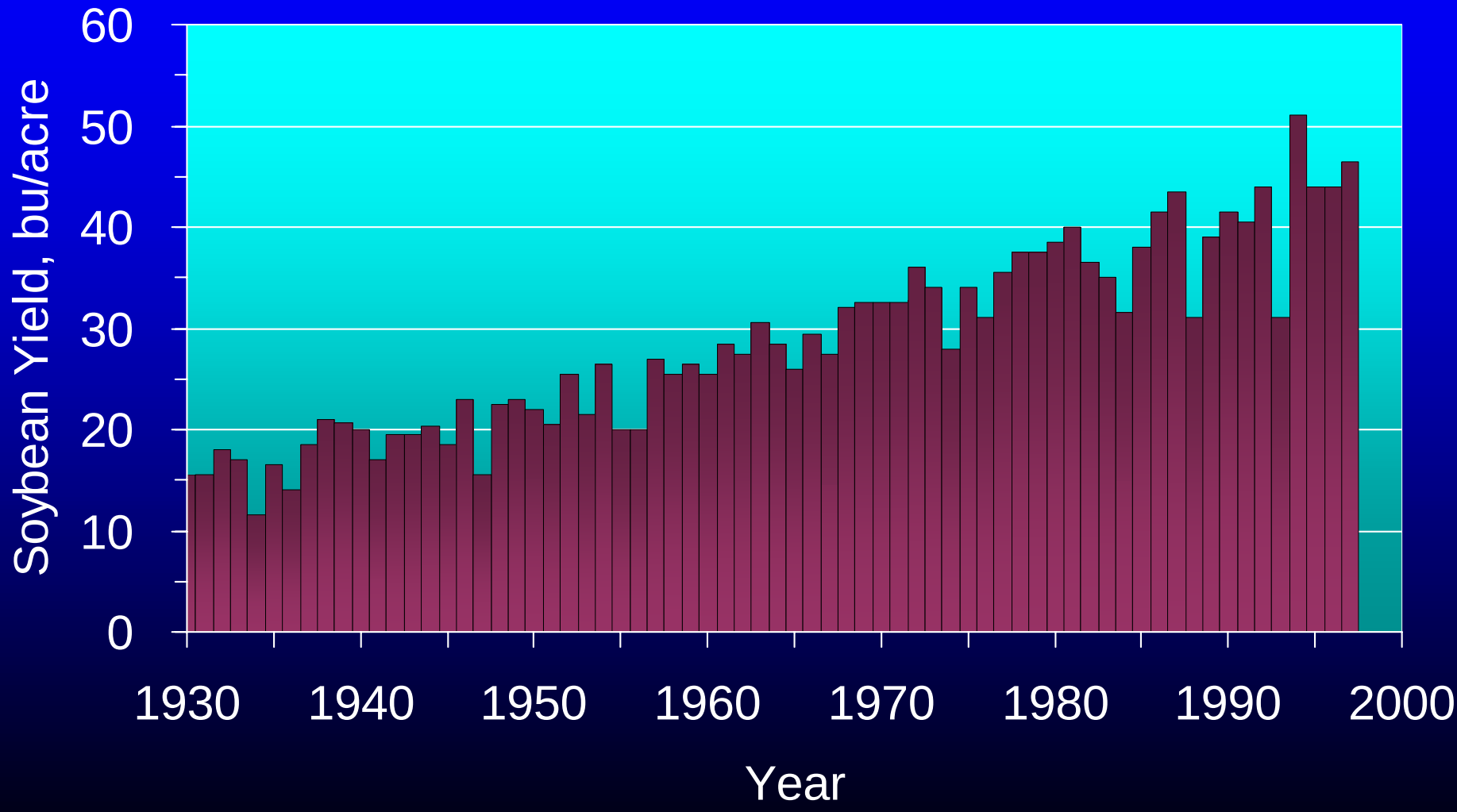
Annual Phosphorus Usage In Iowa



Annual Corn Yield In Iowa



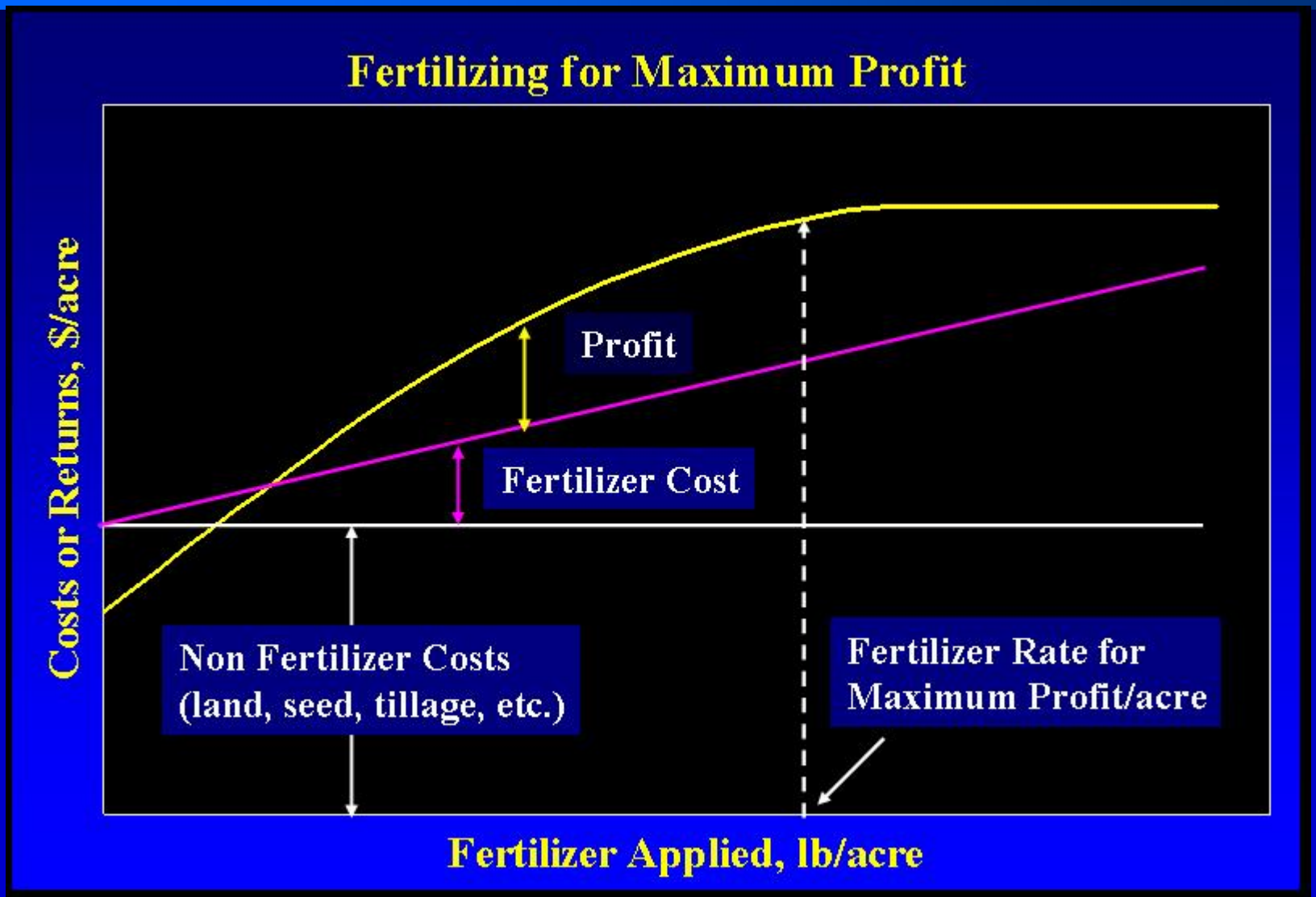
Annual Soybean Yield In Iowa



Nutrient Basics

- Profitable crop production does require adequate soil nutrient levels or adequate fertilization when soil tests are deficient
- Fertilization at rates greater than crop need does influence soil test and yield of subsequent crops
- Crop production is a soil nutrient depleting activity

Fundamental Diminishing Returns



Plant Available Nutrients Excreted by Livestock in Iowa, 1990

Animal	Number of Animals[a]	Available Nutrients[b]		
		N	P_2O_5	K_2O
	(x 1,000)	- - - - - - - - - - Tons - - - - - - - - - -		
Beef (500 lb)	1,347	20,879	21,451	35,696
Dairy (>500 lb)	443	9,968	6,900	15,838
Breeding Hogs	1,680	6,300	6,762	10,080
Market Hogs	11,820	44,325	47,575	70,920
Chickens	11,900	1,413	1,416	1,280
Total		82,885	84,104	133,814
lb/corn acre		13	13	21

[a] From 1990 Crop and Livestock Reporting Service.

[b] Assuming that 50% of the nutrients are recoverable and that 50% of the N and P_2O_5 and 100% of the K_2O is available to plants the first year of application.

Plant Available Nutrients Excreted by Livestock in Iowa, 1990

- Value of N: $24,865,000
- Value of P_2O_5: $47,098,520
- Value of K_2O: $34,791,120

Note: Assuming all nutrient is needed for crop production; N at $0.15/lb, P_2O_5 at $0.28/lb and K_2O at $0.13/lb.

Example Value of Plant Available Nutrients In Liquid Swine Manure

- At 3,000 gallons/acre and an analysis of 50 lb N, 35 lb P_2O_5 and 25 lb K_2O/1000 gal

	$/acre
150 lb N:	22.50
105 lb P_2O_5:	29.40
75 lb K_2O:	9.75
Total:	61.65

Note: Assuming all nutrient is needed for crop production; N at $0.15/lb, P_2O_5 at $0.28/lb and K_2O at $0.13/lb.

Manure Management Goals

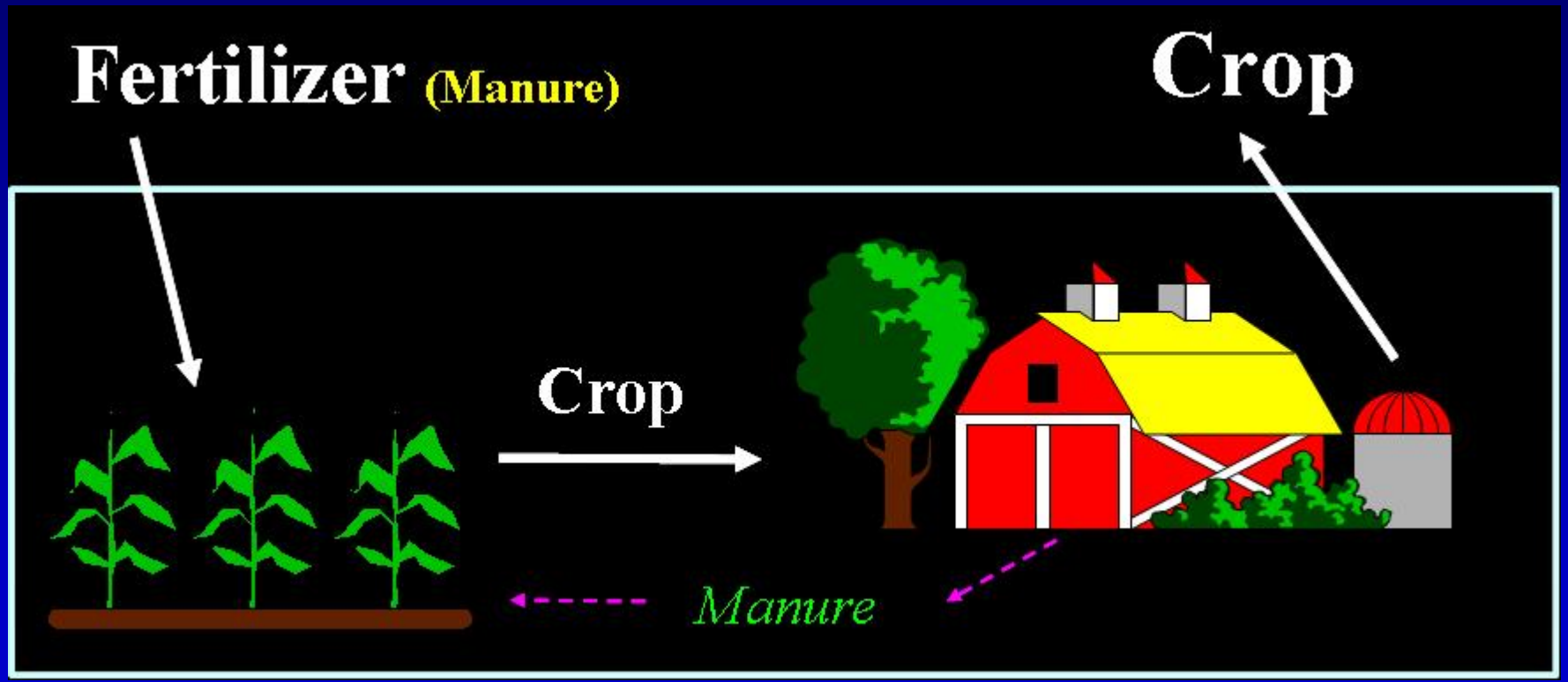
- Manure production
  - Keep it on site
  - Keep it in storage
- Manure application for crop production
  - Keep it in the field
  - Keep it in the soil
  - Keep it off / out of watercourses
  - Don’t over-apply / over-load nutrients
  - Have a Whole Farm Nutrient Plan

Manure Nutrient Storage

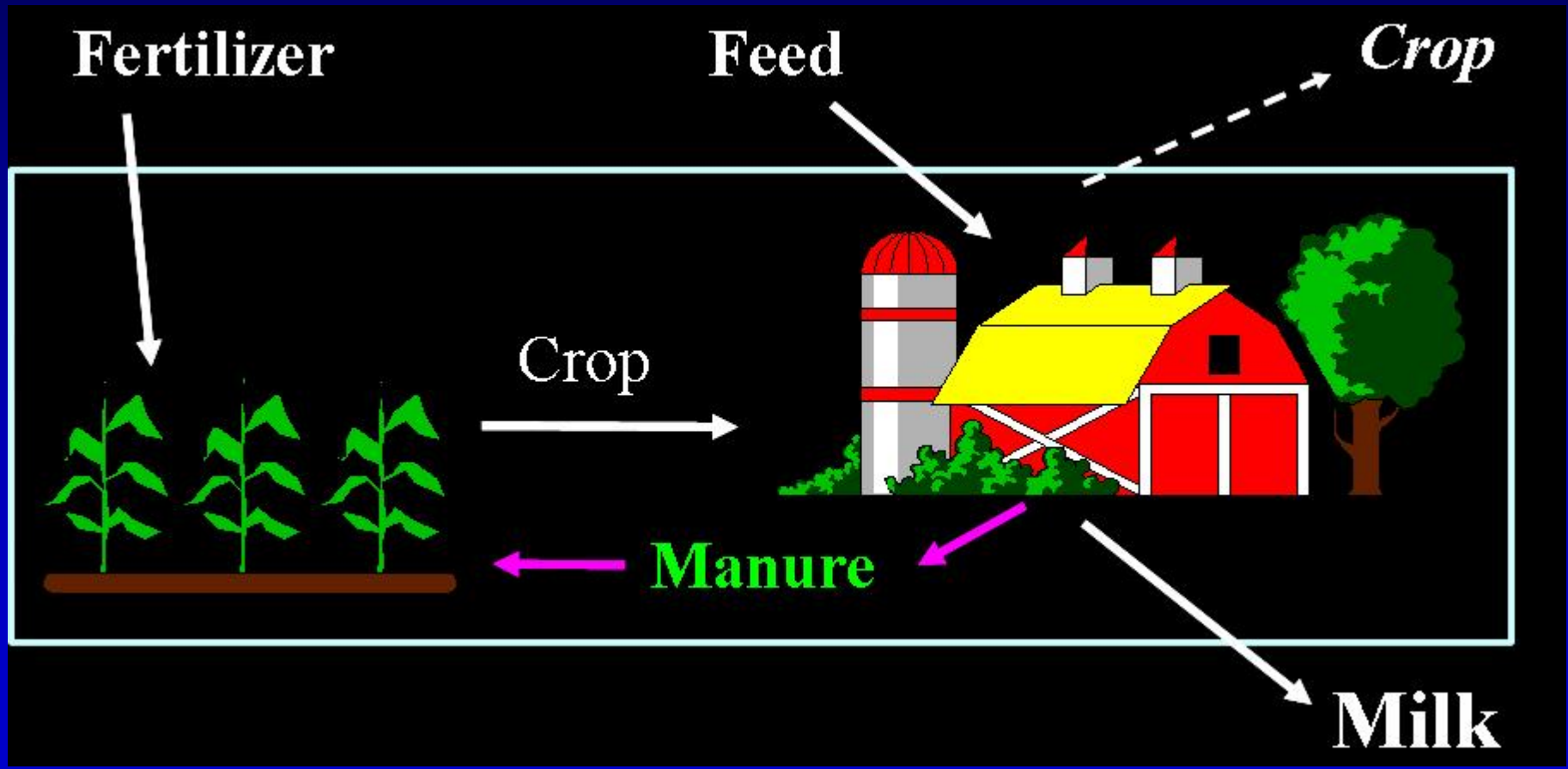
For 500,000 gallons of manure with a chemical analysis of 50 lb N, 35 lb P_2O_5, and 30 lb K_2O per 1,000 gallons. The total amount of manure in storage is:

N:	50 lb x 500 = 25,000 lb N
P_2O_5 :	35 lb x 500 = 17,500 lb P_2O_5
K_2O :	30 lb x 500 = 15,000 lb K_2O

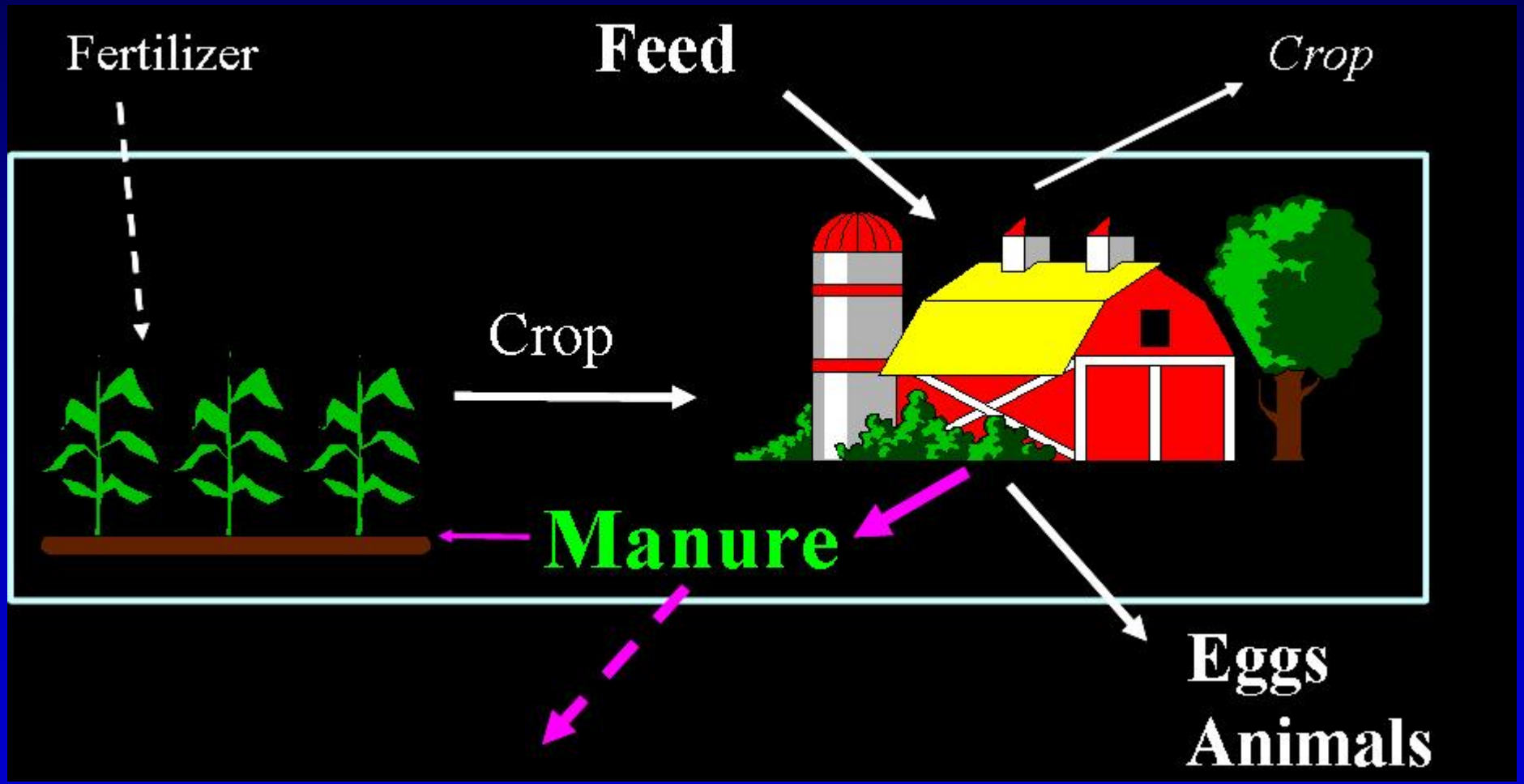
Low Manure Intensity Farm (Cash Crop)



Medium Manure Intensity Farm (Small to Medium Dairy)



High Manure Intensity Farm (Poultry/Swine)



Nutrient Planning

- Long-Term Management
- Whole-Farm Management
- Site-Specific
- Comprehensive Management
- Formal, Written, Implemented
- Database stored and driven

Components of A Plan
(NRCS 590 Standard)

- Location / Photos
- Fields / Acres
- Resource Assessment
  - Proven Yield / Productivity
- **Environmental Assessment**
  - Soil Erosion Considerations
- Soil Test Results
- **Nutrient Sources / Inventory**
- Legume and Manure Credits
- Crops Nutrient Needs / Application Rates
- Nutrient Product / Timing / Placement

Nutrient Planning Importance to Farmers

- Maintain Profitability
- Maintain Viability
- Balance Long-Term and Short-Term Risks
- At the Same Time Be an Environmental Steward

Future Directions in Nutrient Management

- For Phosphorus and Potassium
  - Refinement of soil tests indexes
  - Environmental phosphorus issues
    - P Index or soil test P
- For Nitrogen
  - Less emphasis on fall N
  - More emphasis on rates
  - Assessing corn N needs by in-season measurement and application

Issues Related to Manure Nutrient Management

- Manure application to soils
  - Based on N or P?
  - Alfalfa and soybean crops
  - Manure nutrient variability
- Soil P loading
  - Low phytate - P grains
  - Phytase enzyme
  - Reduced inorganic P supplement
  - Solids separation

P Loading (N vs. P?)
P and K from Liquid Swine Manure Application

Total Nutrients from Liquid Pit Swine Manure Based on the N Application Rate				Crop Nutrients in Grain Based on 55 bu Soybean and 150 bu Corn		
Nutrient				Soybean	Corn	Rotation
	- - - -	lb/acre	- - - -	- - - - -	lb/acre	- - - - -
N	150	200	225	200	135	335
P_2O_5	105	*140*	*158*	44	56	100
K_2O	75	100	113	83	45	128
gal/acre	3,000	4,000	4,500			

Using book values for swine grow-finish pit system: 50 - 35 - 25 lb/1,000gal