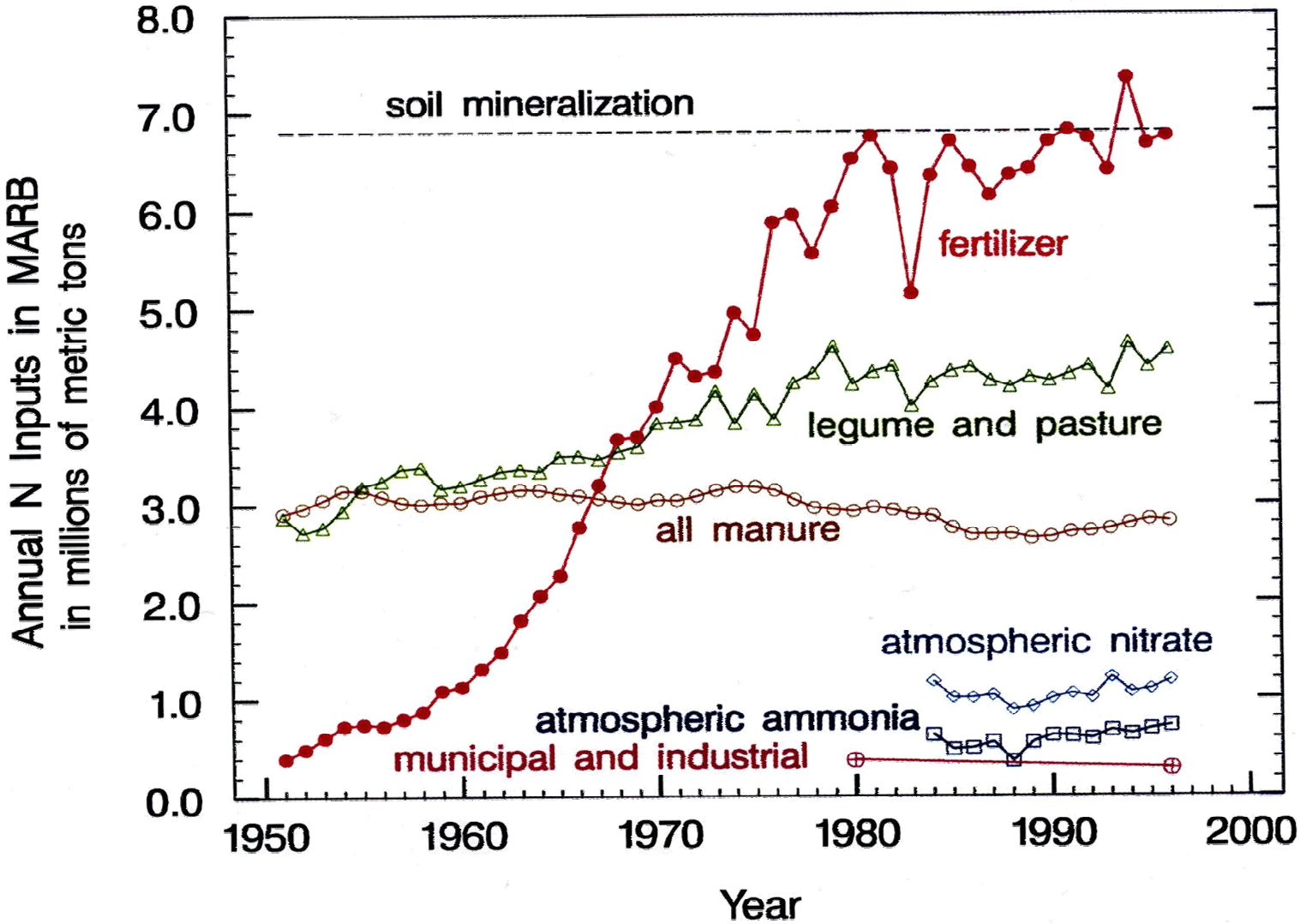
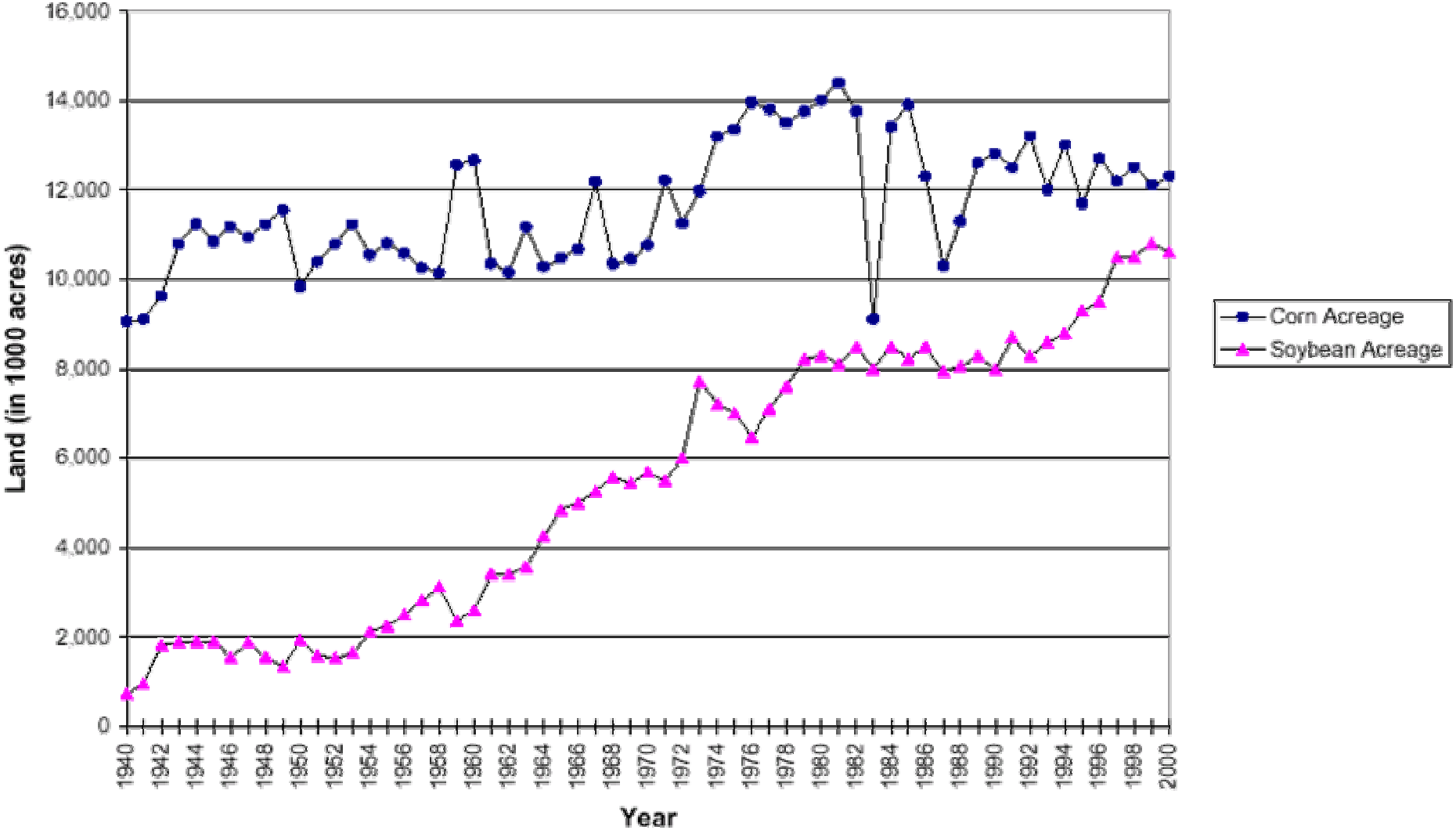
Trends

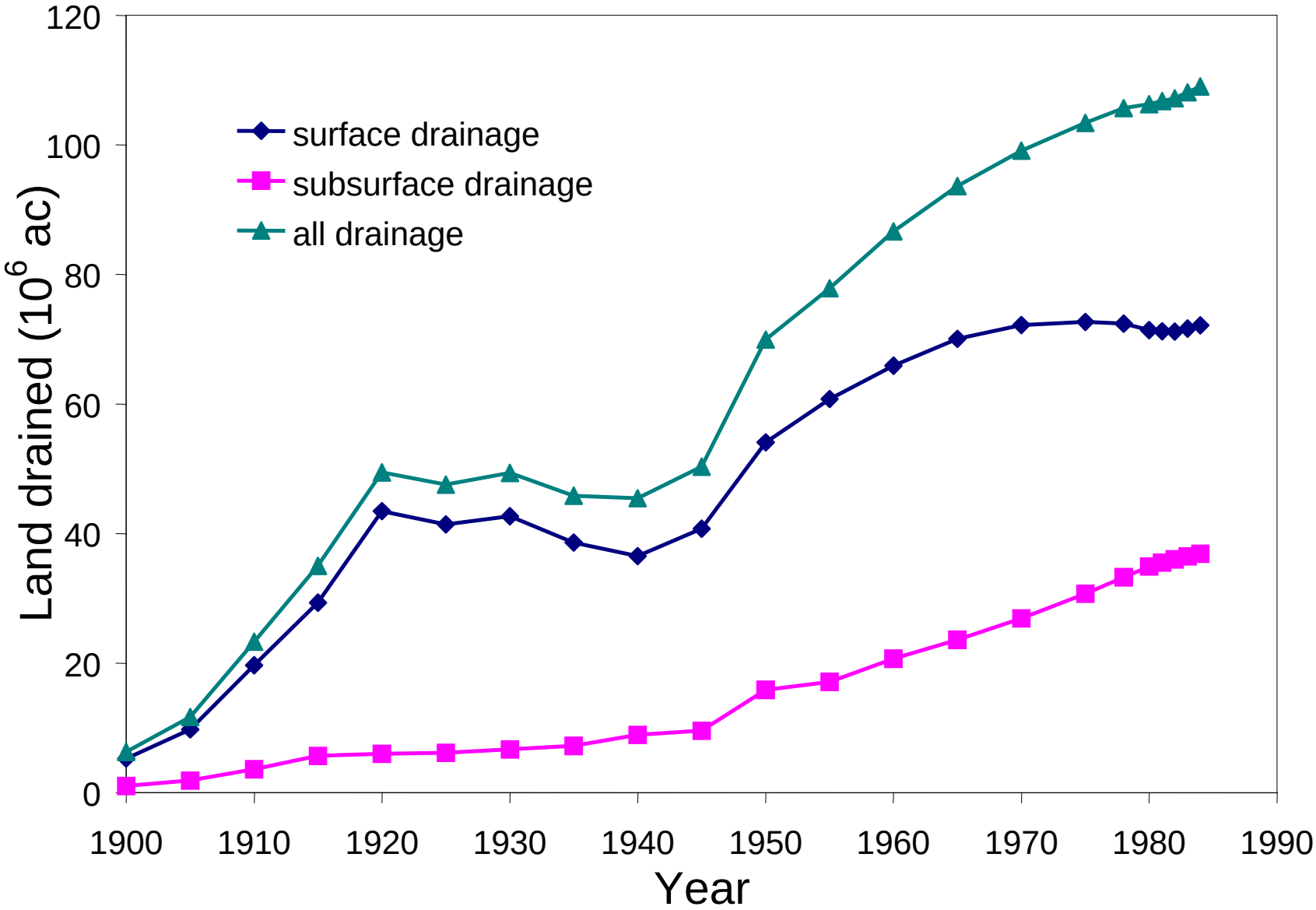


Goolsby et al. (1999)

Corn and Soybean Acres Planted, Iowa



Source: Iowa Agricultural Statistics
Prepared by: Agronomy Department, Iowa State University
Updated: 7/10/00



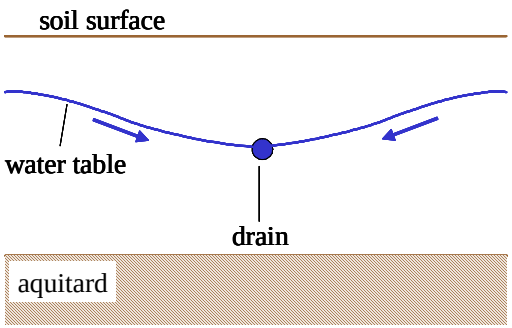
Pavelis, 1987, Economic Survey of Farm Drainage

Suggested Solutions

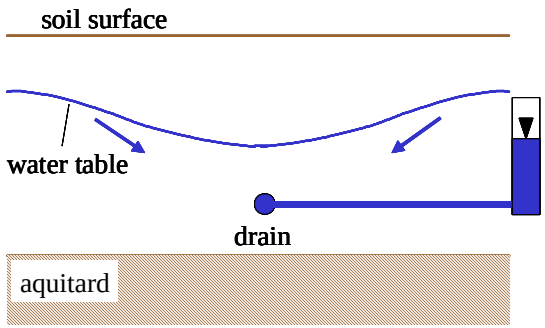
- **Reduce N-fertilizer rates?** - can reduce SON/SOC
- **Fine-tune N-fertilizer rates?**
  - Follow Univ. Recs. (EONR;MRTN) - variable
  - Rate and timing - 30% reduction in N loss (yield?)
  - Precision Agriculture - not cost effective
- **Modify tile design and management**
- **Cover crops and new crop rotations**

Alternative designs for reducing nitrate leaching from tiles

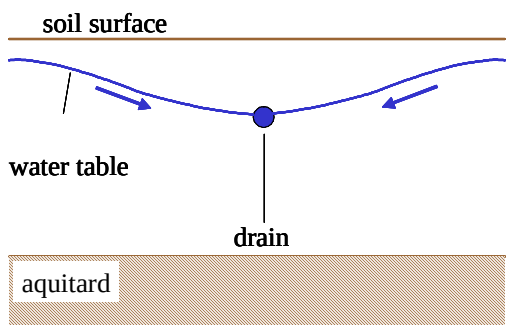
conventional



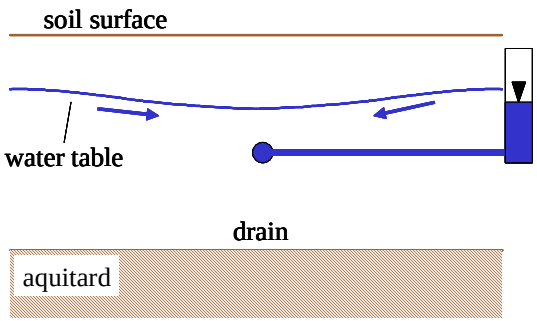
deep



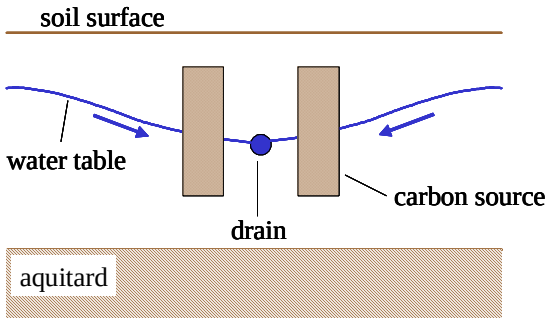
shallow



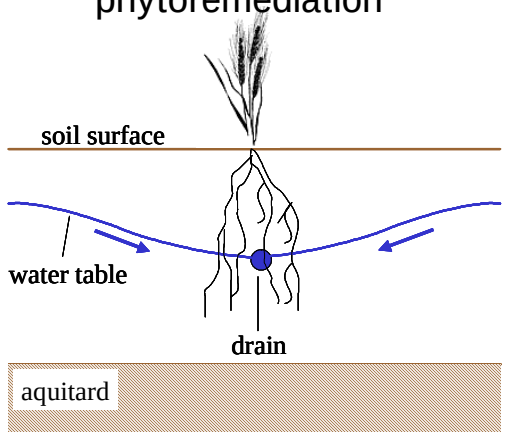
drainage water management



bioreactor



phytoremediation



Fall Rye Cover Crop - Results

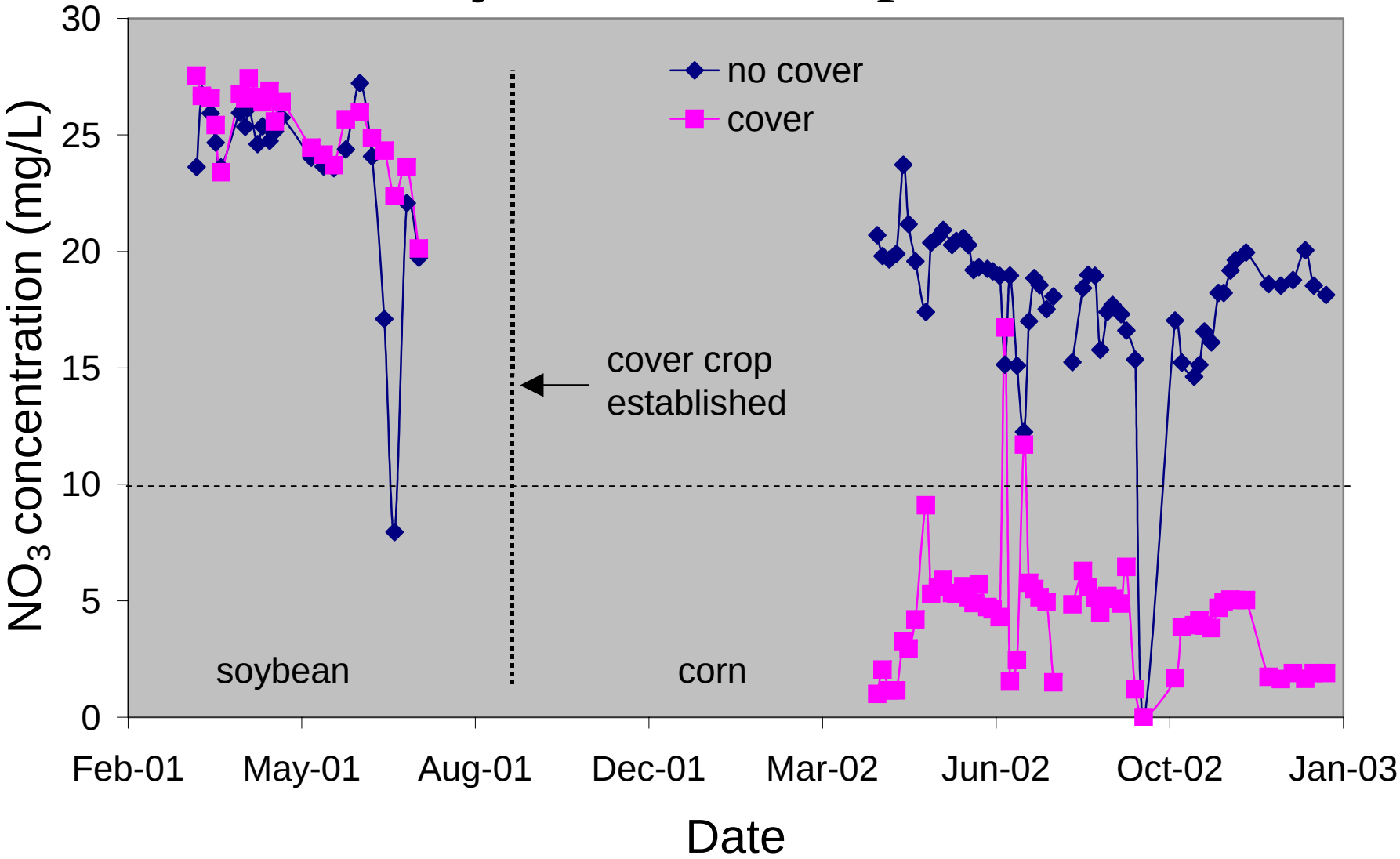


Table 1. Total nitrogen (TN) and total phosphorus (TP) potential nonpoint source (NPS) loss reductions estimated on a multiple year basis for conservation practices.

Conservation Practice	Percentage Impact on NPS Loss Reduction[1] TN	TP
Conservation Tillage		
Moderate vs. Intensive Tillage		
No-Till vs. Intensive Tillage	+10%	+70%
No-Till vs. Moderate Tillage	+5%	+45%
Cover Crops	+50%[2]	+50%[2]
Diverse Cropping Systems		
Drainage Management		
Controlled Drainage vs. Uncontrolled Drainage		
Water Table Management vs. Uncontrolled Drainage	+30%	-10%
Shallow and/or Wide vs. Standard Tile Placement	+20%	-10%
In-Field Vegetative Buffers	+25%	+50%
Landscape Management	-10%	+50%
Nitrification and Urease Inhibitors	+10%	N/A[3]
Nitrogen Nutrient Application Techniques	+10%	N/A
Nitrogen Nutrient Timing and Rate Conservation Management		
Timing: Spring vs. Fall Application	+15%	N/A
Timing: Soil-Test Based Split In-Season vs. Fall	+30%	N/A
Timing: Soil-Test Based Split In-Season vs. Spring	+15%	N/A
Rate: Yield Goal or Crop Removal Based vs. Excessive	+35%	N/A
Rate: Soil-Test Based vs. Excessive	+60%	N/A
Rate: Soil-Test Based vs. Yield Goal or Crop Removal Based	+25%	N/A
Pasture/Grassland Management		
Livestock Exclusion from Streams vs. Constant Intensive Grazing	+30%	+75%
Rotational Grazing vs. Constant Intensive Grazing	+20%	+25%
Seasonal Grazing vs. Constant Intensive Grazing	+20%	+50%
Phosphorus Nutrient Application Techniques		
Deep Tillage Incorporation vs. Surface Broadcast	N/A	-15%
Shallow Tillage Incorporation vs. Surface Broadcast	N/A	-10%
Knife or Injection Incorporation vs. Surface Broadcast	N/A	+35%
Phosphorus Nutrient Timing and Rate Conservation Management		
Timing: Spring vs. Fall Application	N/A	+30%
Soil-Test P Rate Balanced to Crop Use vs. High and Excessive	N/A	+40%
Time to Runoff Event: 1-month vs. 1-day	N/A	+30%
Riparian Buffers	+40%	+45%
Wetlands	+30%	+20%

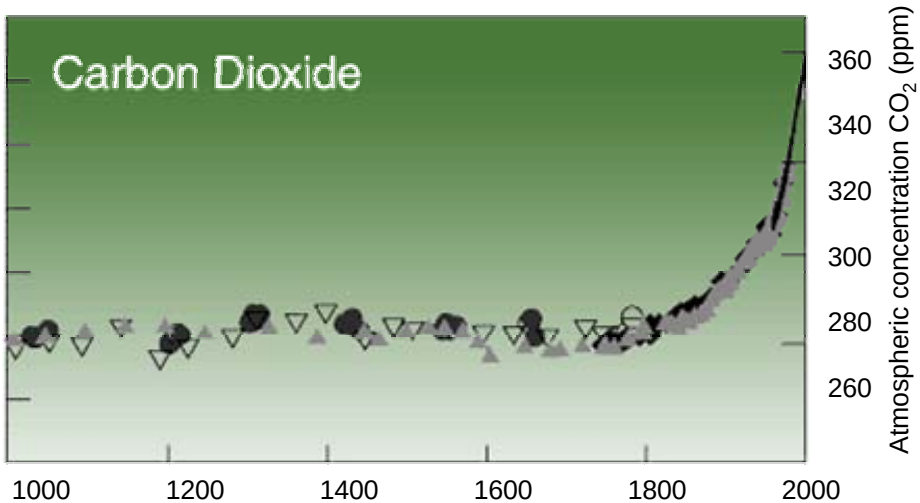
[1] Positive percentage number indicates reduced nutrient NPS pollution of surface waters; Negative percentage number indicates increased nutrient NPS pollution of surface waters.

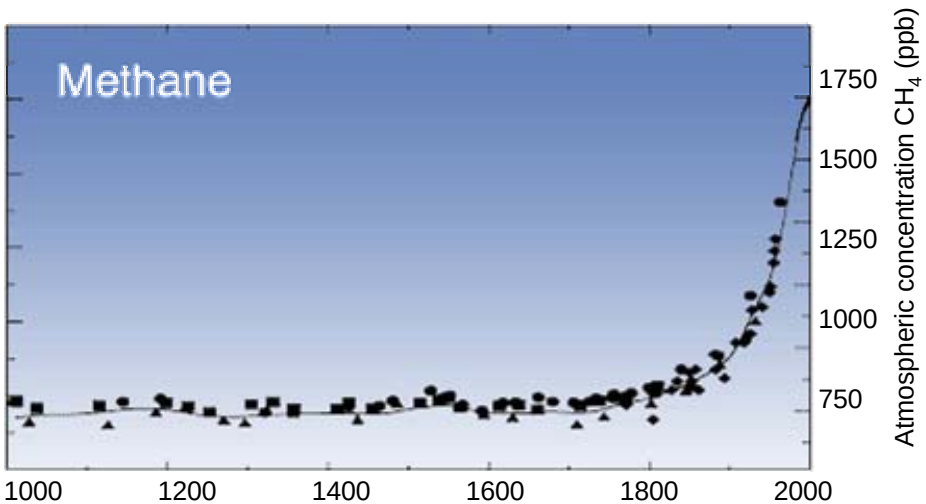
[2] Estimate is based upon the conservation practice applied only to the most applicable systems for cover crops in Iowa, which the primary crops are harvested and removed in mid- to late-summer.

[3] N/A represents "not applicable."

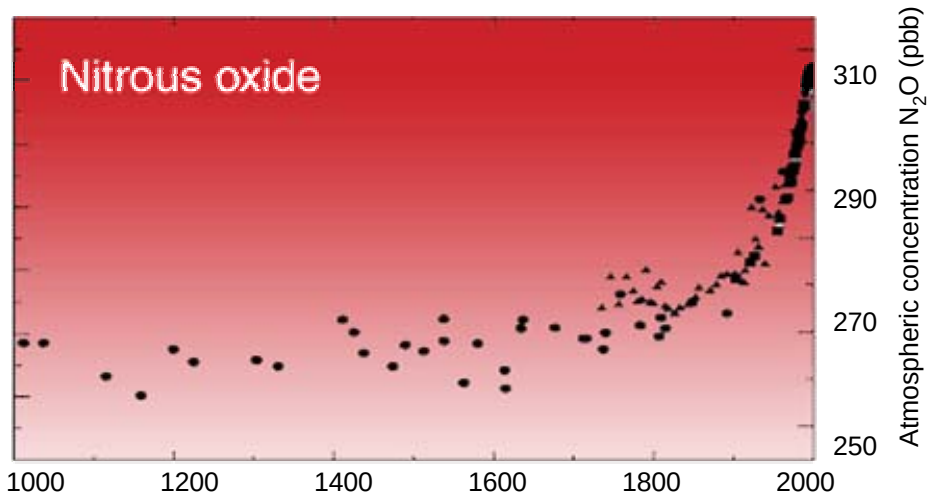
Dinnes, Assessment of Practices ... (2004)

Changes in Greenhouse Gas Levels





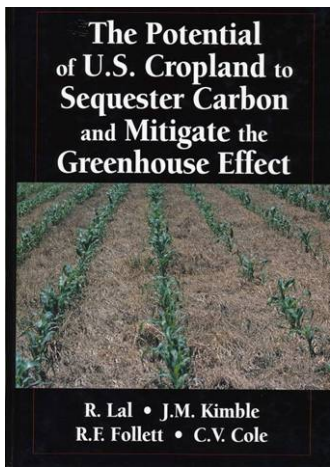
CO_2, CH_4, and N_20 – A Thousand Year History



Source: IPCC Third Assessment Report (2001)

GRACEnet

- Greenhouse gas Reduction through Agricultural Carbon (C) Enhancement network
- Soil C sequestration and greenhouse gas mitigation due to agricultural management.
- 29 ARS locations (not all measure N_2O)
- Standardized measurement protocols; process model development; data base management
- Summary papers for policy makers, action agencies
- Management guidelines to reduce GHG intensity for use by producers, federal and state agencies, and environmental credit brokers



GRACEnet - Objectives

- Determine net GHG emissions (CO_2, CH_4 and N_2O) for both typical and alternative agricultural systems
- Determine environmental effects (water, air, soil quality) of new agricultural systems developed to reduce GHG emissions and increase C storage

Chamber system, ARS, Lincoln, NE

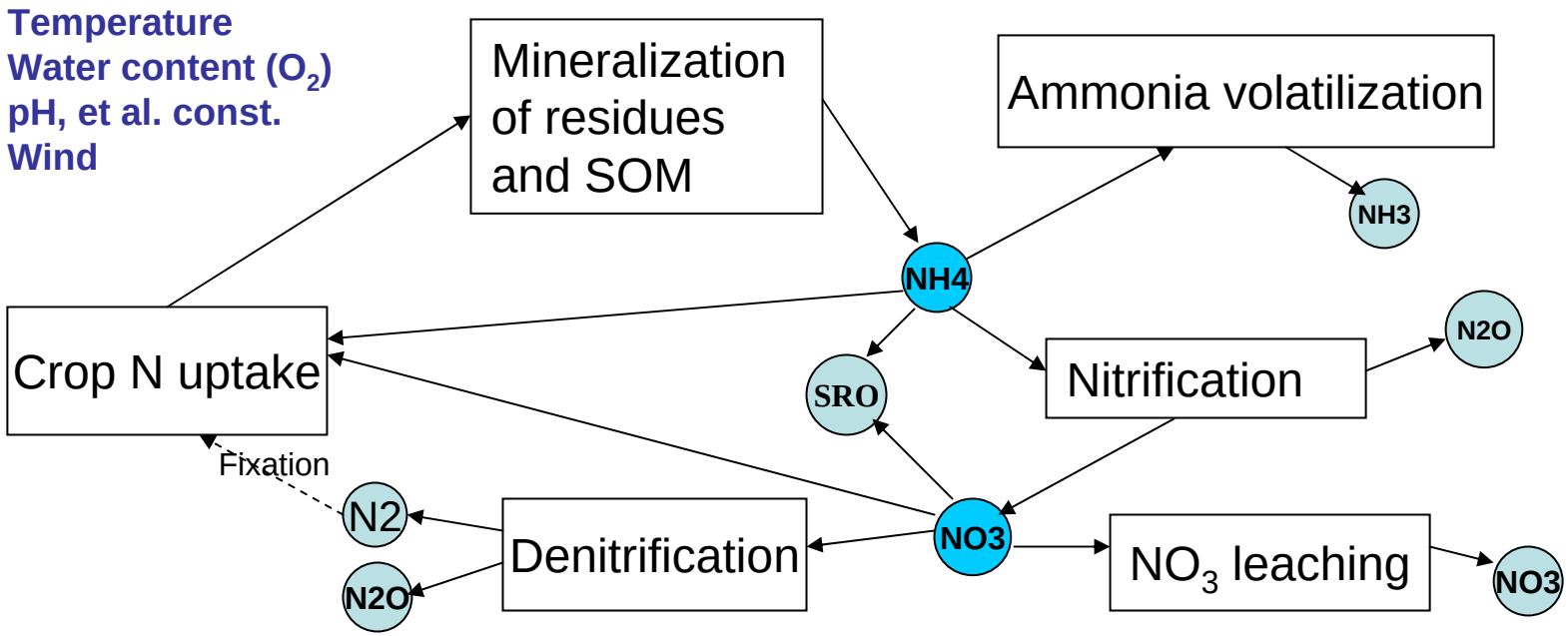
NLEAP – Nitrate Leaching & Economic Analysis Package

- Estimates N losses from agricultural fields
- Goal: Develop improved soil & nutrient management systems for sustained productivity & environmental quality
- Rationale:
  - N losses from farm fields are difficult to measure (both temporally and spatially)
  - Modeling provides a practical method of estimating N losses for the large number of soil-crop management-climate conditions that exist across farms in an area or region

NLEAP

- Field-to-regional scale, process oriented, predictive simulation model
- Rapid and efficient method of determining potential NO_3 leaching from agricultural practices
- Uses information about on-farm management practices, soils, & climate to project N budgets & calculate NO_3 leaching indices
- Calculates potential NO_3 leaching below the root zone & to ground water, to approximately 1 m depth
- User-oriented front end for assessment & planning
- Executable over a range of time scales (single events to annual cycles)
- Calibrated/validated using lysimeter, field plot, and farm field data in 8 states

NLEAP Modeling of Agricultural Systems



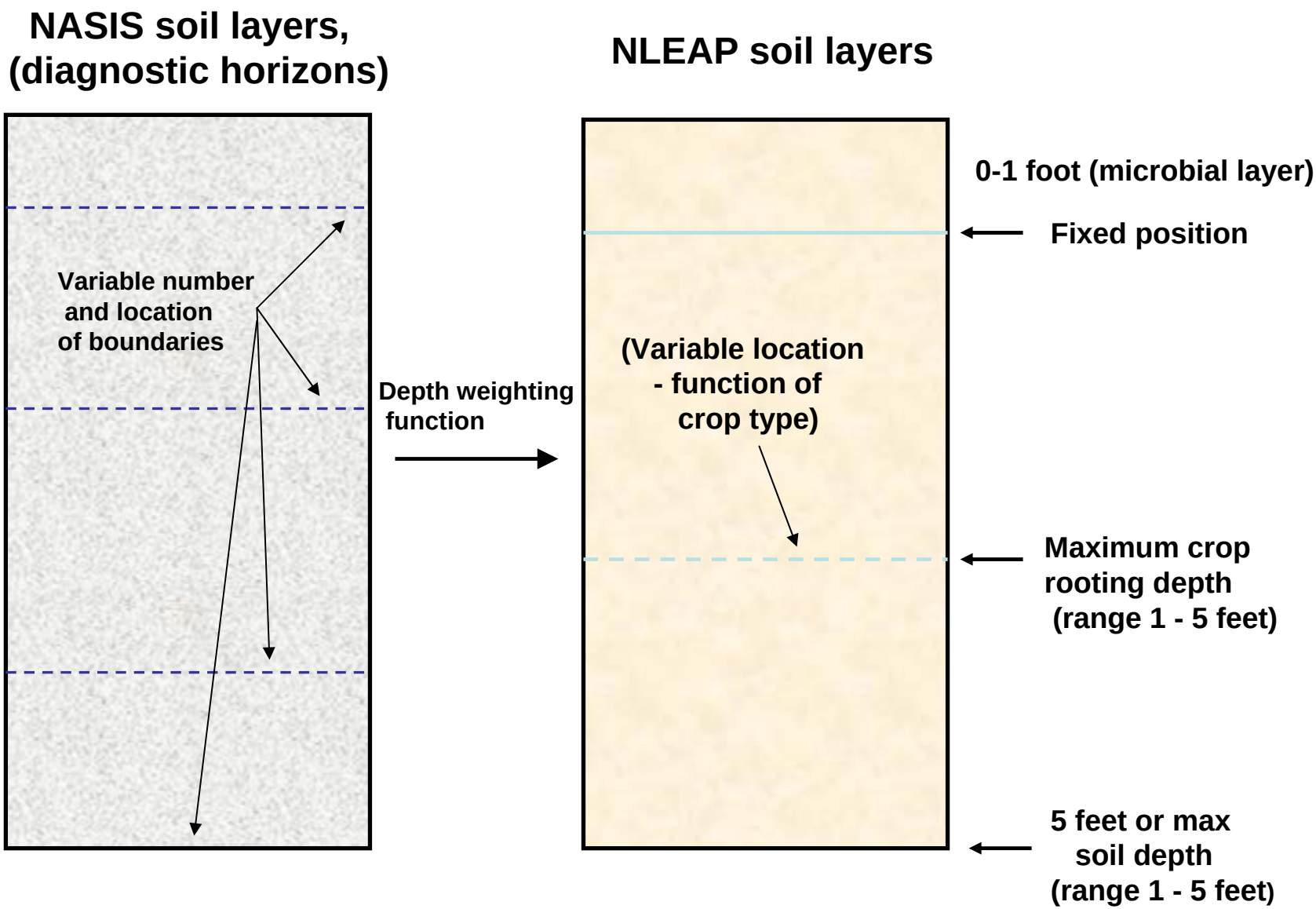
The NLEAP model simulates and links the major N-cycling processes as a function of the state input variables.

NLEAP Input DATA Requirements Summary:

- **Soils data – download NRCS NASIS files and convert using NLEAP C++ program or build own files using Excel spreadsheet.**

- **Climate data – download NRCS climate data files and auto-convert or build own files using Excel spreadsheet.**

- **Management event data – use/modify NLEAP management database or build own data set using Excel spreadsheet.**

- **Georectified (GIS) soil and farm maps – download NRCS SSURGO files, get additional map layers from public Web sites, and use your GIS program to install. NLEAP requires a text file with a list of soils in your farm field(s) and returns a results database table compatible with ESRI shapefiles.**

NLEAP Soil Horizons (layers)