

Phosphorus (P)-Index

Nutrient Management Planning Tools Workshop

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What is a Phosphorus (P)-Index?

- A risk assessment tool that was developed to assess the potential for P delivery from fields to surface water resources.
- The P-Index rating can be used to prioritize fields for nutrient and soil management practices.

Relating the P-Index to the CNMP

- Each state NRCS was required to revise its nutrient management policies, guidelines, and standards by May 2001, which included the 590 Nutrient Management Standard.
- NRCS national policy and guidelines and EPA CAFO rules require P planning (soil-test P values, threshold limits, or a P-risk index).
- P-Index tool can be integrated into the nutrient management and land treatment practices of a CNMP.

Need for a P Assessment Tool

- Manure is an unbalanced fertilizer compared to crop nutrient removal.

<u>Manure Source</u>	<u>N:P₂O₅</u>
Swine lagoon	2.7
Swine slurry	1.7
Dairy lagoon	1.2
Dairy slurry	2
Poultry litter	1

Need for a P Assessment Tool (Continued)

- Crop nutrient removal rates.

<u>Crop</u>	<u>N:P₂O₅</u>
Corn	2.7
Soybean	5.2
Alfalfa hay	5
Fescue hay	4.4
Pasture	15

Eutrophication

- Progressive deterioration of water quality from overstimulation by nutrients is called eutrophication.
- Most fresh water systems are growth limited by P as compared to nitrogen.
- Excessive levels of P in fresh water systems overstimulate the water body and lead to water quality problems.

P-Index Versus Soil-Test Thresholds

- P-Index considers source factors and transport factors.
- Soil-test thresholds only consider P source factors and are much more restrictive than the P-Index; leave little management flexibility for the producer.
- The P-Index is more comprehensive and scientifically based.

P-Index Components

- **Source Factors**
 - Soil test phosphorus
 - Rate of application
 - Method of application
 - Timing
- **Transport Factors**
 - Erosion
 - Runoff
 - Infiltration

Components of the Iowa P-Index

- **Erosion Component** (Potential P Delivered to Surface Water with Sediment):
 - Gross erosion x (Sediment trap factor or Sediment Delivery ratio) x Buffer factor x Enrichment factor x Soil Test P Erosion factor

Erosion Component Factors

- **Gross Erosion:** Soil loss in tons/acre/year estimated using RUSLE
- **SDR:** Depends on soil type and distance to water
- **Buffer Factor:** Vegetative buffer that meets NRCS standards for filter strips
- **Enrichment Factor:** Accounts for the increase in the proportion of fine particles contained in eroded sediment
- **STP Erosion Factor:** Represents the amount of particulate P in delivered sediment that will be released to the water over a long period of time.

Components of the Iowa P-Index

- **Runoff Component** (Potential P Delivered to Surface Water in Runoff):
 - Runoff factor x Precipitation x (Soil Test P Runoff factor + P Application factor)

Runoff Component Factors

- **Runoff Factor:** Uses the NRCS Runoff Curve Number (RCN) to convert precipitation to a fraction of water that runs off a field.
- **Precipitation:** The 30-year average annual precipitation for each county divided by the constant 4.415 to convert inches of rain to million pounds of water/acre.
- **STP Runoff Factor:** Consists of total dissolved P concentration in runoff estimated from STP.
- **P Application Factor:** Estimate of the additional impact of recent P applications on STP.

Components of the Iowa P-Index

- **Subsurface Drainage Component (Potential P Delivered to Surface Water with Subsurface Drainage):**
 - Precipitation x Flow factor x Soil Test P Drainage factor

Subsurface Drainage Component Factors

- **Precipitation:** The 30-year average annual precipitation for each county divided by the constant 4.415 to convert inches of rain to million pounds of water/acre.
- **Flow Factor:** Determined by the presence or absence of subsurface/substrata flow; dependent on tiles or coarse-textured soils.
- **STP Drainage Factor:** Consists of two classes with a value of 0.1 or 0.2 depending on STP values.

Iowa P-Index Delivery Risk Interpretation Classes

- Cumulative P-Index Score: Erosion Component +
Runoff Component + Subsurface Drainage
Component
- Very Low (0-1)
- Low (1-2)
- Medium (2-5)
- High (5-15)
- Very High (>15)

Conclusions

- Soil loss values are the dominant factor in determining the P-Index value and rating. The P-Index will dictate soil conservation practices.
- If soil loss is minimized, such as in a pasture, soil-test P can be high (>300 ppm) before the field will rank in the “high” category.
- Distance to water has little effect on the P-Index values until the distance is 500 feet or less.