

INCORPORATING GEORGIA'S PHOSPHOROUS INDEX IN POULTRY NUTRIENT MANAGEMENT PLANS

Dr. Dan L. Cunningham and Dr. Casey Ritz
Department of Poultry Science
The University of Georgia

The primary purpose of a nutrient management program is to assure that nitrogen and phosphorous (nutrients found in poultry manure/litter) are applied in agronomically sound method so as to reduce the potential of nutrient contamination of the state's water. For this purpose, Georgia's poultry producers have been implementing CNMPs on their farms since 1999. These CNMPs focused initially on nitrogen-based programs until tools could be developed to incorporate phosphorous. Phosphorous is a very important nutrient from an environmental standpoint. It is the nutrient of greatest concern for protection of Georgia's waters. Georgia's Phosphorous-Index (**P-Index**) has recently been developed to take into consideration phosphorous in nutrient management plans and is now available for use by poultry producers.

Georgia's P-Index is a tool to assess the risk of applying bio-available P found in poultry manures/litter to Georgia soils. **Soil test phosphorous level by itself is not enough to determine environmental risk.** The P-index is a site specific assessment of the possibility of bio-available P loss from grass lands, cropped fields, and other agricultural lands to surface waters. Loss of bio-available P to surface waters is a concern because it can accelerate eutrophication in lakes and streams of the state.

The P-Index is a computer based program developed by a group of scientists with the University of Georgia, USDA, and NRCS*. The P-Index takes into consideration the main pathways of P loss, namely 1.) Soluble P in surface runoff, 2.) Particulate P in surface runoff, and 3.) Soluble P in leachate. For each of these pathways, the P-Index estimates the risk of P loss by considering the sources of P and the transport mechanism involved, as well as management practices that can reduce P losses. These estimates are done based on scientific formulas developed by soil scientist as part of the computer program. The total risk of P loss from a field is computed by adding the various calculations of the risk from each of the pathways. Fields are categorized by cumulative scores as either **Low (less than 40 points), Medium (less than 75 points), High (less than 100 points) or Very High (more than 100 points)**. In this scoring system, individuals applying poultry litter/manure would develop or maintain management programs that would keep the P-Index below a score of 75. Scores over 75 indicate a high potential for P movement from the field. The P-Index score could then be reduced below 75 by applying less litter and/or adding buffers or applying other management procedures.

I. Sources of Risk for Soluble P in Runoff

1. Soil Test P– Soil test P for the index should be determined by analyzing soil samples

from the field. Procedures for soil sampling are part of Georgia’s CNMP program. Soil samples for P level should be done at least every five years. The higher the level of soil test P, the greater the risk score for this component of the P-Index.

2. Organic Fertilizer P– Organic fertilizer P refers to the P added with animal manures or organic amendments. The amount of water soluble P applied can be determined by laboratory analysis of litter samples when submitted to the lab or by multiplying the total P in the manure/litter by the fraction of P present in water soluble form from a table (Table 1).

Table 1. Water Soluble P in Selected Manures

Manure/ Litter	Water Soluble P (Fraction of Total P)
Poultry litter with alum	0.15
Poultry litter without alum	0.30
Layer manure	0.40
Dairy manure	0.65
Swine manure	0.40
Layer slurry	0.40
Dairy slurry	0.65
Swine slurry	0.25

The method of application of poultry manures/litter also affects the risk of soluble P in surface runoff. Soluble P runoff is reduced when application is banded, incorporated, or surface applied at a time of year when the probability of surface runoff is low (Table 2).

Table 2. Application Method Factor

Method of Application	Risk Factor
Banded/injected more than 2"	0.10
Incorporated immediately or sprinkler applied	0.20
Surface applied, incorporated less than 30 days	0.40
Surface applied not incorporated May-Oct.	0.60
Surface applied not incorporated Nov, Mar., and April	0.80
Surface applied not incorporated Dec-Feb	1.00

As indicated in Table 2, applications that incorporate the manure into the soil substantially reduce the risk factor for soluble P runoff. Most applications of poultry manure are, however, surface- applied with no incorporation, thus time of year becomes more important. Surface application from May through October (growing season) represents the lowest risk

factor with surface application.

3. Inorganic Fertilizer– Inorganic fertilizer P refers to the amount of P added with commercial fertilizers. The amount of water soluble P in conventional fertilizers is calculated by multiplying total P by the fraction of P present in water soluble form (0.9). Thus the presence of soluble P is greater in commercial fertilizers and the use of these conventional fertilizers will increase the risk of soluble P runoff.

4. Curve numbers and Buffers– The P-Index also uses a curve number for fields based on soil type, slope and crop type to estimate the risk of soluble P runoff. In addition, the risk of soluble P runoff is reduced with the use of a vegetative buffer at the edge of the field. A vegetative buffer is defined as a vegetated area under the producers control with greater than 80% ground cover, no channelized flow, no P application, and a soil test P of less than 450 lb/acre. In the P-Index, providing a vegetative buffer zone as narrow as 10 feet can significantly reduce the risk of P runoff from the field. Thus, the use of a vegetative buffer zone can be a powerful tool for keeping the overall P-Index value below the 75 point threshold.

The risk of soluble P loss in surface runoff is computed by adding the risk rating for each of the soluble P sources and multiplying that number by the curve factor and the buffer effect (Soil Test P + Organic P + Inorganic P x Curve number x Buffer Effect).

II. Particulate P in Surface Runoff

Particulate P is defined as phosphorous that does not pass through a 0.45 micron filter. Although particulate P is not in solution and therefore is not directly bio-available, it can play an important role in accelerating eutrophication by releasing bio-available P. The P-Index estimates the risk of P loss through particulate P by estimating sediment loss from a field, the bio-available P that can be released from particulate P, and taking into account the retention of P by the presence of a vegetative buffer.

1. Sediment Loss from a Field– Sediment loss from a field (ton/acre) requires computation using a procedure referred to as the Revised Universal Soil Loss Equation (RULSE). Determining this sediment loss factor for a field requires knowledge and training in the use of the RULSE. Thus, producers utilizing the P-Index will need assistance from trained individuals.

2. Effect of Buffer Width– The P-Index reduces particulate P losses in runoff when a vegetative buffer is used along the down slope edge of a field. A vegetative buffer is defined as a vegetative area under the producers control, with 80% ground cover, no channelized flow, and no P application. A vegetative buffer can be a very powerful management tool for reducing the overall P-Index score for a field.

The risk of bio-available P in particulate form is computed by multiplying the bio-

available P loss by the buffer effect (Bio-available P Loss x Buffer Effect).

III. Soluble P in Leachate

Soluble P present in water percolating through the soil profile can contaminate a shallow water table or tile water directly connected to surface water. The P- Index estimates the risk of soluble P loss in percolating water by considering 1.) All sources that can contribute soluble P, 2.) The volume of percolating water, and 3.) The depth to the water table.

1. Sources of Soluble P in Leachate– The main sources of soluble P in percolating water are soil test P, inorganic fertilizer P and organic fertilizer P. The P-Index uses a relationship between each of these P sources and the concentration of soluble P in solution to obtain a rating for the risk of P loss. Addition of organic fertilizer P may significantly increase the concentration of soluble P in percolating water when the soil already has an elevated level of Soil Test P (greater than 450 lb/acre). Thus the effect of organic fertilizer P is not taken into account for soils testing below 450 lb P/acre. As is the case with organic fertilizer P, the addition of inorganic P is not considered to have an effect on soluble P in leachate when soil test P is below 450 lb/acre.

2. Volume of Percolating Water– The P-Index uses a Percolation Index to estimate the risk of leaching from a field. This index uses a curve number associated with the different soil hydrological groups (Table 3.).

Table 3. Percolation Curve Numbers by Soil Groups

<u>Hydrologic Group</u>	<u>Curve Number</u>
A	28
B	21
C	17
D	15

3.Depth to Water Table– When the depth to the water table or drainage tiles is less than 0.5 feet (plow layer), it is assumed that all the soluble P in percolating water is transmitted to the water table or tile. However, below a depth of 0.5 feet, the transmission decreases, reaching a value near zero at 8 feet. Thus, the further the water table from the surface, the less the risk factor and a water table below 8 feet will have no impact on this assessment.

Risk of Soluble P in Leachate (Source Risk x Leaching Risk x effect of Depth to Water Table).

Computation of the P-Index

The P-index for a given field is computed by adding the risks associated with the different pathways of P loss described above. Individuals using the P-Index computer-based program do not need to do the various scientific calculations for the risk factors. The P-Index program contains the different calculations needed for the required risk factors and will do the computations upon entering certain basic information. This P-Index has been incorporated into a Poultry CNMP computer program available through the County Extension Agent. This program has simplified the use of the P-Index so that individuals trained in its use can more easily generate a nutrient management plan that also assesses the risk of P application.

Interpretation of the P-Index

Score of 0–39. Low potential for P movement from field.

Score of 40–74. Medium potential for P movement. Use management practices to keep below 75.

Score of 75–99. High potential for movement. Reduce the rate of P application and/or add buffers. If a P-Index below 75 can not be reached, a plan needs to be developed to achieve a P-Index score of less than 75 within 5 years.

Score of 100 or more. Very high potential for P movement. Reduce the rate of application of P or add buffers to achieve a P-Index of less than 100 in the first year. Develop a 5-year plan for reducing the P-Index score below 75.

***Georgia P-Index Team**

M. L. Cabrera, Chair, Crop and Soil Sciences, University of Georgia, Athens, GA.

D. H. Franklin, USDA-ARS, Watkinsville, GA.

G. H. Harris, Crop and Soil Sciences, University of Georgia, Tifton, GA.

V. H. Jones, USDA-NRCS, Athens, GA.

H. A. Kuykendall, USDA-NRCS, Athens, GA.

D. E. Radcliffe, Crop and Soil Sciences, Athens, GA.

L. M. Risse, Biological and Agricultural Engineering, Univ. of Georgia, Athens, GA.

C. C. Truman, USDA-ARS, Tifton, GA.