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Livestock Waste Management and Conservation

Tennessee Phosphorus Risk Index

(Class I & II – Large and Medium CAFOs)

Tennessee CAFO Factsheet #15

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Why is phosphorus (P) a concern?

In a waterbody, P is required for algae growth. In most waterbodies, the limited supply of P limits algae growth. Large amounts of P promote rapid growth of large amounts of algae or algae "blooms." This excess algae damages aquatic habitats by reducing sunlight penetration, reducing dissolved oxygen levels and promoting the growth of a toxic form of microscopic marine life. In short, it can result in fish kills, reduce aesthetic value and could make the water less desirable for livestock watering. An example of actions taken to prevent P enrichment of surface water is the lowering of phosphate levels in detergents. The P in manure and litter is also a concern. Many states have taken steps to limit the amount of manure P applied to all fields. In Tennessee, the goal is to limit the amount of manure P applied to fields with a high potential for run-off.

What is the P Index?

The Tennessee Phosphorus Risk Index (P Index) is a planning tool that estimates the potential risk of phosphorus movement from an application site to a waterbody. Phosphorus (P) movement is determined by the source of the P, how the source is managed and the potential for movement from the field. The P Index will identify fields where the risk of P movement is relatively higher than in other fields. When individual parameters of the index are analyzed, it may become apparent that one parameter is significantly influencing the potential for P movement. This could provide opportunities to make changes to decrease the potential for P movement.

How does the P Index work?

The P Index uses eight parameters (separated into two categories) unique to each field receiving manure application. When all eight of the parameters are analyzed, the field will fall into a rating of low, medium, high or very high potential for P movement off the field.

The source and management category analyzes the following four parameters:

1. Soil Test P: The soil test P level is used to determine the P carrying capability of the soil. This may only play a small role in determining the amount of P run-off.
2. P or P_2O_5 Application Rate: The source and quantity of P play an important role in P run-off. The P in commercial fertilizer is more water-soluble and more available than P in manure, compost or biosolids. Also, some P in manure is organically bound and released over a longer period of time than commercial fertilizers. Additionally, the use of alum on poultry litter produces a relatively insoluble P compound, and will affect potential movement of P as well.

3. Application Timing: This parameter considers historical weather data for periods when the most rainfall occurs and the active growing period for crops. In Tennessee, most rain falls during months when crops are least active.
4. Application Method: There is a greater risk for P movement when manure and/or fertilizer are surface-applied as compared to incorporation of the manure or fertilizer.

The transport category analyzes the following four parameters:

1. Hydrologic Soil Groups: Soils are categorized based upon estimates of run-off potential determined by the rate of water infiltration when the soil is saturated, not covered by vegetation and receiving precipitation from a long-duration storm.
2. Erosion Potential: Fields are assessed for the risk of sediment-bound P movement in run-off. The slope of the land, the length of the slope, the type of tillage used, the presence of cover crops and the texture of the soil all factor into this parameter.
3. Permanent Vegetative Buffer Width: Research indicates vegetated buffers are effective best management practices in keeping sediment and other potential pollutants from leaving the field. Buffers act as filtering devices for nutrients in sheet flows from fields. Buffers must be installed and maintained according to NRCS Standards.
4. Non-Application Width from Surface Water Conveyance: This parameter measures the distance from the edge of the cropped area to the nearest conveyance to surface water where no manure or fertilizer is applied.

What do the results mean?

The results of the P Index will give an approximation of the risk of P movement from fields and the potential impact on water quality. The results can be used in resource management planning and to direct conservation efforts to reduce the risk of P loss. If there is a “very high” potential for P movement from the field with an adverse impact on surface waters, all necessary soil and water conservation practices, plus a P-based nutrient management plan, must be implemented to avoid the potential for water-quality degradation. If the potential for P movement is “high,” the chance for adverse impact to surface waters is likely unless action is taken. Soil and water conservation practices must be implemented (if practical) to reduce the risk of P movement. If actions cannot be taken to reduce the risk, then a P-based nutrient management plan must be implemented.

If there is a “medium” potential for P movement from the field, the potential to adversely affect surface water does exist. However, a nitrogen (N)-based nutrient management plan can be used if conservation measures are implemented to lessen the probability of P loss. Over time, soil P levels and P loss potential may increase due to the N-based nutrient management. If a field is considered to have “low” potential for P movement from the field, there is a low probability of adverse impact on surface waters from P losses. A N-based nutrient management plan is acceptable for this field if current farming practices are maintained. However, over time, soil P levels and P loss potential may increase due to the N-based nutrient management.

How does the P Index help producers?

Some states require that all manure and litter be spread based on soil P test. As a result, more land is needed for application as compared to applications based on nitrogen. In Tennessee, if a soil test recommends additional P, producers can apply manure based on N needs. If a soil test recommends no additional P be added or if the soil is "high" or "very high" in P, the P Index will be run to determine if additional P will adversely impact surface waters. The benefit of the P Index is that it is a field-specific assessment of the potential for P loss. The P Index identifies individual fields with the highest risk for P loss. In fields where the risk of P loss is “medium” or “low,” then application rates can be based on N rather than P, meaning less land will be needed for application. On most farms, this will mean only a few, if any, fields will need a P-based application. Additionally, in some cases, additional conservation practices or changes in management practices can be implemented to reduce the potential for P loss, allowing for N-based application.

Reference

Tennessee Phosphorus Index: **A Planning Tool to Assess and Manage P Movement**. Natural Resources Conservation Service, United States Department of Agriculture. November 2001.

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