Work-Load Issues Concerning the Use of RUSLE to Estimate Soil Losses in P Index Assessment Tools in the Mid-Atlantic Region

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The Phosphorus Index and RUSLE

Most states in the Chesapeake Bay Watershed are considering adoption of the Phosphorus Index (P-Index) as a primary P management tool for implementing P-based nutrient management plans. The P-index is a field-level assessment tool that integrates soil, management, environmental, and hydrological (transport) characteristics to determine the relative risk of P losses through erosion, surface runoff and subsurface transport to water bodies. In this approach, site specific information is used to evaluate two categories of factors that contribute to the potential for P loss from agricultural land: 1) P loss potential due to site and transport characteristics; 2) P loss potential due to management and source characteristics. In the original NRCS P-Index, the potential risk of P loss in eroded sediment required an estimate of soil erosion loss using RUSLE.

RUSLE or the revised universal soil loss equation is a tool developed by USDA-NRCS to estimate soil erosion losses as affected by rainfall, the erodability of the soil, percent slope, slope length, the type of cropping system and the presence of conservation practices. Estimated soil losses using RUSLE1 or RUSLE2 are calculated separately for input into the P-Index which requires a field visit to collect site specific information (i.e., slope, slope length, etc.).

However, there have been some concerns in the Mid-Atlantic region of the US (especially those states in the Chesapeake Bay Watershed) regarding the workload associated with using the P-Index, especially with estimating erosion losses using RUSLE. An important question that has been asked in some states is whether the process/steps in estimating erosion losses can be streamlined or simplified. Thus, it is prudent to explore possibilities for streamlining or simplifying estimations of erosion losses.

Regional Assessment

Our goal was to assess the implementation of the P-Index as a management tool and to determine how the respective states in the Mid-Atlantic region are dealing with erosion estimates. In particular, what are the current issues regarding RUSLE & the P-Index and what are some possible strategies for streamlining or simplifying the process of using RUSLE to estimate erosion losses in P-Index determinations. To accomplish our goal a workshop was conducted in 2004 attended by university scientists and state/regional representatives from USDA-NRCS who work with RUSLE. A general consensus of the workshop participants was that if the process of assessing erosion using RUSLE is to be streamlined or simplified, NRCS should be fully involved in this process. States represented include Delaware, Maryland, New York, Pennsylvania, Vermont, Virginia and West Virginia.

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Phosphorus Based Management & The P-Index

        Several states have regulations requiring P-Based Nutrient Management Plans (NMP's) and they vary in the use of the P-index as the primary P management tool. Each states approach is summarized below.

Pennsylvania
- **NMP Requirements**:
  - Pennsylvania has had regulations that require an approved N based NMP on Concentrated Animal Operations (CAOs) that have ≥ 2 animal units/acre and volunteers who receive government financial assistance with nutrient management. New regulations have been developed, but not yet adopted, that will require a P Index based plan on CAOs. A recent court decision however, has resulted in an immediate implementation of P Index based planning for CAOs and volunteers.
  - All NMP's are written by private-sector employees.
- **Use of the P-Index:**
  - All existing plans (~1200) and new operations will require the use of the PA P-Index. Existing plans will be updated over a three year period.
  - As a screening tool, the PA P-Index is assessed on all fields having > 200 ppm Mehlich-3 soil test P or if the field is <150 feet from water.
- **Use of RUSLE in the P-Index**
  - The PA P-Index uses RUSLE1 to estimated erosion and NRCS staff make the RUSLE determinations for each field.
- **Questions Regarding Erosion Estimates and the P-Index**
  - Is the rotation soil loss acceptable or do we need an annual calculation?;
  - What is a field for the purpose of determining the P Index?; and
  - If a Conservation Plan exists and is implemented, is it acceptable to just use "T" in calculating the P-Index?

Maryland
- **NMP Requirements**:
  - Maryland has state regulations requiring P-based NMP's.
  - Phosphorus based Plans are required on all fields having a soil-test P > 150 FIV.
  - NMP's are written by state-certified Nutrient Management Advisors who are either private-sector employees or employed by Maryland Cooperative Extension. Most of these certified advisors do not write farm conservation plans.
- **Use of the P-Index**:
  - All of the P-based plans require the use of the MD P-Index and this impacts ~ 30% of the agricultural land in Maryland.
- **Use of RUSLE in the P-Index**
  - The MD P-Index uses RUSLE1 to estimate soil erosion.
  - For training purposes: MD-NRCS conducts the RUSLE training as a cooperating partner with MD Cooperative Extension's P-Index training.

- RUSLE – The main emphasis for reducing the work load associated with RUSLE has been to simplify the actual RUSLE calculations once the field data has been collected. To accomplish this. MD-NRCS has modified RUSLE1 into a tabulated "erosion estimator". This modified version of RUSLE1 has been incorporated into the MD-P-index software. RUSLE2 is currently being incorporated into the MD P-Index software.
  - In Maryland it was estimated that it can take 5-15 minutes to determine the slope and slope length of a field and 15-30 minutes per field for the whole P-Index.
  - It was noted that a challenge for training of advisors is having them find representative slope and slope lengths in the field, which becomes less of a problem with experience.
  - Erosion is one of the most heavily weighted inputs for the MD P-Index.
- **Questions Regarding Erosion Estimates and the P-Index**
  - Based on current experience, some producers are requesting the P-index run on fields with an FIV < 150 to see if higher rates of P can be applied.

West Virginia
- **NMP Requirements**:
  - Currently West Virginia does not have any nutrient management legislation which require NMP's
  - Paper NMP's have been written in WVA for the past 10-15 years.
  - NMP's are written by WV-NRCS. Since 1999, ~120 individuals have been certified.
- **Use of the P-Index**:
  - The WV P-Index is required only for operations in the Potomac Valley Soil Conservation District. These are the 5-counties in the headwaters of the Potomac River Watershed.
  - WV P-Index does not have an upper limit "No P Application" category. Nitrogen based NPM's can be implemented if used in combination with BMP's.
- **Use of RUSLE in the P-Index**
  - RUSLE2 has been in use for erosion prediction since Jan. 2004.
  - Based on field experience in WVA, "slope length" is the most variable field measurement associated with RUSLE determinations.

Delaware
- **NMP Requirements**:
  - State regulations required P based NMP's on all fields with a soil-test P FIV > 150.
- **Use of the P-Index**:
  - Use of the DE P-Index when developing P based NMP's is voluntary.
  - If a producer decides not to use the P-Index, maximum P applications allowed correspond to the estimated 3 year crop P removal.
- **Use of RUSLE in the P-Index**
  - The DE P-Index uses RUSLE1 to estimate soil erosion.

New York
- **NMP Requirements**:
  - State regulations require P-Based NMP's on large (~ 160 farms) and medium (~350 farms) CAFO's.
  - ~90% of the plans are written by private-sector employees.

- **Use of the P-Index:**
  - All required P-based NMP's require the use of the NY P-Index.
  - For every field, soil test P and potential transport is assessed.
- **Use of RUSLE in the P-Index**
  - RUSLE2 has been in use since May 2003.
  - RUSLE2: NY allows for the grouping of similar fields on a farm such that RUSLE2 may not be calculated for every individual field. To be grouped the fields must have the same soil type, k, and T. For the group of fields, the worst case scenario is selected for use on the rest of the fields.
- **Questions Regarding Erosion Estimates and the P-Index**
  - A current question being considered in New York is whether P-Index calculations should be based on estimates of annual soil loss or rotational soil losses based on the EPA funded Agricultural Environmental Management Systems recommendations.

Virginia
- **NMP Requirements**:
  - State regulations require NMP's for permitted animal feeding operations.
  - Plan writers are certified by the state.
  - Permitted poultry operations are required to have P-Based NMP's (effective 10/01/01) while all others are currently required to have N-Based plans.
- **Use of the P-Index:**
  - For permitted poultry operations, the maximum P application rate allowed is the recommended fertilizer P rate based on soil testing or estimated crop P removal, whichever is higher.
  - The VA-NRCS 590 standard includes the Virginia P-Index. For participants in NRCS programs the P-Index would be used on fields having a degree of P saturation (DPS) ranging from 20 to 65%. For fields with a DPS < 20%, N based management is recommended and for fields with a DPS > 65%, no P application would be recommended.
  - Pending state regulations will require permitted animal feeding operations to manage P based on either soil test recommendations or the VA P-Index.
- **Use of RUSLE in The P-Index:**
  - The VA P-Index Technical Guide recommends the use of RUSLE2 in estimating soil erosion losses
  - To ease the potential workload for using the P-Index in developing P-based NMP's, VA Dept. of Conservation & Recreation has developed a Soil Erosion Risk Assessment Procedure (ERA) for estimating soil loss for P-Index determinations.
    - The DCR ERA does not require a field visit.
    - In lieu of a field visit, the ERA uses typical/default slope (S) and slope length (L) values
    - For multiple soil mapping units in a given field, the ERA calculates a weighted average based on the default S and L for each mapping unit.

Regional Issues Related to using RUSLE in P-Index Calculations

        A potential major issue of using RUSLE1 or RUSLE2 as a component of developing P-based NMP's is the amount of time/work it takes to make this calculation. A consensus of our group is that as we consider "simplifying" the process of writing NPM's and in particular P-based plans, our goal should be to simplify the report that is delivered to the farmer. That is, this report should be easy for him/her to understand. However, nutrient management planning is a complex process and this process should be science-based. Thus we should be cautious in simplifying the science that is involved in developing a NMP. If fields are visited and data collected for the purpose of writing a NMP, all available data should be used to develop the best site-specific NMP for the farmer.

        During our workshop, several issues (open questions) relative to RUSLE and the P-Index were raised. Most of which will/could have implications for all states in the Mid-Atlantic Region:

Should default values for slope (S) and slope length (L) be used in RUSLE calculations for P-Index calculations?

    Consensus:

- Using default values in RUSLE and RUSLE2 should be discouraged. It was recommend that the science not be compromised and that field visits are necessary for developing NMP's.
- If default values are used, they should be conservative to protect the environment.
- NRCS Perspective: If we are to use any default numbers in RUSLE calculations, these must represent the worst case scenario for each mapping unit, which will protect the environment, but may result in giving overly conservative recommendations to the producer. Default RUSLE calculations could save time and be adequately accurate if they are only used to document that a farmer is meeting P index requirements for P management. They are probably not accurate enough to prove a farmer is not meeting P Index requirements because of the problem of being overly conservative.
- If default values are used, producers should be given the option of requesting a full RUSLE assessment of any field, which includes a field visit.
- A suggested method of using default values would be to use them for preliminary development followed by a site visit and full NMP implementation within 3 – 5 years.
- Based on the Delaware experience, another approach might be to randomly select a number of permitted farms requiring P-Based plans (say 20%/year) for full implementation.
- *Question*: How should defaults be applied to fields with multiple soil mapping units?

For P-Index calculations, should annual or rotational erosion estimates be used?
(i.e., Should we use the erosion estimate for the planning period of the NMP or the
estimated erosion for each year of the planning period?)

Pennsylvania – example:
- 4-corn - 4-alfalfa rotation in a conventional tillage system
- Rotation A-value is 5 ton/A
- Individual years: corn A-value is 11 ton/A (this is 24 ton/A for corn silage!) and alfalfa is 1 ton/A
- **PA P-Index**
  - ➤ Rotation P-index = 60 (*Medium Rating*)
  - ➤ Corn P-Index = 93 (*High Rating*) (Corn Silage = 164)
  - ➤ Alfalfa P-Index = 38 (*Low Rating*) with everything else the same
  - ➤ *Question*: If the manure is going on the corn in the rotation, is 93 (164) a better assessment of the risk than 60?

- **New York Example**: If the P-index is based on annual soil loss values, the traditional corn silage-4 hay-4 rotations could not use manure on the 3rd and 4th year of the corn.
- One suggestion is to use the soil erosion for the planning period of the NMP. For example, if a plan is renewed every three years, use the cropping sequence to be grown for the period in the RUSLE calculation.
- This issue needs further discussion.

How do we define a field in P-Index/RUSLE calculations?
- This issue needs further discussion.

Examples:
- If an NRCS Conservation plan exists and is implemented, is it acceptable to use "T" in calculating the P-Index?
- Are erosion estimates in Conservation Plans suitable for P-Indexing purposes?

Using Screening Tools in P-Index Assessment

Are these acceptable "up front" methods to determine if P-index assessment is necessary? The primary intent of these "screening tools" is to determine the need for assessing the P-Index on an individual field. Consensus: If screening tools are used in the application of the P-Index they should be science based. Screening tools are currently used in Pennsylvania, Maryland, Delaware, Virginia and New York.