Reducing Nutrient Loads from Agriculture in the Upper Mississippi River Basin – Modeling Considerations

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Outline

- Not a review of models
- Do models have use in setting acceptable levels?
- Complexity and scale of model?
- Potential gaps and need relative to modelling

Setting Acceptable Levels

- What is the water quality target!
- If we are to set acceptable field losses we need to know:
  1. What is the goal downstream?
  2. That if we reduce field losses that improvements will be observed in downstream water quality

Do Models Have a Use?

- Models can be very useful in identifying critical source areas
- Useful in predicting potential impacts of land management practices on runoff and downstream water quality
- Used extensively in TMDL development and implementation – where they are used to allocate loads

Use of Terrain Modeling to Highlight Critical Source Areas

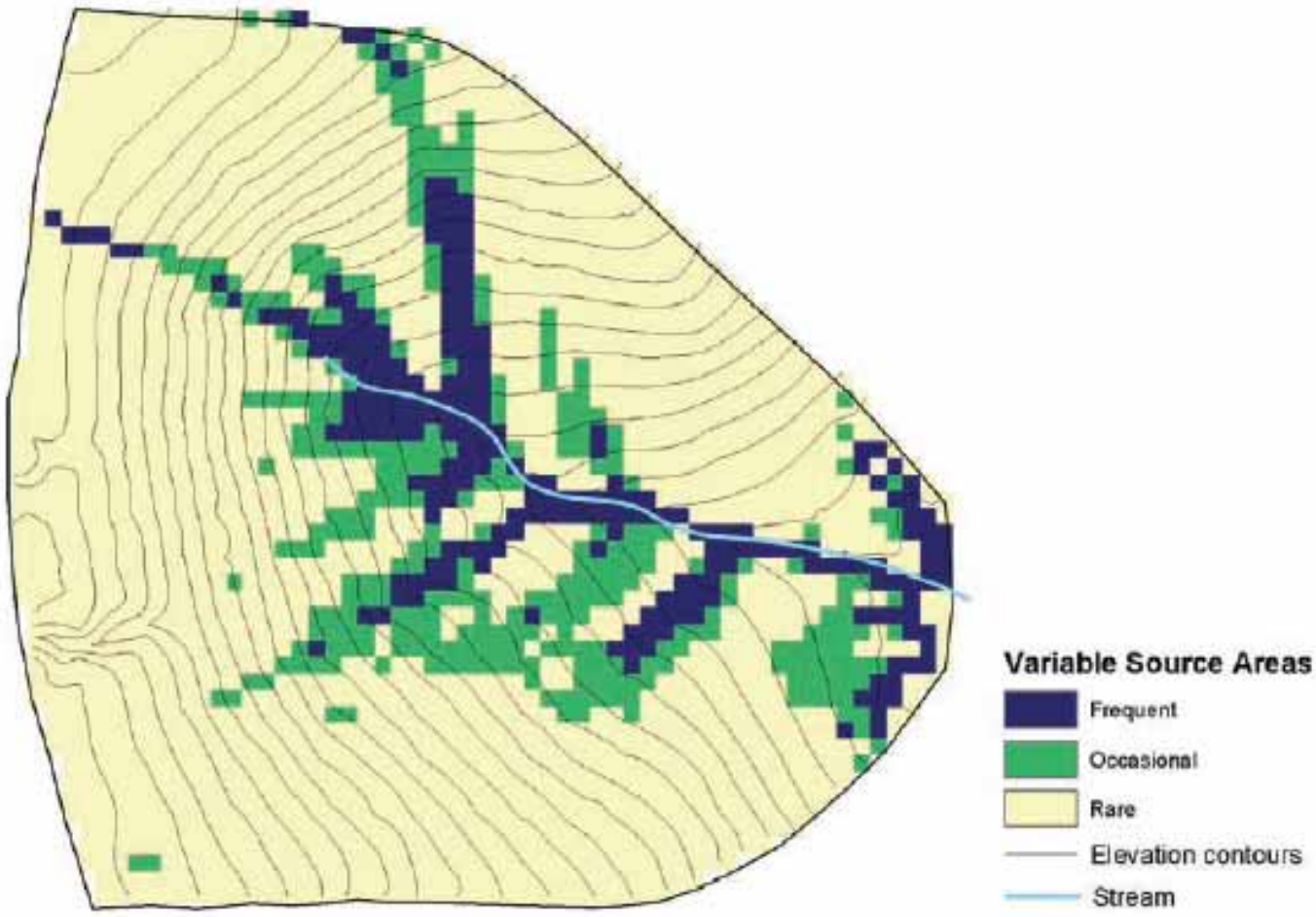


Figure 5. Example map of digital terrain modeling output highlighting variable source areas for runoff generation, where conservation measures would most be needed (Tomer, 2004).

What Scale or Complexity of Model is Appropriate

- Many complex watershed scale models
- Some more empirical models that evaluate potential for nutrient losses (e.g. P-Index)
- If models are used who is the user?
  - Full watershed scale models may limit the users
  - More empirical models could provide some of the necessary information without the level of complexity.

Comparison of Site Ranking with SWAT and P-Index

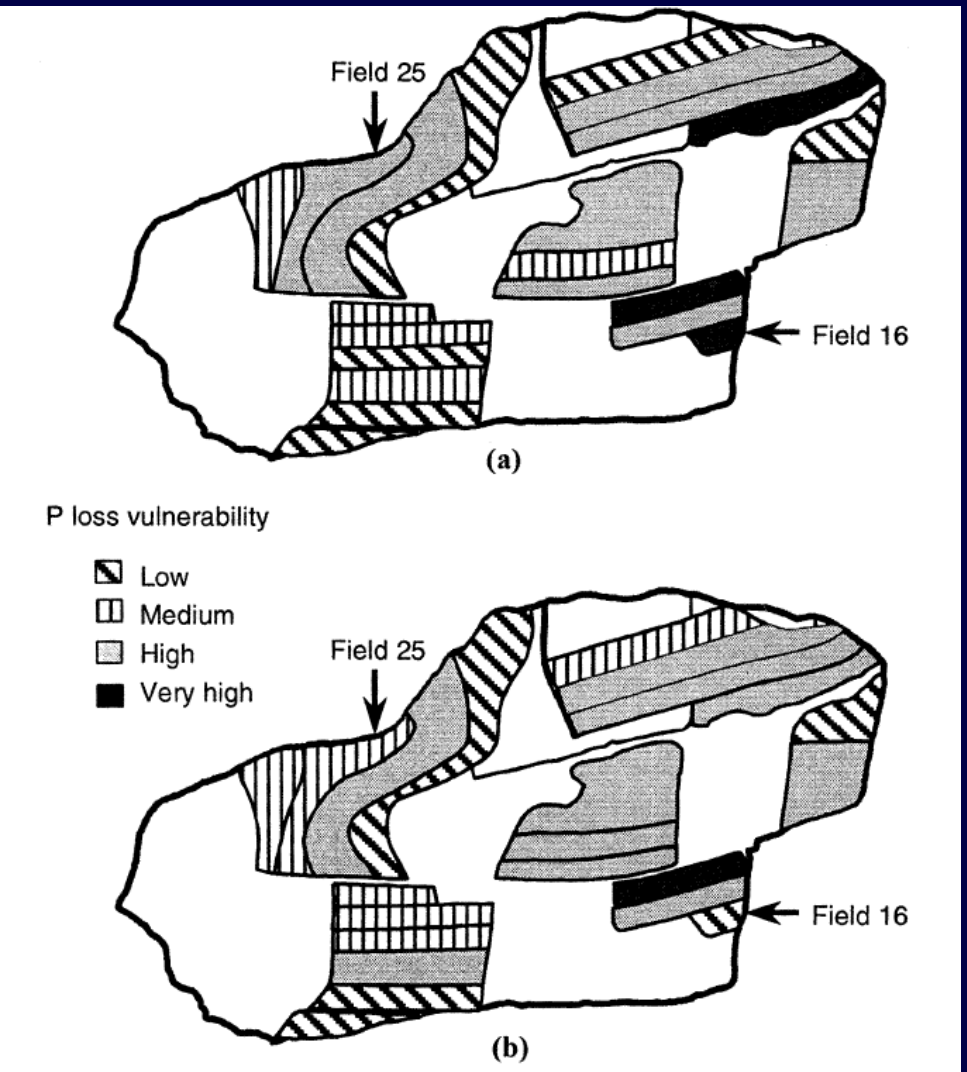


Figure 2. P Index and SWAT ratings for FD-36 reported on a field-by-field basis: (a) P Index ratings without the distance factor, and (b) SWAT ratings.

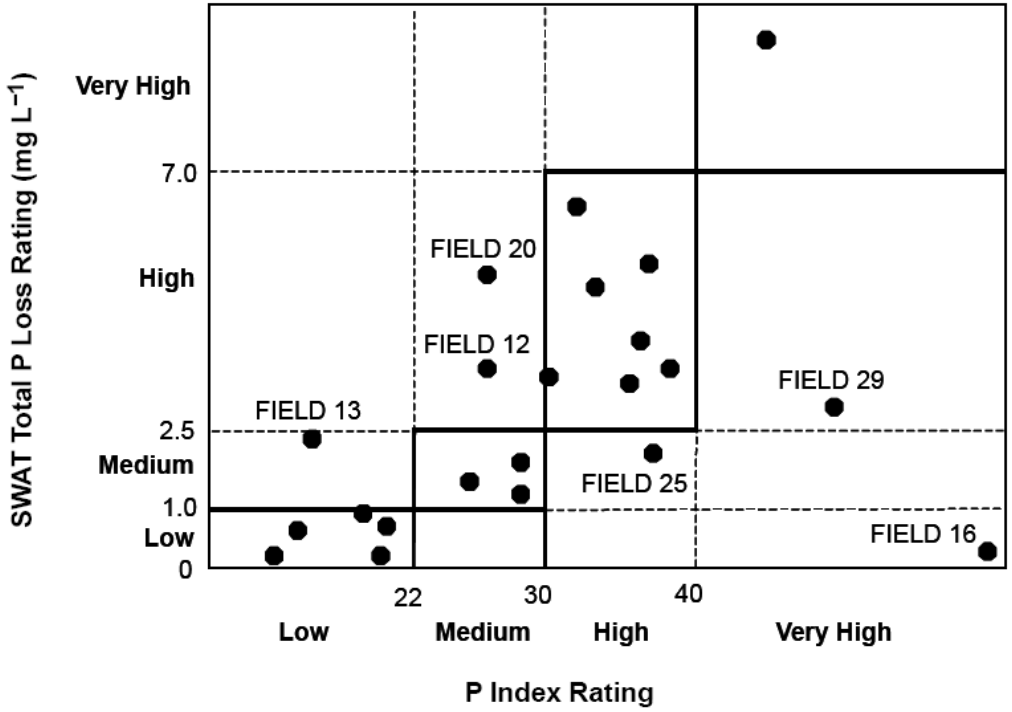


Figure 3. Correlation between P Index and SWAT vulnerability ratings.

Veith et al., 2005

Needs of Model

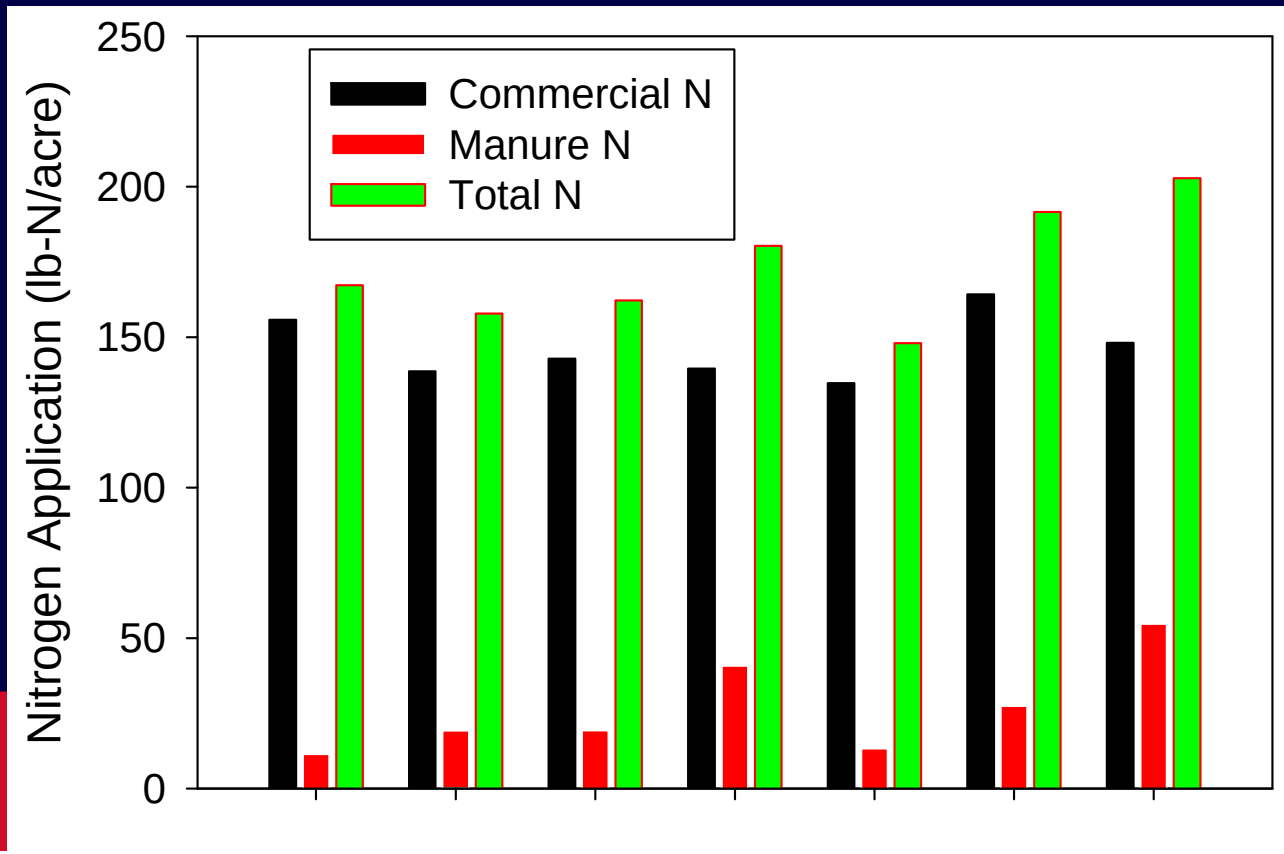
- Accurately reflect hydrology
- Reflect impacts of various field management scenarios and placement or targeting of these practices within field or watershed
- Account for risk of loss to stream – delivery to stream not just field loss
- Consider in-stream processes

Does Pollutant of Concern Impact Ability to Predict Watershed-Scale Response?

- In Upper Midwest significant portion of nitrogen inputs to the stream may have fairly defined source from the tile lines – reducing nitrate to some acceptable level from drains may be relatively quickly reflected in watershed N-levels
- Phosphorus source may be both field and in-stream which may greatly limit the ultimate impact of setting field acceptable levels

Do We Have Necessary Information to Model and Predict Performance?

- Maybe but need good input information on:
  - Landuse
  - NUTRIENT INPUTS
  - Topography



Possibilities for Model Use

- Various models have been used to development and implement TMDL's where modeling from various sources is necessary
- Models should be of use in modeling contributions from various fields in a watershed
- Models would be of use in identifying critical source area
- Can watershed models adequately account for the spatial location of practices?
  - To set or determine if acceptable levels are being met this may be necessary

Gaps, Concerns, and Opportunities

- For larger watersheds is it realistic to model all fields to set individual field level acceptable losses
- In-stream processes and sources of nutrients need to be accurately accounted for in modeling
- Pathways of water flow need to be accurately reflected since this greatly influences transport of nutrients. Need to know quantities and rates of
  - overland flow, tile flow, and groundwater flow

Gaps, Concerns, Needs, and Opportunities

- Ability to accurately simulate hydrology, specifically peak flows will be important since disproportionate amounts of nutrients may be transported during these events depending on form of nutrient
- Models should be used for the scale which they were developed
- Need for additional watershed studies where agricultural BMP's are implemented and nested monitoring is performed to evaluate performance of practices and monitoring at various scales

Question

- How confident would we be with the model without calibration?
- Is there a need for studies that evaluate model performance where “best estimates” for parameters are used and no calibration is performed?