Simulating Phosphorous Indices at the Farm Scale in Vermont

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Eutrophication of water-bodies is one of the most significant environmental impacts of agriculture. In freshwater bodies, phosphorus loading can cause eutrophication, which threatens native species, increases water-treatment requirements, and reduces recreation value. In the state of Vermont, Lake Champlain has been declared impaired by phosphorus pollution. In response, Environmental Protection Agency has drawn up load allocations to reduce phosphorus emissions to levels consistent with the health of the Lake and new regulations have been created for Vermont Farmers, including Vermont Act 64.

Nutrient Management Plans (NMPs) have become an increasingly important part of agricultural regulation. NMPs involves enumerate all inputs of the nutrients in question, as well as recording important farming operations that are known to have impacts on loss or retention of these nutrients. Nutrient-management plans are increasingly supplemented with empirical models of nutrient loss, which can be used to guide farm management choices or form the basis of regulatory policy or incentives, including nutrient cap-and-trade programs. The Vermont Phosphorus Index (VTPI) is now a required aspect of NMPs for many farms.

Watershed-scale eutrophication is usually modelled utilizing high-complexity process-based spatially-explicit models. Most often used is the Soil and Water Assessment Tool (SWAT). These tools have numerous advantages, but require an enormous number of data inputs, many of which may not be available. In this project, we build a spatially explicit implementation of the VTPI on top of high-resolution land-cover data as a flexible and simple platform for scenario analysis.

Utilizing the VTPI in this way has several advantages:

* Being far less computationally expensive than SWAT, it is easier to explore a wide range of management scenarios and perform calculations on extremely high-resolution land-cover data.
* Crop fields are analyzed as complete units, which are, rather than pixels, the units on which farm management decisions are made.
* The inputs of the model are required elements of legally-mandated NMPs, facilitating validation of field-scale practices through public records requests on NMPs.

**Desired Outcomes:**

This project will have several significant outcomes:

* Current estimates of P Loss from agricultural systems in the Champlain Valley.
* Explorations of “maximum BMP scenarios” as well as scenarios with more transformative changes in agricultural systems (changes in crop mix and animal numbers as well as land retirement.)
* A detailed uncertainty analysis to understand which elements of the VTPI are most influential in determining modelled P balance and thus may require further research.