A rapid approach for estimating the impact of legacy soil phosphorus in the Chesapeake Bay watershed

Peter Vadas
peter.vadas@ars.usda.gov

Nicole Fiorellino

Frank Coale

Bob Kratochvil

Alisha Mulkey

See next page for additional authors

Follow this and additional works at: https://scholarsarchive.byu.edu/iemssconference

vadas, peter; Fiorellino, Nicole; Coale, Frank; Kratochvil, Bob; Mulkey, Alisha; and McGrath, Josh, "A rapid approach for estimating the impact of legacy soil phosphorus in the Chesapeake Bay watershed" (2018). International Congress on Environmental Modelling and Software. 64. https://scholarsarchive.byu.edu/iemssconference/2018/Stream-F/64

This Oral Presentation (in session) is brought to you for free and open access by the Civil and Environmental Engineering at BYU ScholarsArchive. It has been accepted for inclusion in International Congress on Environmental Modelling and Software by an authorized administrator of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.
A Rapid Approach for Estimating the Impact of Legacy Soil Phosphorus in the Chesapeake Bay Watershed

Peter Vadas¹, Nicole Fiorellino², Frank Coale², Robert Kratochvil², Alisha Mulkey³, Josh McGrath⁴
¹USDA-ARS Dairy Forage Research Center, Madison, WI
²University of Maryland
³Maryland Department of Agriculture
⁴University of Kentucky

Abstract: The concept of chronically elevated, or legacy, soil phosphorus (P) and its impact on long-term water quality trends and goals has become an important scientific and policy topic as communities and regions continue to struggle with degraded water quality due to P inputs to water bodies from agricultural lands. We present an analysis for use of the APLE agricultural P loss model in the Chesapeake Bay watershed to estimate both the rate of soil P drawdown for state of Maryland soils and the impact of different soil P and erosion transport scenarios on statewide, edge-of-stream P loss from agricultural fields. Our results show that APLE can reliably estimate both soil P drawdown and related P loss. Because APLE is designed to be user friendly and requires a minimum of input data, it can be used to assess a variety of agricultural P management scenarios very rapidly and cost effectively. Output from APLE can thus provide near-term, realistic goals for both P management and policy development. In the specific context of the Maryland situation, APLE results suggest that a concerted effort to reduce Mehlich-3 P content in all agricultural soils across the state to optimum agronomic levels could reduce edge-of-stream P loss to the Chesapeake Bay by 40%. However, this P loss reduction would be achieved gradually over several decades, since soil P drawdown through crop uptake and harvest removal alone is a slow process, and there are currently no better ways to substantially reduce soil P than through crop uptake. Soil mixing through tillage can help dilute P accumulated in shallow surface layers into deeper layers, but could increase P transport in erosion in the year of tillage. The APLE results also suggest that combining soil P drawdown with soil conservation to reduce P transport though erosion could achieve a 62% reduction in state-level P loss in Maryland, given our assumptions for runoff and erosion rates and areal distributions. This 62% P loss reduction could be considered a maximum amount possible that is still compatible with modern, intensive agricultural production. In comparison, the USEPA total maximum daily load prescribed a goal for 12% reduction in P loss (732 to 655 Mg) from Maryland agricultural land to the Chesapeake Bay from 2009 to 2025 (http://www.chesapeakeprogress.com/clean-water/watershed-implementation-plans). There are many more possibilities for field management to reduce erosion compared to reducing soil P, but it is important that efforts to reduce particulate P transport with erosion do not increase dissolved P transport. Overall, APLE results suggest there is potential to substantially reduce P loss from Maryland agricultural lands, but it will require a concerted, long-term effort to reduce both legacy soil P in high P soils and P transport in runoff and erosion from all cropland.

Keywords: phosphorus, model, Chesapeake Bay