Water Sustainability and Climate
In the Yahara Watershed
UNIVERSITY OF WISCONSIN–MADISON



RESEARCH BRIEF

Are water quality policies hitting runoff hotspots? Maps reveal a disconnect

Summary

Mapping where soil erosion and nutrient reduction policies are applied on the landscape provides a holistic view of how multiple government efforts work together to improve lake water quality, enhancing decision making. Maps of Wisconsin's Yahara Watershed revealed a disconnect between where policies are applied and where major sources of phosphorus pollution are located.

Background

In the United States, all levels of government—federal, state, county, and municipal—apply erosion and nutrient runoff reduction policies to a landscape in myriad shapes and forms, including incentives (e.g. grants to implement reduction measures), regulations (e.g. land use restrictions), land acquisitions (e.g., establishing parks), and direct management practices (e.g., creating stormwater basins). This multilevel governance system has benefits, such as adaptability and more resources, but it can be difficult to get a clear picture of where and how progress is being made. This study examined Wisconsin's Yahara Watershed, an urbanizing agricultural region where most water quality policies target phosphorus runoff, to reveal where the policies overlap or stand alone and whether they are hitting areas of greatest concern to water quality, or phosphorus hotspots.

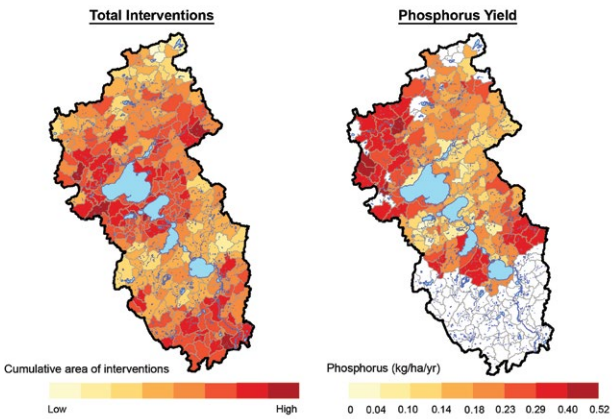
Research Design

The research team used ArcGIS to map publicly funded, land-based policy interventions to reduce nutrient (phosphorus and nitrogen) and sediment runoff to surface waters in the Yahara Watershed that were implemented between 2007 and 2012, totaling 35 policies. They compared the locations of interventions with total phosphorus yields for the year 2008 across 300 subwatersheds, as modeled by the widely used Soil and Water Assessment Tool (SWAT). Document analyses, meeting observations, and interviews with government officials and NGO representatives revealed barriers to spatially targeting phosphorus hotspots.

Findings

Targeting phosphorus hotspots

Although widely varied, the full palette of policies implemented in the watershed is missing some of the areas of greatest concern to surface water quality—there was a negative correlation between intervention coverage and phosphorus hotspots. Overall, urban areas—especially in and around Madison, the largest municipality in the watershed—contain the highest concentration of policies, indicating that urban areas receive more policy intervention. Yet, phosphorus hotspots are concentrated primarily in agricultural areas. This disconnect may be the result of implementation barriers and implies the need for a more integrated approach to targeting hotspots across the urban-rural gradient.



These maps compare policy applications (left) with phosphorus yields (right). Red indicates high numbers of policies and high amounts of phosphorus runoff, respectively; white indicates no data available. As an example of the disconnect between the number of policies applied and phosphorus hotspots, look to the Madison isthmus between the top two lakes (in blue).

Spatial configuration of policies

The spatial extent and location of the interventions varied by level of government and type of tool deployed. In terms of their rulemaking functions, state-created policies covered the largest percentage of the landscape. In terms of the implementation of those rules, county-led efforts covered the largest percentage, revealing the County's critical role in implementation. Regulatory tools encompassed far more area than incentives, acquisitions, and direct management.

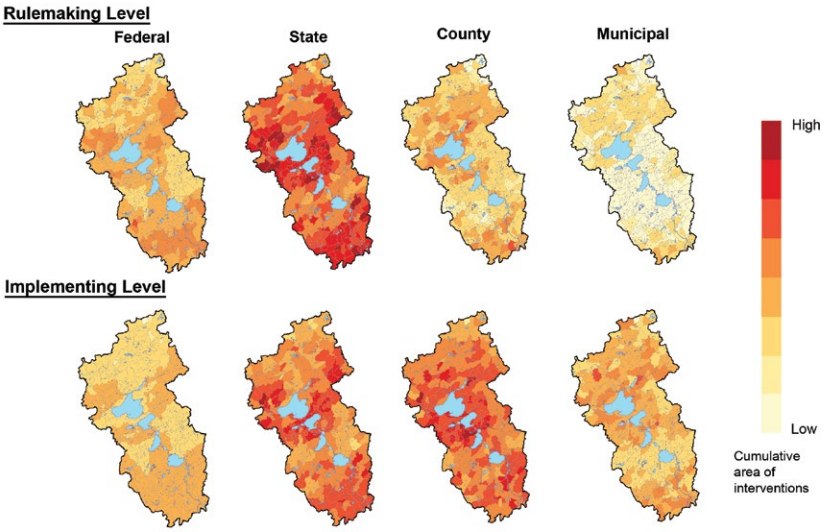
Barriers to spatial targeting for water quality protection

The team identified four major barriers to targeting phosphorus hotspots. First, there is insufficient farmer participation in incentive programs to reduce nutrient runoff, which is related to the programs' voluntary nature. Second, funding constraints and programmatic structure, such as the limited funding available through Clean Water Act grants and the need to rapidly recruit land owners to participate in new programs, can constrain targeting and participation in policies. Third, incomplete or inaccessible data on soil phosphorus, farm management, nutrient reduction outcomes, and costs inhibit the capacity to target hotspots. Finally, there is tension between funding equity and efficiency; pressure to equally allocate funding to land owners to implement best management practices can conflict with the efficiency goal of targeting funding at phosphorus hotspots.

Implications

Understanding where nutrient and sediment reduction efforts exist on a landscape is a first step to figuring out how to improve these efforts. Spatial targeting can help improve the efficiency of these efforts and the money spent on them. This study's findings indicate a disconnect between where policies are applied in the Yahara Watershed and where the major sources of phosphorus pollution, or hotspots, are located. This does not mean existing policies are ineffective at reducing nutrient and sediment runoff. Instead, it reveals policies are missing some of the areas of greatest concern to surface water quality.

In overcoming barriers to hitting phosphorus hotspots, the type of policy tool matters, as each produces different results and is appropriate for different areas. Program rules should better enable and encourage targeting, such as lengthening grant cycles to allow agency staff more time to build relationships with land managers and, thus, increase participation. Moreover, improving access to data and intergovernmental coordination could improve hotspot targeting at the landscape level.



These maps show the total percent area of interventions at the rulemaking and implementation levels across the Yahara Watershed, divided into 300 subwatersheds. The darker the subwatershed, the higher occurrence of interventions.

Source

Wardropper, Chloe B., Chaoyi Chang, Adena R. Rissman. "Fragmented water quality governance: Constraints to spatial targeting for nutrient reduction in a Midwestern USA watershed." *Landscape and Urban Planning* 137 (2015): 64-75. doi: 10.1016/j.landurbplan.2014.12.011.

Research sponsor

This material is based upon work supported by the National Science Foundation under grant DEB-1038759. Any opinions, findings, conclusions, or recommendations expressed in the material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Water Sustainability and Climate Project

The Water Sustainability and Climate Project (WSC) at the University of Wisconsin-Madison is an integrated effort to understand how water and the many other benefits people derive from nature could change over time. The five-year project (2011–2016) is focused on the Yahara Watershed in southern Wisconsin and funded by the National Science Foundation. Visit wsc.limnology.wisc.edu.

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