Evaluating the effects of the Renewable Fuel Standard on Water Quality: An Integrated Ecosystem-Economic Assessment

Kelsie Ferin[1*] (kmferin@iastate.edu), Sarah Acquah,[2] Jia Zhong,[2] Madhu Khanna,[2] and **Andy VanLoocke[1]**.

[1]Iowa State University, Ames, IA; [2]University of Illinois, Urbana, Ill.

https://cabbi.bio/research/sustainability-theme/

Project Goals: This research aims to assess the impact of Renewable Fuel Standard (RFS) on water quality improvement in the Mississippi River Basin and Gulf of Mexico Hypoxic Zone, above-ground and soil carbon sequestration and GHG emission benefits, and spatial differences in the observed co-benefits.

Increased demand for biofuel production motivated by the Renewable Fuel Standard (RFS) has increased the area of land under corn production to meet the 15 BG corn ethanol mandate. A major consequence of expanded corn-based ethanol production has been intensification of nitrogen application on cropland and worsening of the Gulf of Mexico hypoxia (GMH) problem. Diversifying cropland to produce perennial crops such as Miscanthus and Switchgrass has the potential to reduce nutrient run-off from cropland. However, the extent of these benefits will depend on where energy crops are produced, the type of land allocated to energy crop production and the mix of crops and bioenergy feedstocks across the rainfed region of the US. We used a combination of economic (BEPAM) and ecosystem models (Agro-IBIS and THMB) to quantify the benefits of these mixes under three scenarios based on the RFS policy that represents the next two decades: No-Policy, RFS – corn ethanol only (RFSco), and RFS – corn and cellulosic ethanol (RFScc). BEPAM simulations were used to determine the mix of crop production and management that would meet biofuel mandate production targets at minimal cost and maximal total economic benefit. The water quality simulations were evaluated using observations from the USGS stream monitoring database. The amount of land allocated to annual row crops and fertilizer application increases in the RFSco and RFScc relative to the No-Policy scenario. Total nitrogen delivered to the Gulf of Mexico increased by 6.4% under the RFSco and was reduced by 3.6% under the RFScc, compared to the No-Policy. Our findings indicate that implementing cellulosic bioenergy production under current economic policy scenarios could reduce GMH, however simulated nitrogen export surpassed GMH targets even in the RFScc. This suggests that for future renewable fuel policies to meet GMH targets, they will likely require more targeted changes to land use and crop management that are linked to water quality improvements and costs of nutrient reduction.

This work was funded by the DOE Center for Advanced Bioenergy and Bioproducts Innovation (U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research under Award Number DE-SC0018420). Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the U.S. Department of Energy.