**Pollution trading and water quality on the Eastern Seaboard of the US**

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Maintaining water quality is a significant challenge in Food-Energy-Water nexus across much of the United States. While food production requires fertilizer and manure application, these nutrients can enter and contaminate water through direct application, surface and subsurface runoff, and atmospheric deposition. Heavy rainfall and flooding are primary drivers of intensified nutrient runoff from agricultural land leading to water pollution. An excellent example was the doubled hypoxic zone after the flooded Mississippi poured a huge amount of nutrient-rich runoff from farm lands into the Gulf in 1993, whereas in 1988, the year of a great drought in Midwest, the ‘dead zone’ was almost absent. Excessive concentrations of nutrients in coastal oceans leads to hypoxic zones and result in loss of biodiversity and habitat degradation. Here, we propose a framework that integrates weather, agriculture, urban, and water components to identify sustainability solutions for local to regional water quality problems through a global-local-global framework. Considering the trade-off between food production and water quality, we seek to identify alternative resource allocations that might improve water quality with minimum cost to the food system, which may include improvement to urban N management.

* The costs of mitigation vary greatly by polluting sector and activity so there are potential gains from trading pollution permits. Pollution markets (via water quality trading) allows the low-cost agricultural agents to sell their permits for nutrient discharge to municipal utilities and other non-farm point sources by reducing nitrogen leaching.
* EPA has recently called for increased pollution trading as part of its enhanced support for the Gulf Hypoxia Task Force.
* Wetlands can play a key role in mitigating nutrient runoff, but development of wetlands has been limited to date. We model the decision to allocate land to cropland, pastureland, and wetlands considering economic motives.
* Urban storm water, suburban N fertilizer reductions, septic N vs. wastewater treatment plant (WWTP) N management and upgrades could all be part of the trading program
* We model the benefits and costs of reducing nitrogen fertilizer in terms of revenues from water quality permits, as well as yield penalties resulting from reduced cropland area and reduced nitrogen application rates.
* We integrate SIMPLE-G and Agro-IBIS modeling frameworks within fine-scale agricultural production units. The SIMPLE-G model provides the connection from national food markets to local agricultural producers and determines the land, water, and fertilizer uses at each grid-cell. The Agro-IBIS model provides the yield responses and the resulting impact on nutrient leaching.
* By extending SIMPLE-G to include pasture land, while also integrating sources of pollution associated with human population, we will enhance its relevance for watersheds along the Eastern Seaboard, including the Chesapeake Bay watershed.