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The Potential Role for Nitrogen Compliance in Mitigating Gulf Hypoxia

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Introduction

Each summer a large hypoxic zone forms in the Gulf of Mexico. This hypoxic zone, where dissolved oxygen is too low for many aquatic species to survive, is fueled by nutrient (nitrogen and phosphorus) runoff from the Mississippi/Atchafalaya River Basin (MARB). Agriculture is a major source of nutrients discharged into the Gulf, making policies for reducing the loss of nutrients from cropland an important component for any strategy for reducing the size of the hypoxic zone.

Compliance is a tool to encourage farmers to adopt conservation practices. Compliance requires farmers to meet some minimum standards of environmental protection on environmentally sensitive land as a condition for eligibility for many Federal farm program benefits. Under current compliance requirements, farm program eligibility could be denied to producers who:

- Fail to implement and maintain an NRCS-approved soil conservation system on highly erodible land (HEL) ;
- Convert HEL grasslands to crop production without applying an approved soil conservation system;
- Convert a wetland to crop production.

If the program benefits subject to forfeiture are much higher than the cost of implementing conservation practices, then farmers are likely to remain in the programs and adopt the required conservation measures. To address environmental problems associated with nutrient runoff, it might be possible to extend the compliance provisions to include nutrient management.






Objective

We assess the potential effectiveness of a nutrient compliance policy on nitrogen applications in the MARB. We consider two key questions:

- To what extent do crop producers who have the greatest potential for reducing nitrogen emissions also participate in farm programs?
- Are government payments to these producers large enough such that their potential forfeiture would encourage broad adoption of practices that improve nitrogen use efficiency and reduce nitrogen emissions?

Methodology

We assess excess nitrogen applications at the farm level in the MARB with data from the 2012 Census of Agriculture. Procedures developed by NRCS were used to take Census data on crop yields and livestock production to estimate plant nutrient uptake and manure nutrient production (Kellogg et al. 2000). Fertilizer nutrients applied on farm were estimated using farm-level fertilizer expenditures and crop production. Combining estimates of nutrient applications and nutrient uptake we generate per-acre “excess” nitrogen applications of commercial fertilizer and manure, where excess is defined as rates greater than plant uptake. We assigned each farm to one of 5 excess application categories:

-  0 lbs/acre;
-  >0 and <20 lbs/acre;
-  >=20 and <50 lbs/acre;
-  >=50 lbs/acre and <100 lbs/acre;
-  >= 100 lbs/acre.

Farm-level data on program benefits were obtained from the 2012 Census of Agriculture. Benefits subject to compliance in 2012 include Direct Payments, Counter-Cyclical payments, ACRE payments, conservation payments, loan payments, and disaster payments. The 2014 Farm Bill deleted and added programs that affected benefits subject to compliance. After 2014, benefits subject to compliance include conservation payments, loan payments, disaster payments, Price Loss Coverage (PLC), Agricultural Risk Coverage (ARC), and crop insurance subsidies. Since PLC and ARC were not available in 2012 our “current” scenario does not include them. Whether the changes made in 2014 increased or decreased benefits subject to compliance is still unclear.

We assume that a nutrient compliance policy would require the adoption of a nutrient management plan (NMP) consistent with the NRCS practice standard: :

- All commercial fertilizer is applied 14 days prior to planting, except for acres susceptible to leaching loss.
- For acres susceptible to leaching, nitrogen is applied in split applications.
- Manure applications during winter months are moved to the spring.
- All fertilizer and manure is incorporated or injected.
- All nitrogen application rates for all crops except cotton and small grains are limited to 1.2 times the crop removal rate. For small grains, nitrogen applications are limited to 1.5 times the crop removal rate. For cotton, nitrogen applications are limited to 50 pounds per bale.
- Phosphorus application rates are adjusted to be equal to 1.1 times the amount removed in the crop at harvest.

Nutrient management costs include implementation costs and costs associated with changes in crop yields from reduced nutrient applications net of savings from reduced commercial fertilizer purchases. The per-acre cost of implementing a NMP was estimated at the watershed scale (4-digit HUC) with a sample of field-level survey data and field-level modeling from the NRCS Conservation Effects Assessment Project (CEAP). Estimated yield changes from adopting NMP were obtained from CEAP and were valued with 2012 price data from NASS. Fertilizer cost savings were estimated with the CEAP data and valued with 2012 N and P prices based on the prices of anhydrous ammonia and diammonium phosphate.

Results and Discussion

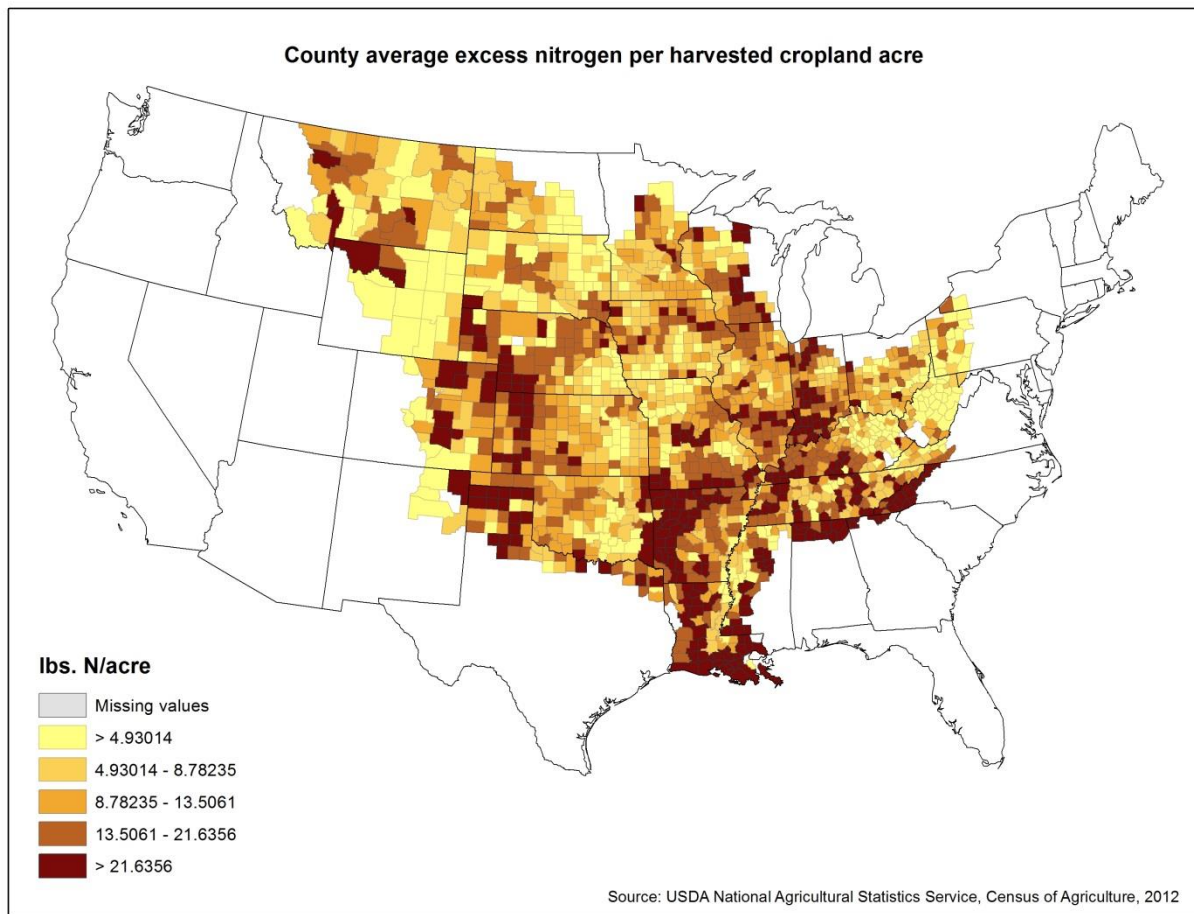


Figure 1. High levels of excess applications occur in all regions

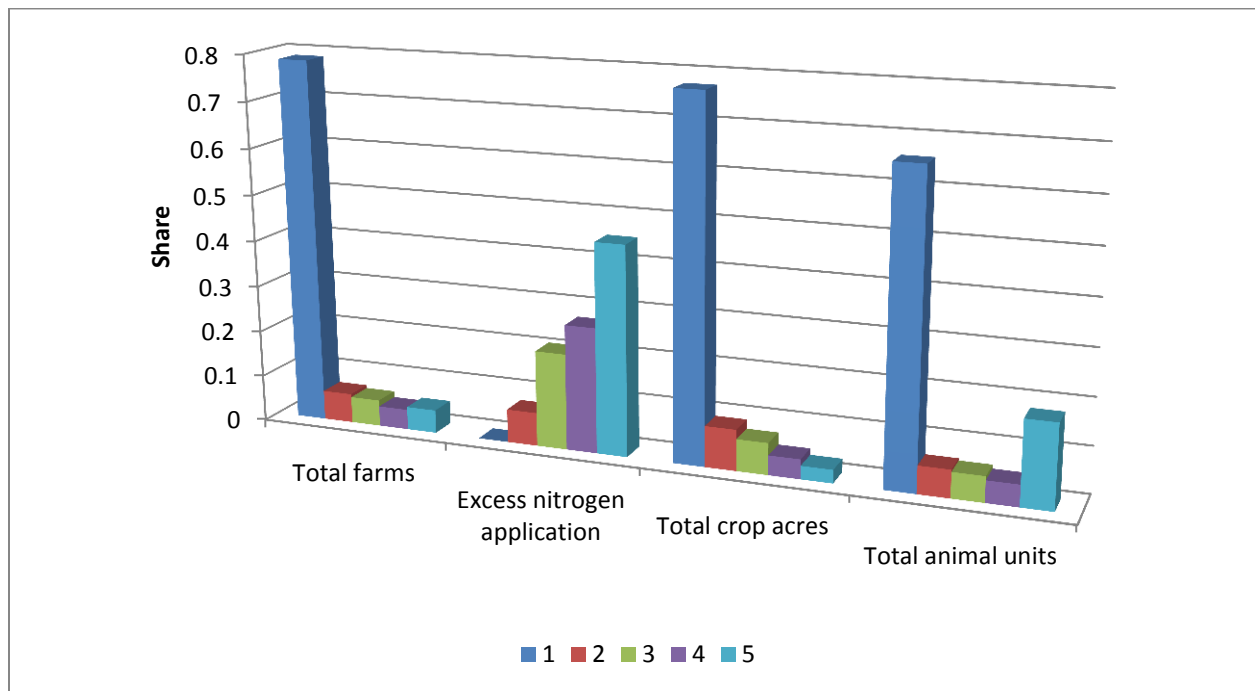


Figure 2. Farms in the highest excess application categories make up a small percentage of all farms, yet they produce the most excess applications and a disproportionate share of animal production.

The majority of farms have relatively low levels of excess nitrogen applications. Less than 10 % of farms are in the highest two categories of excess applications, and operate on only about 7% of cropland, but they contribute 72 % of all excess nitrogen applications and sell 23 % of animal units. Animal operations tend to have excess applications of manure nutrients.

Farms in the highest excess application category receive the highest amount of program benefits, on a per-acre of cropland basis, by a wide margin. Program changes brought about by the 2014 Farm Bill did not have a major impact on the total amount of benefits received by any of the five categories. Program benefits were between a quarter and a third of the total value of production, on average, across all farms. This seems a significant amount of income that should make farmers who receive benefits seriously consider nutrient management practices if they became a condition for receiving benefits.

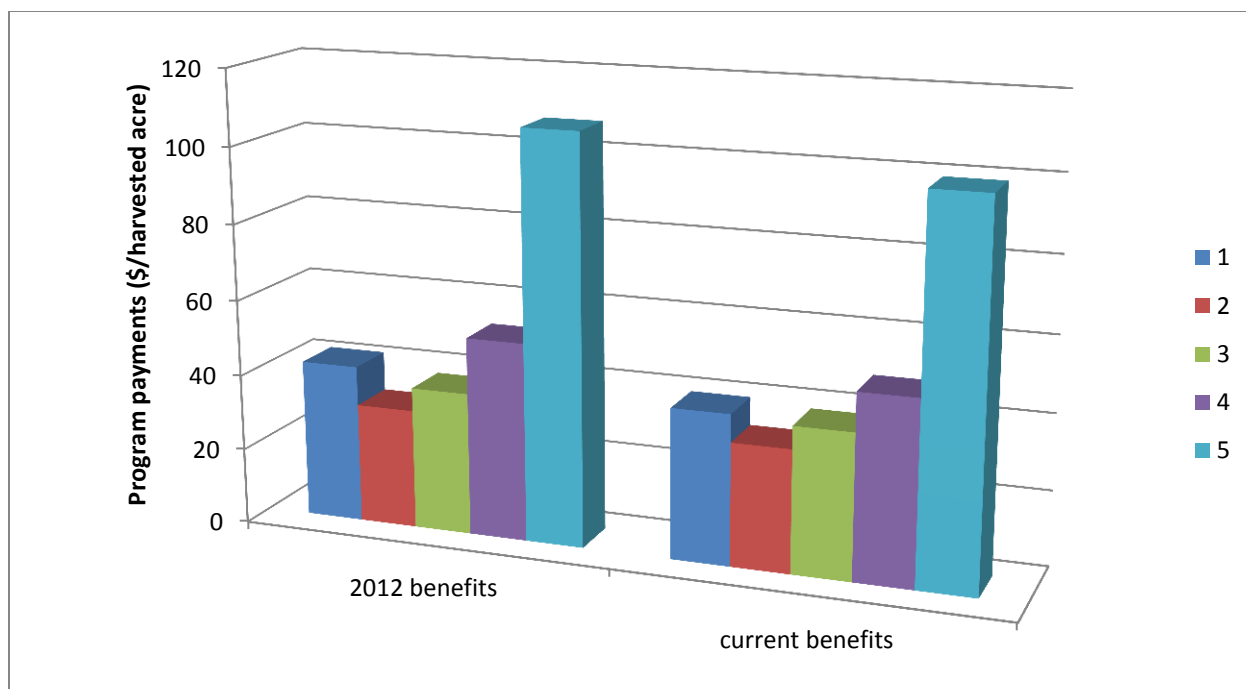


Figure 3. Farms with the most excess applications receive the most program benefits on a per-acre basis.

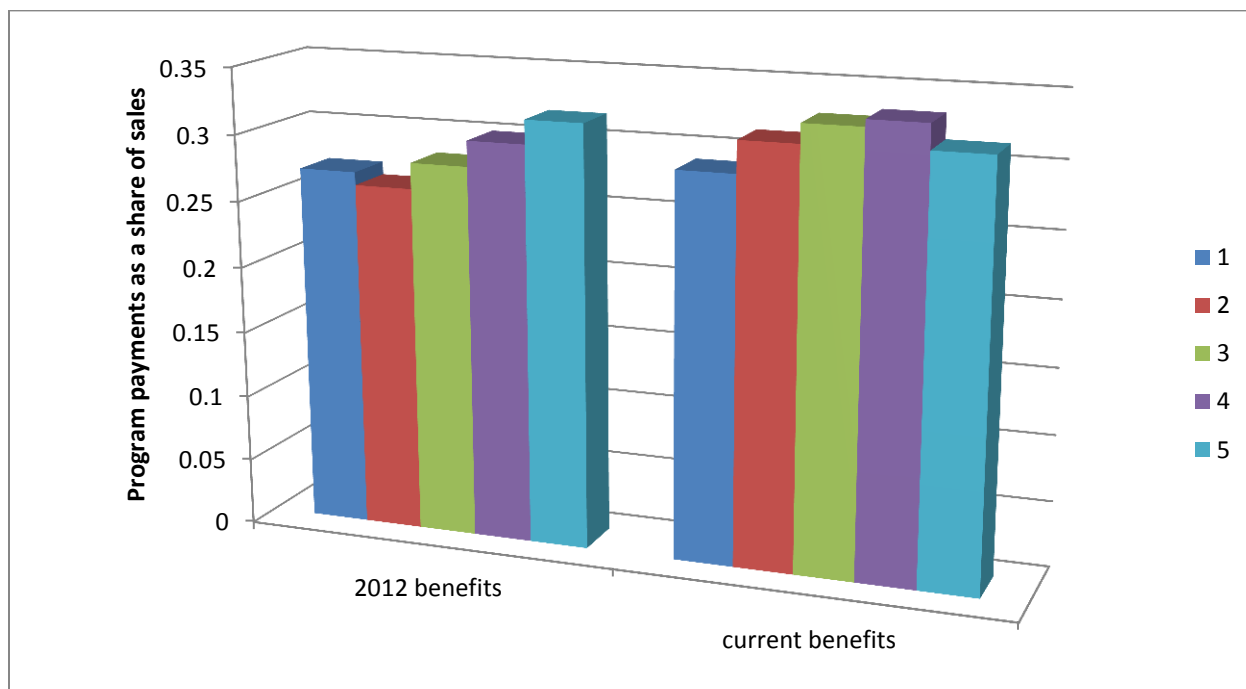


Figure 4. The importance of program benefits to farm finances did not vary much between excess application categories.

When costs are considered, nutrient compliance would provide the greatest incentive to farms that also produce the most excess nutrients. For the first three categories, the costs of adopting a NMP are greater than the program benefits received.

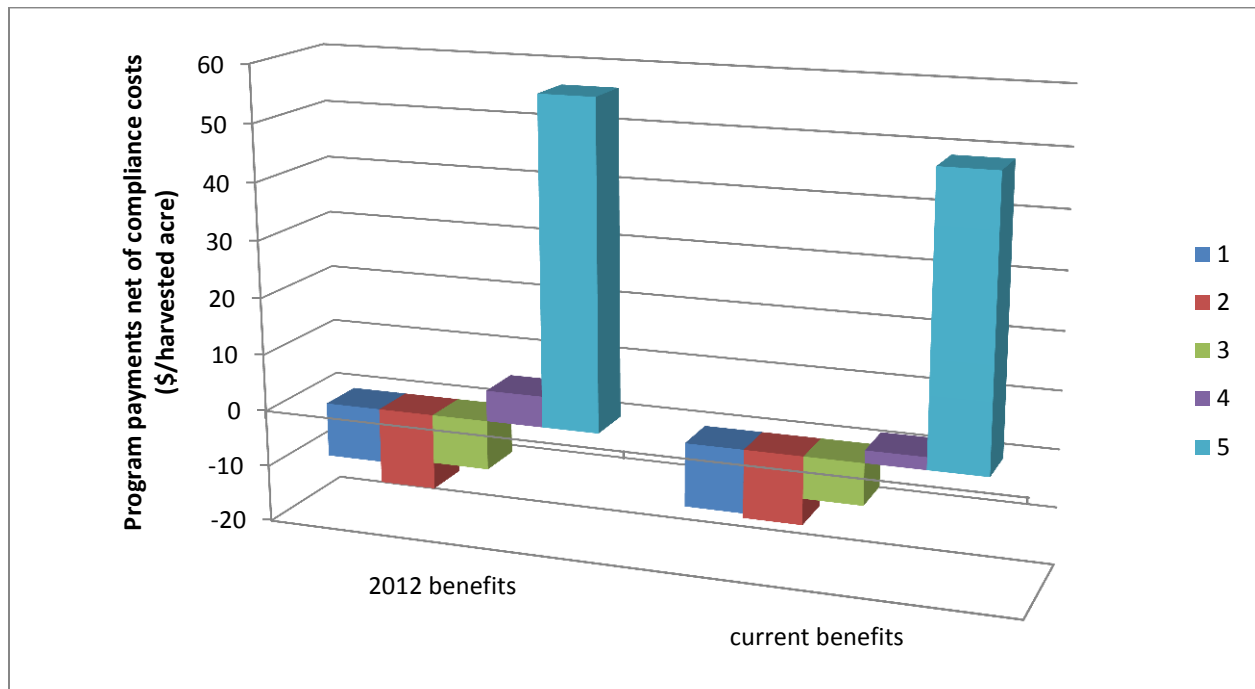


Figure 5. Nutrient compliance would provide the strongest incentive to those farms with the highest rates of excess fertilizer applications.

Implications

Making nutrient management a condition for receiving USDA program benefits such as conservation payments, loans, crop insurance subsidies or disaster payments would provide the greatest incentive to those farms that generate the most excess nutrient applications. Nutrient compliance could therefore become an important addition to the set of policy tools that might be used to address hypoxia in the Gulf of Mexico. A potential weakness of compliance policies is that its strength is subject to changes in programs and budgets. In our example, changes made to USDA commodity programs and compliance provisions in the 2014 Farm bill did not greatly affect our estimate of the potential strength of compliance, based on 2012 data, even without including the two new commodity programs.

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