COVER CROP ADOPTION COST
HETEROGENEITY AND POLICY DESIGN IN DELAWARE’S PART OF THE CHESAPEAKE BAY
University of Delaware Water Resource Center
Undergraduate Internship Program 2014-2015

BRIEF ABSTRACT
A cover crop cost effectiveness analysis was performed for corn production fields in Delaware to generate knowledge about how abatement-procurement cost for nitrogen and phosphorous varies between modeled emissions and current incentive payments. The results indicate that the variation in per-acre subsidy payments does not match heterogeneity in modeled nutrient reduction, expressed in pounds.

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Abstract - Cover crops are thought to be a cost effective nutrient management practice that include environmental and on-farm benefits. The former may reduce nitrate leaching to surface waters as much as between 45-90%, depending on agronomic factors (Snapp et al., 2005; DNREC WIP Phase II), while the latter includes a potential increase in cash crop yield, a reduction in nutrient loss, an increase in soil biomass and organic carbon content, and improved water infiltration and holding properties (Fageria et al., 2005; Singer at al., 2006; Snapp et al., 2005; Wilke and Snapp, 2008).

In response to the Chesapeake Bay TMDL, the Delaware WIP Phase II seeks 92,000 acres of traditional and non-commodity cover crops within its Chesapeake Bay drainage by 2025. Delaware’s cover crop program currently has approximately 18,000-23,000 acres in cover crop and subsidies of flat per acre fees ($30-$50) based on when the cover crop is planted (Kent and Sussex County Conservation District fact sheet).

Incentive payment flexibility provisions are a promising strategy for greater adoption. Maryland has intensively focused on building a cohesive statewide cover crop program using dedicated funding. In recent years at least $18 million per year has been spent to pay farmers for planting over 400,000 cover crop acres. Maryland’s program has a matrix of flexibility options for farmers to choose from with corresponding per-acre payments for non-harvested cover crops that range from $45-$100. Flexible payments are designed to target practices that reduce nutrients to waterways such as early planting, using cover crops in fields where manure was spread, and planting rye (MDA Cover Crop fact sheet).

This research focused on increasing cost effectiveness in cover crop procurement by using Maryland’s cover crop program payment flexibility in Delaware. The integrated analysis utilized Maryland’s Nutrient Trading Tool (NTT) which simulated nutrient load reductions of twelve cover crop treatment options on 144 randomly selected Delaware cornfields. This was to be compared to cover crop treatment options, which have six corresponding per-acre subsidy payments. The project goals were to first estimate the heterogeneity in cover crop treatment reductions in pounds of nitrogen and phosphorous. The second goal was to determine if the mean reductions per treatment were equal. The third goal was to impute the cost per pound reduced based on the variable payment structure. This step involved utilizing the scientific efficiency removal for the cover crop treatments by assigning a percentage to each dollar spent for nitrogen and phosphorous.

Results show highly heterogeneous reductions ranging from 0.14 to 12.16 (lbs/ac) for nitrogen and 0.01 to 41.91 (lbs/ac) for phosphorous based on field and cover crop treatment, as hypothesized. What is unexpected is that late planting, which currently receives lower payments than early and standard planting reduces as much as, if not more than, early and standard planting. The per-acre payments, when converted to per-pound payments for nitrogen and phosphorous, also, as hypothesized, are highly heterogeneous with large ranges. Nitrogen payment ranges from $2.34 per pound for early no-till/drill wheat up to $485.87 for standard no-till/drill rye. Phosphorous payments exhibit the greatest heterogeneity of payment from zero (because there is no scientific efficiency applied to late planting) to $1,091.69.

Conclusions are that the cover crop payment structure, although attempting to pay for the greatest environmental benefit per acre, does not match the heterogeneity in modeled nutrient reduction (on the average) that the individual fields are expected to produce. The current incentive structure for cover crop payment on a per acre basis assumes the acres deliver similar reductions. Thus, there is incongruence between predicted load reductions and current payments.

In this research, heterogeneity in reduction was modeled using the NutrientNet interface. The current payment per acre structure does not match the dollar per pound reduction paid for the nutrient removal. This is also important to consider as nutrient credit trading is proposed for payment on a per pound basis. Payments made for nitrogen and phosphorus, whether made by government or private entities, should display similar prices per pound. The heterogeneity indicates that the current per acre payment for cover crops is unlikely to be cost effective.
Figure 1: Nitrogen pounds reduced per acre.

This graph shows heterogeneity in the cover crop treatments for reducing nitrogen. For the planting date variable, early planting has the greatest reductions, followed by late, and then standard. This is notable as Maryland’s payment program pays more per acre for standard than it does late. For seed type, rye reduces more than wheat, with planting date held constant. Furthermore, no-till/drill tends to reduce more and has a greater reduction range than conservation-till/drill, with planting date held constant.

Notes:
1) Planting dates
   Early September 5
   Standard October 15
   Late November 1
2) Conservation till indicates <30% residue on field, no-till indicates >30% residue. These are two tillage options in NutrientNet. In the figures, drill is conservation till and Nt-d indicates no-till drill.
3) All fields were assigned drill seed method, other planting method options (broadcast and aerial) resulted in the same reductions as drill planting method in NutrientNet.
4) Agronomic variables such as P205 soil phosphorous concentration (ppm) and manure concentration were randomly assigned to the fields within a range of values based on previous data collection. Three levels were selected from the ranges to randomly assign to the 144 fields, therefore each field was assigned one of nine combinations.
5) Reductions for nitrogen and phosphorous based on simulation through Maryland’s Nutrient trading Tool for 144 randomly selected corn fields in Delaware.
Figure 2: Phosphorus pounds reduced per acre.

Similar to Figure 1, this graph reflects heterogeneity in the cover crop treatments for reducing phosphorus. For planting date, there is low heterogeneity between the planting dates for conservation-till/drill fields, but reductions still followed the pattern of early showing the greatest reductions and standard showing the least reductions. No-till/drill crops showed much greater reductions (ten fold) at reducing phosphorus than conservation-till/drill. Furthermore, rye seed choice shows greater reductions than wheat seed choice.

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5) Reductions for nitrogen and phosphorous based on simulation through Maryland’s Nutrient trading Tool for 144 randomly selected corn fields in Delaware.
Figure 3: Dollars paid per nitrogen pound reduced (adjusted for scientific efficiency of removal for treatment types).

Data reflect large variation in payment per pound of nitrogen based on planting times, tillage type, and seed choice (cover crop treatment variables).

Notes:
1) The cover crop treatments have six payment levels based on Maryland’s cover crop payment schedule.
2) The per pound reductions in figure 1 and figure 2 were multiplied by the total acres paid according to the payment schedule for that crop treatment.
3) Nitrogen and phosphorous payments were split based on the scientific efficiency of removal assigned to cover crop treatments.
Figure 4: Dollars paid per phosphorus pound reduced (adjusted for scientific efficiency of removal for treatment types).

Data reflect large variation in payment per pound of phosphorous based on planting times, tillage type, and seed choice (cover crop treatment variables).

Notes:
1) The cover crop treatments have six payment levels based on Maryland’s cover crop payment schedule.
2) The per pound reductions in figure 1 and figure 2 were multiplied by the total acres paid according to the payment schedule for that crop treatment.
3) Nitrogen and phosphorous payments were split based on the scientific efficiency of removal assigned to cover crop treatments.
4) Phosphorous efficiency of removal for late plantings is assigned a “zero” efficiency of removal therefore in the late planting scenario, all payment would be assigned to nitrogen.