
René Roy, Laurie Baker, and Paul J. Thomassin
Department Agricultural Economics, McGill University, Montreal Quebec

Introduction
Several studies have concluded that command-and-control policies to reduce water pollution are not as economically efficient when compared to market instruments (Olmstead, 2010). This research goes further by analyzing the income distribution from a reduction of pollution emission under different scenarios. This study simulates command-and-control regulations by using environmental targets set at the individual producer level and market instruments with environmental targets set at the watershed level.

Objectives
- To compare the net farm income under various institutional arrangements to determine the best policy for reducing the emission of non-point source pollution from agriculture.
- To study the net farm income distribution among different types of agricultural producers.
- To help explain how a certain policy can influence the long term prosperity of farms and their geographical dispersion.

Method
The study uses an integrated economic-hydrologic model to investigate the reduction in net farm income that would result from setting an environmental policy that constrains the amount of pollution emissions from farms. Each farm activity and abatement strategy has an environmental coefficient derived from the GIBSI model (Rousseau et al., 2000) and incorporated into a Mixed Integer Linear Programming (MILP) model. The MILP model’s objective maximizes net farm income subject to environmental and production constraints.

Fig. 1: Optimization framework used in the modelling exercise.

Results
- Aggregate results mask the distributional impacts of changes in the location of crops within the watershed. Figures 4 and 5 show how the cropping patterns vary with the reduction in pollution emission levels.
- There is an impact on the location of agricultural activities in the watershed when there is high heterogeneity in the topography and soil type: Figure 5 shows how crop patterns change with different levels of emission reductions. This means that some producers are affected more by a change in pollution emission reduction than others. Thus, the choice of policy can affect the concentration and location of production.

Fig. 3: Reductions in Net Farm Income due to emission reductions when the constraints were set at the watershed level (MI) and the producer level (C&C) for sediment and E Coli.

Fig. 4: Crop adoption by producers under various sediment emission reductions.

Fig. 5: Distribution of crops in the watershed under various sediment emission reductions (% reduction from the current situation).

Conclusion
The results indicate that market instruments are more efficient than command-and-control measures to reduce environmental pollution. Several distributional measures were evaluated with no noticeable differences except for the cropping patterns adopted in the watershed. This result implies that policies can foster the concentration and location of production in the watershed.

Literature cited

For further information
Please contact Paul Thomassin at paul.thomassin@mcmill.ca or René Roy at rene.roy@mail.mcgill.ca