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Economic Impacts and Environmental Tradeoffs of Low-input Agriculture in Eastern Virginia

Daniel B. Taylor

Economics is the science of tradeoffs.
--John Ikerd, University of Missouri

Any businessperson faces a day-to-day reality of making many decisions about short- and long-term costs and benefits. In the particular business of farming, the costs and benefits to be evaluated are no longer matters only of production and finances; farm economic choices are now inseparable from the environmental impacts of these choices. As a result, farmers and farm interests face the complicated challenge of managing environmental impacts while maintaining a viable farm economy.

Making this challenge even more difficult is that activities designed for one type of resource protection may result in a different resource problem. For example, practices to reduce the surface runoff of agricultural chemicals may result in greater soil infiltration and potential groundwater contamination. Farmers therefore face choices involving costs and benefits both *between* economics and resource protection and *among* various environmental concerns.

Water-resource impacts are among the most important environmental effects of agriculture. Throughout the United States, agricultural activities contribute significantly to nonpoint source (NPS) pollution of surface and groundwater resources by soil, fertilizers, and pesticides. In Virginia, agricultural NPS pollution is a major contributor to water-quality problems in the Chesapeake Bay, a resource of great importance to commercial fisherman, scientists, recreation-seekers, and many other Virginians.

Dan Taylor is an Associate Professor in the Department of Agricultural Economics at Virginia Tech.

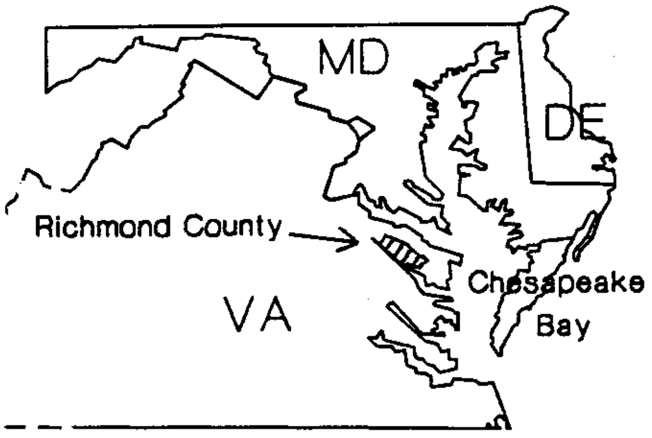
To explore the tradeoffs of managing agricultural NPS water pollution, the author joined with Penny Diebel and Sandra Batie in conducting a study of the economic and environmental effects of low-input agriculture (LIA). LIA is a farming system in which the use of petroleum-based inputs is reduced relative to conventional agriculture. LIA offers farmers a set of farming practices that can potentially decrease the environmental impacts of agriculture.

Because of the impacts of agriculture on the Chesapeake Bay, and the potential for LIA to reduce these impacts, our study focused on Richmond County, located in the Virginia portion of the Bay drainage area (Figure 1). Richmond County was a logical choice because the county borders the Rappahannock River (a major tributary of the Bay), it lies above the Columbia Aquifer, which contains groundwater that seeps into the Bay, and it has a significant proportion of the county area in agriculture (22 percent, as of the 1987 Census of Agriculture).

The Richmond County Model

A mathematical, computer-based model was used to estimate the effects of LIA practices on farm income and on potential pollution by nitrogen, atrazine, and soil sediments. The model, which accounted for a range of production, economic, and

Figure 1. Richmond County (slashed area), part of Virginia's Chesapeake Bay drainage area.



physical variables, selected the production activities that would maximize net returns over a 15-year period under several different policy scenarios. The policy scenarios were designed to encourage or require LIA.

The point of comparison for the policy scenarios was the Base Policy Scenario, which represented current farm practices and public-policy conditions in the county. This scenario involved medium chemical use in a 2-year rotation of corn and small grains with double-cropped soybeans. Six other policy scenarios were imposed on the Base Policy: 1) a cost-share program that made payments to farmers to encourage the use of green-manures cover crops; 2) atrazine-use restrictions; 3) a 300-percent tax on agricultural chemicals; 4) regulatory restriction of chemical loading to runoff and groundwater; 5) enrollment of all eligible land in the Conservation Reserve Program (CRP); and 6) required installation of buffer strips.

For each scenario, the model predicted how farmers would adjust their practices in response to the imposed policy conditions. The model then estimated the soil losses and chemical and nutrient loadings to surface water and groundwater that would result from the farmers' responses. (*Ed. note*: For more details of this research, please contact the author or the *Horizons* editor at the address given on the bottom of this page.)

Income and Environmental Effects

The model's simulated income effects are shown in Table 1. The cost-share program for green-manure cover crops, where farmers received 100 percent of the cost of planting the crops, encouraged the use of rye-crimson clover, and resulted in a 20-percent increase in farm income over the period (Table 1). CRP enrollment increased the 15-year income by 13 percent. Only these two programs, in which farmers received a cash payment for adopting an LIA technique, increased farm income.

Table 1. Fifteen-year income effects under various modelled scenarios.[a]

Policy Scenario	Income Change Compared to Base Policy
Base Policy	—
Cost-Share	+21%
1/3 Atrazine	-3%
Chemical Taxation	-41%
40% Runoff/Percolation Reduction	-10%
CRP	+13%
Buffer Strip	-2%

[a]A "+" indicates an increase and a "-" indicates a decrease from the Base Policy Scenario.

The regulatory and tax programs reduced income, but the amount varied considerably. Buffer-strip installation and the 1/3 atrazine restriction reduced income only two and three percent, respectively. Requiring 40-percent reduction of atrazine in surface runoff and in percolation to groundwater reduced income 10 percent. The greatest effect was caused by the taxation on chemicals, which reduced income 41 percent.

Table 2 shows the environmental effects of the policy scenarios. In only two scenarios--CRP and Buffer Strips, the two land-idling scenarios--were there reductions in pollutant loadings from all sources. In the other scenarios, three types of environmental tradeoffs resulted. The first was that a reduction in nitrogen loading to surface water (runoff or sediments) was accompanied by increases in nitrogen percolation to groundwater. The second was that the largest reductions among the three pollutants never occurred under the same scenario. Finally, in the 40-

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Table 2. Fifteen-year total impacts on income and pollutant loadings under various modelled scenarios.[a]

Scenario	Nitrogen (lbs) Runoff	Percolation	Sediment	Total	Atrazine (lbs) Runoff	Percolation	Sediment	Total	Soil Erosion (tons)
Base Policy	226,547	7,024,204	6,309,252	13,560,003	172	253	3	428	882,772
Cost-Share	-120,787	+2,687,430	-6,257,458	-3,690,815	-114	-23	-3	-140	-527,626
1/3 Atrazine	-16,845	+754,648	-1,437,414	-699,611	-114	-170	-2	-286	-12,661
Chemical Taxation	-50,855	+2,373,756	-6,237,438	-3,914,537	-172	-253	-3	-428	-124,022
40% Runoff/ Percolation Reduction	+24,858	+1,133,671	-944,552	+213,977	-84	-106	-1	-191	-31,169
CRP	-51,157	-1,619,565	-1,430,449	-3,101,171	-40	-58	-1	-99	-200,520
Buffer Strip	-4,165	-129,468	-116,307	-249,940	-3	-5	b	-8	-16,270

[a]A "+" indicates the amount of increase and a "-" the amount of decrease in a measure of change from the Base Policy Scenario.

[b]Less than 1 pound difference.

percent reduction scenario, a reduction in total atrazine loading was accompanied by an increase in total nitrogen loading.

Another implicit tradeoff is that the general banning of a targeted chemical may result in the use of other chemicals whose toxicity, persistence, and cost must be considered. Many LIA practices include the use of organic sources of nitrogen, such as poultry litter, which--like inorganic sources--also have the potential for nitrogen pollution of groundwater.

Making Informed Choices

LIA promises reductions in chemical contamination of water resources. Although this promise may indeed be fulfilled, tradeoffs will likely occur among reduced pesticide contamination, losses of nitrogen or other nutrients, soil erosion, and farm income. But "[t]radeoffs are the key to decision-making," as John Ikerd has written. The crucial need is for the information to make knowledgeable decisions. Research like the Richmond County study can provide the information needed to make responsible choices among policy options.

To enhance the value of LIA in reducing the environmental impacts of agriculture, LIA practices need the same type of information-gathering that is part of Integrated Pest Management. Such a program will require more time spent in farm management, perhaps with assistance from extension specialists who have computer programs designed to assist the farmer. If this type of technical assistance can be financed and delivered, it will help farmers make the tough choices necessary when they are faced with conflicts among production costs, income, and environmental impacts.

References for Further Reading

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U.S. Department of Agriculture. *Magnitude and Costs of Groundwater Contamination from Agricultural Chemicals: A National Perspective*. Washington, D.C.: USDA/ERS Staff Report AGES870318, 1987.

An Update on Drinking Water

The State Water Commission introduced a bill into the 1992 General Assembly to authorize the Virginia Department of Health (VDH) to set graduated fees for Virginia's waterworks. According to the February 1992 issue of *Water News* (from the Virginia Water Resources Research Center at Virginia Tech), House Bill 236 would require waterworks serving 500 or more people to pay an annual fee ranging from $500 for smaller systems to $160,000 for the largest; systems serving fewer than 500 people would pay no annual fee.

The fees would generate an estimated $4 million annually to be used by VDH to assist waterworks operators in complying with Safe Drinking Water Act requirements. VDH has estimated that this amount will be needed annually for 10 years for additional staff to monitor compliance and provide technical assistance. The proposed bill would not, however, provide money for waterworks infrastructure needs, which have been estimated to cost a much larger amount, especially for rural waterworks (see *Horizons*, May/June 1991).

As of March 2, HB 236 had passed the House of Delegates and was due for consideration on the floor of the Senate. For more information on this or any other legislation, contact House Legislative Information at (804) 786-6530.

NOTICES

* "All politics are local," it has often been said. Town and city residents throughout Virginia have a chance to influence their local affairs by voting May 5 in municipal elections. The deadline for registering to vote in this election is April 4. For more statewide election information, contact the State Board of Elections at (800) 552-9745.

* The Virginia Water Resources Conference will be held April 13-15 in Richmond. Over 60 talks on a variety of water-related topics will be presented. Registration costs $75 before April 1, $90 afterward. For more information, contact Elizabeth Crumbley, Virginia Water Resources Research Center, 617 N. Main St., Blacksburg, VA 24060-3397; (703) 231-8038.

* Two new REAP Reports have been published: Report #5, *Why Virginia Hog Producers Quit in the 1980s*, by Suzanne Thornsbury et al.; and Report #6, *The Financial Feasibility of Finishing Feeder Pigs Under Production Contract in Virginia*, by Lauren Harper et al. Printed copies of Report #5 are no longer available, but a photocopy may be requested by contacting REAP. Report #6 is available free from Extension Distribution, Landsdowne Street, Blacksburg, VA 24061-0512; (703) 231-6192; request 1991 Publication 448-205/R006.

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