Economic Impacts of Chemical Use Reduction on the South

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INTRODUCTION

A growing segment of society is concerned about a myriad of health and environmental issues related to the use of pesticides and other agricultural chemicals. Despite the leveling-off of agricultural chemical use in the 1980s, chemical use in agriculture has come to be seen as a two-edged sword. On the positive side, agricultural chemicals have become the engine for world-wide productivity gains. These chemicals have contributed to increased yields per acre and have reduced waste in storage and distribution. On the negative side, agricultural chemicals are perceived by many to present risks to the safety of the food we eat, to the quality of our drinking water, to the wildlife population, to applicators and to people who inadvertently come into point contact with them.

It is these risks, real or perceived, that have caused some to seek alternative approaches to producing food and fiber. Unfortunately, the public debate and, occasionally, the professional debate about pesticides have been dominated by emotion rather than by cold marginal analysis of tradeoffs on the basis of hard scientific and economic evidence. In the words of Gerald Sirkin, writing for the Wall Street Journal, "...environmental regulation is a scientific and economics issue that is being guided not by science and economics but by the skills of street fighters in the back alleys of politics, the courts, and the media." It should be added that a bureaucratic tug-of-war between several Federal and State Agencies, with purview over regulatory elements of the pesticide issue and about acceptable health standards, adds to the problem.

Extreme views that we are killing the planet with agricultural chemicals are often countered in the media with the equally extreme view that we will all starve to death without chemicals. Rarely do we hear meaningful discussion of partial restrictions between these two extremes, except regarding individual pesticides that are in the registration process.

Because of the street-fighter tactics dominating the public policy debate, and because of the incredible complexity of the health, economic, environmental, and ecological issues surrounding agricultural chemicals, there is a dearth of operational chemical use reduction proposals, short of maintaining the status quo or completely eliminating pesticides and other agricultural chemicals. It is easy for the media or other special interest groups to talk about restricting chemical use by, say, 50 percent, but it is very difficult to operationalize such a concept as an implementable or analyzable policy. Is the objective to reduce use of each individual chemical by 50 percent, or is it to reduce total chemical use by this amount? Should this objective be accomplished by reducing application rates by 50 percent, or by reducing the number of applications by 50 percent? Should the 50 percent reduction be implemented uniformly across all regions or targeted by completely banning chemicals in some regions but allowing for unrestricted use in others? Does one effect the reduction by regulations or by economic incentives/disincentives? Obviously, the answers to these and more complicated questions can have a major impact on the economic and other aspects of a policy.

The fact that major players in the media and political arenas have not advanced well defined, viable agricultural chemical policy alternatives makes it difficult to forecast what kind of policy will evolve in the near future. This, in turn, makes it difficult to discuss how the South will be affected by impending legislation. Consequently, our remarks are based on: (1) a rather hazy crystal-ball assessment of where the major players appear to be headed; (2) A review of a study we did considering three scenarios of outright bans on groups of purchased chemical inputs that was intended to establish the *maximum* economic impact of chemical use reductions; and (3) a review of three policies targeted to reducing pesticide levels in groundwater. These six scenarios do not, by any means, cover the full relevant range of policies, but they do serve to illustrate the direction and possible magnitude of regulation. We do not consider a complete complement of alternatives simply because estimates of per-acre crop yield and cost

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changes by crop and region are not available for most other alternatives.

FOOD AND SAFETY AND WATER QUALITY CONCERNS

Food safety and drinking water quality appear to dominate the current debate over agricultural chemical use, although other environmental considerations certainly are not discounted. With regard to food safety, pesticides used on fruits and vegetables appear to be of primary concern. This is because pesticide application rates are often higher on fruit and vegetable crops than on major crops such as corn, soybeans, and wheat, and because pesticide use is much closer in time to consumption of these products. Since significant fruit and vegetable production is located in the South and Southeast, pesticide regulations can have a major impact on agricultural income and rural economies in these regions. Unfortunately, we do not have adequate data on regional pesticide use for fruits and vegetables, or yield and cost consequences of alternative policies to quantitatively address economic impacts. It should be noted that USDA has initiated a Food Safety Initiative designed to provide data needed to address food safety and economic issues pertaining to fruits and vegetables.

The presence of pesticide residues, especially herbicides, that have been detected in groundwater is the second major area of concern in the current agricultural chemical policy debate. A preliminary report by USEPA estimates that ten percent of the nation's community drinking water wells and about four percent of rural domestic drinking water wells have detectable residues of at least one pesticide, and about two percent of the drinking water was found to exceed the maximum nitrate contaminant level. However, fewer than one percent of the wells have pesticide residues above levels considered potentially dangerous to human health. The questionable validity of the nitrate standard for human health is addressed by Swanson and Taylor.

It appears that public policy proposals coming out of Federal Agencies will likely target real or potential groundwater contamination from pesticide use. Maps of potential pollution, such as the DRASTIC zones shown in Nielsen and Lee appear to be playing a key role in pesticide policy formulation. These maps shown that the South and Southeast generally have high DRASTIC index values; therefore, pesticide regulations targeted at improving groundwater quality will likely be more severe in these regions than in those regions with low DRASTIC values, such as the Northern and Southern Plains.

AGGREGATE EFFECTS OF CHEMICAL RESTRICTIONS AND BANS

This study considers three pesticide bans targeted at reducing or eliminating pesticide residues in groundwater in areas identified as having significant real or potential problems. These options, which are a sub-set of regulatory possibilities that have been under evaluation by analysts at the USEPA,[1] exclude usage of aldicarb, triazines, or acetanilides on: (1) two DRASTIC zones with index values greater than 160; (2) DRASTIC zones with an index greater than 130; and (3) all DRASTIC zones (see Nielson and Lee). The three groups of pesticides in the USEPA study are used primarily on corn, but have limited use on cotton and soybeans. In addition to the DRASTIC options, three combinations of chemical use restrictions evaluated by Knutson, Taylor, Penson, and Smith are discussed, especially with respect to their regional impacts. These alternatives are: (4) a national ban on the use of all herbicides; (5) a ban on the use of herbicides, insecticides, and fungicides; and (6) a ban on the use of inorganic nitrogen fertilizer in addition to herbicides, insecticides, and fungicides.[2] These six options will henceforth be abbreviated as (1) DRASTIC-2; (2) DRASTIC-4; (3) DRASTIC-all; (4) No-H; (5) No-Pest; and (6) No-Chem.

Yield and Cost Data

Aggregate economic analysis of phasing out specific chemical groups requires information on crop yields and production costs for all major crops. Since pests, soil fertility, and climate vary considerably across the United States, yield and cost impacts were required for specific regions of the country to obtain an accurate indication of aggregate effects. On-farm data representative of field conditions for each sce-

[1] Arnold Aspelin, Art Grube, and Bob Torla, USEPA/OPP, personal communication. These options do not represent official EPA policy or necessarily indicate the future direction EPA will go with groundwater quality regulation; rather, they simply represent three options analyzed.

[2] The broader studies upon which this article is based addressed the impact of seven specific combinations of insecticides, fungicides, herbicides, and inorganic nitrogen fertilizer restrictions in U.S. crop production. These are published in a data base report (Smith et al.) and in an aggregate economic assessment report (Knutson et al.). To ease the economic transition and account for carryover chemical effects, yield and variable input use changes were phased in over a three-year period: 50 percent of the yield and cost changes would occur by 1991, 70 percent by 1992, and 90 percent by 1993. The full yield and cost impacts were assumed to be in effect by 1994.

nario were not available for most regions and crops. Furthermore, an experimental approach to obtaining such data for a broad range of policy options would be quite expensive, have debatable relevance to actual field conditions, and, given pressures to act quickly, could not likely be completed before regulatory decisions are made. Hence, aggregate studies, since they require yield and cost estimates for all regions and crops, must at this time rely on scientific judgement.

Yield and cost estimates for the three groundwater options were obtained from analysts at EPA.[3] These estimates are given in appendix tables in Taylor and Penson. Yield and cost estimates for the three national chemical bans, which are reported in Smith, Knutson, Taylor, and Penson, were based on the expertise of over 140 crop scientists and farm management experts around the country.

Modeling Procedures and Assumptions

Sectoral and macroeconomic relationships were then used to determine the effects that these alternative regional yields and production input outlays would have upon aggregate supply, farm product prices, input prices, and net income for both crop and livestock producers for farmland values, food prices, food expenditures, inflation, gross national product (GNP), and other key aggregate economic variables. Given the per-acre yield and cost effects of a pesticide regulatory option, the AG+GEM model developed by Penson and Taylor was used to estimate the aggregate economic impacts. This model is a formal linkage of the AGSIM econometric-simulation model of regional crop and national livestock production and consumption model developed by Taylor and others[4] with the COMGEM macroeconomic model developed by Penson and Hughes. A major feature of AGSIM is its regional supply response, showing how producers would respond to changes in per-acre yields, variable costs, and prices. Comparisons of the values for specific economic variables given by the AG+GEM model simulations under the baseline and six pesticide regulatory scenarios represents the method of analysis adopted in this study.[5]

Several major assumptions were made for the aggregate economic evaluation, as follows:

- The basic policy concepts contained in the 1990 Food, Agriculture, Conservation, and Trade Act were assumed, with target prices in all future years held constant in nominal terms at announced 1991 levels.
- The 34 million acres now in the Conservation Reserve Program will remain in the program, even with a phasing out of agricultural chemical use.
- The Federal Reserve was assumed not to respond to higher food prices by adopting a more restrictive attitude toward the growth in monetary aggregates. This assumption permits analysis of the unfeathered impact that phasing out specific agricultural chemicals would have upon the economy. A tighter monetary policy to lower inflationary pressures would raise interest rates and exchange rates, and thus adversely affect agriculture.
- The United States would protect consumers from imports of products grown outside the United States that do not meet the same quality and safety standards expected of domestic producers. In the absence of such protection, consumers could be exposed to *greater* hazards to human health since pesticides not registered for use here are currently used to produce imported raw agricultural products. This assumption was implemented by restricting import levels to those projected in the baseline scenario.
- Finally, since fruit and vegetables are not specifically modeled in AG+GEM at present, but are likely to be seriously affected by severe chemical use restrictions, assumptions were made as to what might happen to the nominal prices of these commodities over the 1991-1994 period. Prices of fruit and vegetables were assumed to remain unchanged for the DRASTIC options, but to have real increases of 15 percent, 125 percent, and 125 percent over the 1991-1994 period under the No-H, No-Pest, and No-Chem scenarios. These price increase assumptions, which have a significant macroeconomic impact, were based on extremely limited information.

[3]The yields and costs estimates were by Art Grube, Bob Torla, and Arnold Aspelin, USEPA, largely on the basis of earlier pesticide assessment studies by USDA (1985a and 1985b and by Osteen and Kuchler.

[4]Econometric equations used for the livestock component of the simulation model were developed largely by Peel.

[5]A general description of the AG+GEM econometric model is presented by Penson and Taylor in "Modeling the Interface Between Agriculture and the General Economy," AFPC Policy Working Paper 90-13, Department of Agricultural Economics, Texas A&M University, October 1990.

Table 1. Estimated Price Effects of Pesticide Use Options[a]

Commodity	Baseline	DRASTIC-2[b]	DRASTIC-4[c]	DRASTIC-all3[d]	No H[e]	No Pest[f]	No Chem[g]
Corn ($/bu)	2.08	2.11 (1.47)	2.20 (5.47)	2.35 (12.73)	2.79 (33.94)	2.86 (37.14)	3.93 (88.53)
Soybeans ($/bu)	4.89	4.81 (-1.71)	4.67 (-0.22)	4.60 (-5.89)	9.35 (91.14)	9.78 (100.03)	10.86 (121.93)
Wheat ($/bu)	2.92	2.93 (0.36)	2.93 (0.35)	2.93 (0.35)	3.17 (8.62)	3.12 (7.06)	3.52 (20.53)
Cotton lint ($/lb)	0.635	0.639 (0.67)	0.642 (1.24)	0.643 (1.30)	0.696 (9.62)	0.858 (35.23)	1.220 (92.29)
Hay ($/T)	82.69	83.22 (0.64)	83.67 (1.18)	84.10 (1.70)	80.85 (-2.23)	80.85 (-2.55)	87.80 (6.17)
Steers & heifers ($/cwt)	63.79	63.76 (-0.05)	63.64 (-0.23)	63.43 (-0.57)	61.56 (-3.50)	61.38 (-3.78)	60.57 (-5.05)
Hogs ($/cwt)	50.91	51.01 (0.19)	51.37 (0.90)	52.08 (2.29)	62.32 (22.41)	63.99 (25.68)	75.95 (49.18)
Broilers ($/cwt)	24.11	24.10 (-0.06)	24.09 (-0.10)	24.17 (-0.22)	29.41 (21.95)	30.37 (25.96)	35.84 (48.64)
Milk ($/cwt)	14.42	14.42 (0.03)	14.44 (0.11)	14.46 (0.25)	14.56 (1.00)	14.58 (1.08)	14.66 (1.67)

[a] Percentage deviations from the baseline are shown in parentheses. All prices are in constant 1989 dollars. Estimated effects are annual averages for the 1995-98 period.

[b] No usage of aldicarb, triazines, or acetanilides on 2 high DRASTIC zones.

[c] No usage of aldicarb, triazines, or acetanilides on 4 high DRASTIC zones.

[d] No usage of aldicarb, triazines, or acetanilides on all DRASTIC zones.

[e] A national ban on use of all herbicides.

[f] A national ban on use of herbicides, insecticides, and fungicides, except for seed treatment.

[g] A national ban on use of pesticides and inorganic nitrogen fertilizer.

RESULTS

Results presented in this article focus on a few key economic variables chosen from the hundreds of endogenous variables in AG+GEM. Specific variables chosen for discussion include changes in crop and livestock prices, aggregate net income from crops and livestock, consumer surplus of major field crops and livestock products, macroeconomic activity, the consumer price index for food (which includes the fruit and vegetable price impact), and regional net crop income. Yields and production cost effects are not presented or discussed in detail in this article because estimates for the three bans are presented and discussed in Smith et al., and estimates for the three targeted pesticide bans are presented in Taylor and Penson. Unless otherwise noted, all pecuniary variables are expressed in constant 1989 dollars, and all variables are an average of simulated values for the 1995-98 time period.

Farm Level Price Impacts

The AG+GEM model used in this study captures producers' supply response to the yield and cost changes, as well as consumers' response to changes in commodity availability in computing market equilibrium prices. A comparison of real farm level price impacts averaged over the 1995-98 time period is given in Table 1. The three DRASTIC options cause a small shift out of corn and into soybeans, which causes corresponding price changes for these crops, and very small price impacts otherwise.

The No-H option causes the real price of corn to rise by 34 percent and the price of soybeans to increase by 91 percent relative to the baseline. Soybean price increases more than corn price because herbicides in general (but not the pesticides considered in the DRASTIC options) have a relatively larger yield impact on the soybean crop. Wheat prices increase by only 9 percent since herbicides are not extensively used in the production of this crop. Hog and broiler prices increase by about 22 percent as a result of the feed price increases. Steer and heifer prices decrease during the 1991-98 period in which the herbicide ban is phased in, feed prices rise, and herds are liquidated. Although the AG+GEM simulation ended with 1998, a long-run version of AGSIM simulated beyond 1998 showed that steer and heifer prices would be higher than the baseline after

1998. The simultaneous calf prices decrease in the 1991-98 time period partly offsets the lower steer and feed prices to the beef producer. Fed beef price increases are dampened by nonfed beef production costs which are not significantly affected by crop price increases. Milk prices increase only slightly, perhaps because the dairy industry shows substantial profits even with the higher prices for grain and meal (but not for hay) under the No-H option.

Banning all pesticides—the No-Pest option—induces real price effects that are only slightly larger than effects for the No H option, except that cotton lint price increases by 35 percent. This comparison illustrates that herbicides are relatively more important than insecticides for corn, soybean, and wheat production, but not for cotton production.

The most extreme option considered—banning all pesticides and inorganic nitrogen fertilizer (No-Chem)—results in real crop price increases of 89, 122, 21, and 93 percent for corn, soybeans, wheat, and cotton, respectively. Milk prices increase by 2 percent, and steer and heifer prices decrease by 5 percent. Pork and poultry prices increase by almost 50 percent. As in the No-H and No-Pest cases, steer prices do not increase before 1998.

Because inorganic nitrogen fertilizer is banned in the No-Chem case, consideration was given to growing a green manure crop to provide nitrogen for subsequent crops. However, given the price effects (Table 1), a corn/soybean rotation is still more profitable than a corn/green manure rotation in many situations in the Corn Belt. That is, accounting for nitrogen and pest problems, the combined profit over a full rotation of corn on one acre and soybeans on one acre is more that the profit of corn on one acre and a legume plow-down on one acre. We did, however, require 25 percent of the wheat acreage (i.e. one acre for each three wheat acres) to be planted to a green manure crop in the Northern Plains area, 5 percent in the Southern Plains, and 33 percent in the Mountain and Pacific regions. This green manure requirement was specified to provide nitrogen over and above that now provided by leguminous hay and livestock manure. The amount of legumes in rotation would actually be higher than the above percentages because rotation of leguminous hay acreage with wheat would be accelerated with the chemical ban.

With a policy as extreme as a national ban on usage of broad groups of agricultural chemicals, we would expect livestock producers to anticipate the feed price effects. Such anticipation could result in more herd liquidation that our econometrically based simulation model suggests in the early years, and thus a faster than simulated recovery of beef prices.

Effects on Aggregate Welfare Measures

Estimated effects of the six options on aggregate welfare measures are given in Table 2. Perhaps the most striking comparison of effects is between the national bans and the targeted herbicide bans. National bans increase net crop income substantially because the output price effect induced by the large per-acre yield changes more than offsets the reduced yield. However, the DRASTIC options, which have much lower yield impacts but which result in significant per acre cost increases as (more expensive)

Table 2. Estimated Aggregate Economic Impacts of Pesticide Use Options[a]

Item	DRASTIC-2[b]	DRASTIC-4[c]	DRASTIC-all[d]	No H[e]	No Pest[f]	No Chem[g]
Change in net crop income ($ M)	-114	-909	-2119	4824	5387	11916
Change in net livestock income ($ M)	10	-51	-350	-4657	-5256	-6923
Change in net domestic consumer benefits ($ M)	-73	-309	-953	-14677	-17490	-30524
Change in foreign consumer effects ($ M)	-31	-95	-285	-3690	-4526	-7605
Change in price support payments ($ M)	-2	2	1	-34	-38	-38

[a] Estimated effects represent the annual impacts averaged over the 1995-98 time period. All pecuniary values are in constant 1989 dollars.

[b] No usage of aldicarb, triazines, or acetanilides on 2 high DRASTIC zones.

[c] No usage of aldicarb, triazines, or acetanilides on 4 high DRASTIC zones.

[d] No usage of aldicarb, triazines, or acetanilides on all DRASTIC zones.

[e] A national ban on use of all herbicides.

[f] A national ban on use of herbicides, insecticides, and fungicides, except for seed treatment.

[g] A national ban on use of pesticides and inorganic nitrogen fertilizer.

Table 3. Estimated Macroeconomic Effects of Pesticide Use Options[a]

Item	Baseline	DRASTIC-2[b]	DRASTIC-4[c]	DRASTIC-alld	No H[e]	No Pest[f]	No Chem[g]
Real GNP ($ b)	5153	5153	5151 (-0.05)	5143 (-0.20)	5135 (-0.35)	5119 (-0.68)	4969 (-3.59)
Real federal deficit ($ b)	162	162	163 (0.69)	166 (2.60)	166 (2.60)	168 (4.02)	188 (17.95)
Real 3-month T-Bill rate (%)	3.5	3.5	3.5 (1.02)	3.6 (3.75)	3.7 (5.78)	3.7 (7.95)	4.1 (19.05)
Real exchange rate[h]	86.8	86.8	86.9 (0.15)	87.3 (0.56)	87.6 (0.95)	87.9 (1.28)	89.1 (2.69)
GNP price deflator (%)	4.5	4.5 (-0.03)	4.5 (-0.15)	4.5 (-0.29)	4.6 (1.29)	4.7 (4.07)	4.7 (5.15)
Real CPI for food[h]	106.0	106.1 (0.05)	106.1 (0.06)	107.0 (1.00)	110.3 (1.04)	114.5 (1.08)	116.6 (1.10)

[a] Percentage deviations from the baseline are shown in parentheses. All pecuniary values are in constant 1989 dollars. Estimated effects are annual averages for the 1995-98 period.

[b] No usage of aldicarb, triazines, or acetanilides on 2 high DRASTIC zones.

[c] No usage of aldicarb, triazines, or acetanilides on 4 high DRASTIC zones.

[d] No usage of aldicarb, triazines, or acetanilides on all DRASTIC zones.

alternative pesticides and mechanical cultivation are substituted for the banned chemicals, causes net crop income to decrease. For example, the DRASTIC-4 option was estimated to decrease Southeastern corn yield by about six percent and increase variable production costs by about $29/acre, while the No-H option decreased corn yield by about 40 percent and decreased variable production costs by $28. Since the three types of pesticides are used primarily on corn and grain sorghum, income from production of these commodities in the most negatively impacted. Income from soybean production decreases somewhat, due in large part to the price decrease caused by a small shift out of corn and into soybean production nationally.

Comparison of the effects of the DRASTIC options with effects of the national bans demonstrates that the direction of the net crop income effect of agricultural chemical regulation depends on the specific regulatory action.

Net income from livestock production decreases for all options considered, except for the very small increase for the least severe DRASTIC option. Livestock income decreases because the output price increase is not sufficient to offset higher feed prices.

Consumer effects shown in Table 2 are estimates for domestic consumer surplus estimated from general equilibrium points on ordinary demand curves. Fruit and vegetable price increases are *not* considered in the surplus estimates given in Table 2. Demand curves for most commodities in AG+GEM reflect farm level prices, so this surplus measure reflects changes to final consumer surplus combined with changes to agricultural processors' net income. Foreign surplus is a combination of foreign consumer and foreign producer surplus changes because the estimates were based on the net export demand functions for the U.S. As expected, domestic consumer surplus and foreign surplus decrease. Domestic consumer surplus changes in the worst case amount to about 10 percent of food expenditures for an average U.S. consumer.

Changes in price support payments (Table 2) are relatively small because price support payments are low in the baseline simulation. Price support payments are low primarily because the assumption of constant nominal support prices essentially phases out the price support feature of the farm program by 1995. Price support payments increase slightly for DRASTIC-2 and DRASTIC-4 because soybean prices, which are near the $4.92 effective loan rate in the 1990 farm bill, decrease slightly. Although corn prices increase slightly for these two options, the reduced deficiency payments for corn do not exactly offset higher soybean loan costs.

Macroeconomic Effects

The estimated impact that each of the six chemical options would have upon selected widely-tracked macroeconomic variables over the 1995-98 period is presented in Table 3. As expected, the more severe the restriction on chemical use in agriculture, the

Table 4. Estimated Effects of Pesticide Use Options on Regional Net Crop Income[a]

Item	DRASTIC-2[b]	DRASTIC-4[c]	DRASTIC-all[d]	No H[e]	No Pest[f]	No Chem[g]
Corn Belt & Lake States	50	-560	-1848	4338	4831	9204
Northern Plains	98	303	338	1114	1427	2744
Pacific & Mountain	51	116	183	-833	-725	-708
Northeast	-53	-227	-282	288	275	371
Southern Plains	40	78	62	-449	-345	-351
Southeast & Appalachian	-197	-350	-298	237	337	877
Delta	-107	-218	-274	129	-413	-221

[a] All values are in millions of constant 1989 dollars. Estimated effects are annual averages for the 1995-98 period.

[b] No usage of aldicarb, triazines, or acetanilides on 2 high DRASTIC zones.

[c] No usage of aldicarb, triazines, or acetanilides on 4 high DRASTIC zones.

[d] No usage of aldicarb, triazines, or acetanilides on all DRASTIC zones.

[e] A national ban on use of all herbicides.

[f] A national ban on use of herbicides, insecticides, and fungicides, except for seed treatment.

[g] A national ban on use of pesticides and inorganic nitrogen fertilizer.

more negative the impact on the nonagricultural economy. Real gross national product, or GNP, which is the primary measure of our nation's output of goods and services, would decline. Inflation, fueled by rising food prices, would rise. Federal budget deficits would rise as tax revenues fall and as government spending, triggered by cost-of-living adjustments, rises. Interest rates would rise as the government borrows more from the public. Furthermore, the value of the dollar would rise, as reflected in foreign exchange rates, as real U.S. rates rise *vis-a-vis* rates elsewhere in the world economy. A stronger dollar would shift net export demand equations downward. Higher interest rates, higher prices, and higher exchange rates add further impetus to the decline in real GNP, depressing investment, consumption, and net exports.

It should be stressed that the values reported in Table 3 represent average values over the 1995-98 period, thus reflecting the longer-run effects of the six scenarios. Considerably more volatility was observed in the years preceding 1995; such variables as food prices, inflation, and interest rates deviated more sharply from their baseline counterparts over the 1991-94 period when the yield and cost impacts of the six scenarios were phased in.

Regional Crop Income Effects

The regional effects of restricting pesticide use, which is the topic of our article, are illustrated in Table 4 for the six options considered. The three DRASTIC options considered all lower net crop income in the Southeast, Delta, and Appalachian regions. Aggregate effects on the South and Southeast taken together range down to a decrease of about $600 million annually. Income in these regions is lowered primarily because most agricultural subregions in this area are targeted for banning the three groups of herbicides. Furthermore, major agricultural areas of the U.S. are not significantly impacted by these options; consequently, there is little output price impact (Table 1) to offset higher costs and lower yields. The Corn Belt and Lake States also experience income decreases for DRASTIC-4 and DRASTIC-all because these options target areas of these regions for the pesticide ban.

National bans on groups of agricultural chemicals result in substantial net income increases in the Corn Belt and Lake States. The Northern Plains would also experience income gains as yield-induced pressure on the land base and competition of other crops (including legume plow-down for the No-Chem option) for wheat land increase wheat price (Table 1); the increased wheat price more than offsets yield decreases and cost increases. Because pest problems tend to be more severe in the warm southern climates than in the northern climates, the insecticide and fungicide ban results in net crop income decreasing in the Delta, Southern Plains, Pacific, and Mountain regions.

The results of the six options considered suggest, not surprisingly, that agricultural income in the South stands to be negatively impacted by impending pesticide regulations. Although the livestock component of AG+GEM is not yet regionalized, estimated price impacts shown in Table 1 clearly suggest that livestock income in these regions would also be negatively impacted.

Paradoxical Environmental Effects

Although the simulation models used in this study do not directly address environmental consequences of banning specific agricultural chemicals, it does allow us to indirectly and qualitatively analyze some effects of the scenarios on the environment. A paradoxical environmental effect occurs with the national pesticide bans because acreage cropped would increase about 10 percent, which would increase erosion and sedimentation. This expansion would occur largely on marginal, more highly erosive land, and on land now in annual set-aside program. Erosion, therefore, is expected to increase by more than ten percent. Furthermore, higher crop prices and low buffer stocks caused by implementing the three national bans would likely put considerable pressure to return all or part of the 34 million acres of highly erosive land now in the conservation reserve program back into production to soften the price and stock effects caused by the chemical policies.

CONCLUDING REMARKS

Estimates of the aggregate economic effects of six pesticide use options were presented in this article. Three of the policies involved targeted pesticide bans and three policies involved national bans on broad groups of chemicals. National bans on broad groups of chemicals were estimated to decrease livestock income and increase net crop income nationally. Net crop income in the Southeast also increases, but income decreases were estimated for the Delta (except for the no herbicide option) and the Southern Plains. On the other hand, banning the use of three groups of pesticides in DRASTIC zones would decrease net crop income nationally and throughout the South and Southeast. There is a clear need for more rationality and less street tactics in the formulation of pesticide policy. We believe that the agricultural economics profession can make an extremely valuable contribution to the policy debate by defining alternatives that fall between the status quo and complete bans. Although the current policy process is directed toward promulgation of regulations and bans, economic incentives/disincentives need to be considered so that people involved in the policy process can view a full complement of alternatives.

Once viable regulatory and economic incentive alternatives are defined, economists can continue to play a critical role by guiding scientists in estimation of per-acre yield and cost effects, which are required for aggregate economic analysis. Because pesticide policy is evolving rapidly, the process of obtaining yield and cost estimates must rely more on subjective approaches than long-term, hard scientific studies. Although there is much uncertainty about the per-acre yield and cost impacts of any particular pesticide policy and, given yield and costs estimates, there is some uncertainty about economic effects, we must be prepared to quantify to the extent possible the economic and environmental consequences of alternative pesticide policy proposals. Such evaluation will require an objective, professional approach by all those involved—researchers, extension specialists, private industry, public agencies and public interest groups—to bring the best information possible to the decision process.

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