ECONOMIC IMPACTS OF REDUCED CHEMICAL USE

by Ronald D. Knutson, C. Robert Taylor, John B. Penson, Jr., and Edward G. Smith

We appreciate the opportunity to reply to the criticisms raised in CHOICES of our recent study which addressed the economic impacts of reduced chemical use. Ayer and Conklin raise several concerns regarding the design of our study in this issue—all of which were anticipated, but are nonetheless believed to be misguided or erroneous. They also raise a more basic concern regarding our motivations and objectivity. A previous CHOICES article by Doering, while not referring specifically to our study, questioned the usefulness of models and related quantitative techniques in analyzing issues such as the impacts of reduced chemical use.

The two articles in combination take issue with our study along three lines: (1) conflict interest, (2) the usefulness of quantitative models in economic impact analyses, and (3) perceived methodological flaws. Inasmuch as the results of our study have not appeared in CHOICES, this response begins with a brief summary of the origin, methodology, and results of this study.

Origin of Study

Early in the 1990 farm bill debate, we were approached by the American Farm Bureau Federation regarding our interest in undertaking a study of the impacts of reduced chemical use. We drew up a proposal which involved a relatively unique combination consulting and public institution research arrangement. The funders for the project included a consortium of public and private institutions. The data base for the project was developed under a cooperative agreement between the Tennessee Valley Authority and Texas A&M University. The resulting publication, Impacts of Reduced Chemical Use on Crop Yields and Costs provides a complete documentation of the basic yield and cost data utilized in the study.

Knutson, Penson, and Smith are Professors of Agricultural Economics at Texas A&M University. Taylor is a Professor of Agricultural Economics at Auburn University.

The consulting portion of our study utilized the yield and cost data base to analyze the impacts of specific chemical use reduction scenarios upon agricultural and food sectors. The funding for this portion of the study came from a consortium of farm organizations and agribusiness firms which included four companies with agricultural chemical and fertilizer interests. The consulting arrangement facilitated the completion of the study on a timely basis as well as the utilization and further development of a large scale econometric model of agriculture and the U.S. economy. The resulting publication was titled The Economic Impacts of Reduced Chemical Use.

The scope of the study was the subject of considerable discussion among the researchers and the project funders. Perceptions of Ayer and Conklin to the contrary, the scientists—not the funders—insisted on the option of analyzing a ban placed on the use of a broad range of agricultural chemicals. The funders would have preferred a study covering an array of percentage reductions in chemical use. However, an unmanageable number of combinations of bans on individual chemicals, restrictions on usage, and economic incentives/disincentives led us to focus on the extreme case of a total ban on specific chemical groups as a way of determining the maximum economic impact and quantifying the nature of the associated tradeoffs. Furthermore, any choice set of less severe restrictions would likely not have matched those desired by specific groups, and hence would not have eliminated our exposure to such criticism.

We recognized that a study of reduced chemical use which cuts across a whole group of chemicals as well as several major commodities had not previously been undertaken. Research to date had focused on the economic impacts of banning specific chemicals. The limited scope of previous studies made our job considerably more complex. It was our desire to constrain this study to a scope which could be objectively analyzed and completed on a timely basis. Thus, we limited the scope of the study to banning insecticides, fungicides, herbicides, and inorganic nitrogen fertil-

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izer. We did not consider a scenario banning phosphate and potash fertilizer because of the lack of an apparent health risk and because of a desire to avoid the potential appearance that a maximum reduced yield impact was desired. For the same reason, we did not ban the use of defoliants in cotton because, in some regions, it would have made mechanical harvesting impossible. Similarly, seed treatment was not banned. In addition, the study did not restrict the use of nitrogen from organic sources. Because of these exceptions, the study was not titled "Impacts of Banning Chemical Use in Agriculture."

Methodology

The yield and cost data base for the study originated estimates by leading land grant or USDA scientists and agricultural economists for each crop studied. The lead crop scientist was selected after obtaining recommendations from a wide array of industry, governmental, and land grant university sources. The individuals most frequently mentioned as unbiased research authorities on chemical use were selected. Except for TVA, the project funders were not asked for recommendations; nor were they allowed to screen the selection of the lead scientists. For the crop on which he was an authority, the role of the lead crop scientist was asked to evaluate the impacts of:

- No herbicides (except defoliants)
- No insecticides and fungicides (except seed treatments)
- No inorganic nitrogen fertilizer
- No pesticides (herbicides, insecticides, and fungicides)
- No herbicides and inorganic nitrogen fertilizer
- No insecticides, fungicides, and inorganic nitrogen fertilizer
- No chemicals (herbicides, insecticides, fungicides, and inorganic nitrogen fertilizer)

In making these yield estimates, the lead crop scientists were instructed to draw on all available research. Documentation of the basis for their estimates indicate that the estimates involved the input of 140 scientists representing all U.S. production regions. The scientists' estimates were made regionally with documentation of changes in management practices required to adopt to each chemical use reduction scenario. Such management practices included changes in crop rotation patterns, mechanical cultivation, green manure, use of farm labor, and the use of livestock and poultry manure. At each university where the crop scientist was located, a farm management specialist modified the ERS cost of production estimates to be consistent with the yield estimates and management practice changes specified by the lead crop scientist.

To evaluate the regional commodity-level economic impacts, the yield and cost estimates were simulated utilizing a formal linkage between the AGSIM model developed by Taylor and the COMGEM model developed by Penson and Hughes. By linking these two models into one model entitled AG+GEM, Taylor and Penson were able to estimate the impacts of these per acre yield and cost estimates on regional crop and livestock production, farm prices, farm returns, farm land values, as well as on food prices and such macroeconomic variables as the rate of inflation. The major components of the AG+GEM model have been presented in national forums and have been extensively utilized in policy analyses conducted for such institutions as the U.S. Department of Agriculture, the American Bankers Association, and the Environmental Protection Agency.

A draft of the report was orally presented by the four authors to the project steering committee. While there was considerable and sometimes heated discussion of the results, absolutely no changes were made in the study procedures, models, or results. In other words, the results were not "cooked" as implied by Ayer and Conklin. The study was sent out for peer review by the project steering committee to three widely recognized agricultural economists who shall remain anonymous. The reviewers expressed concern with the limited "zero chemical" scope of the study, but did not reflect a concern about basic design of the study or in the use of formal econometric models as a basis for analysis.

Results

Three dimensions of the results of our research can only be expected to whet your appetite for reading at least the two major publications resulting from our study:

Substantially Different Regional Yield Impacts. Under the "no chemical" option, national average yield reductions ranged from 37 percent in soybeans and sorghum to 78 percent in peanuts. With no chemicals, corn experienced a 53 percent reduction while wheat incurred a 38 percent national average yield reduction. With the exception of wheat, the largest yield reductions were in the humid and warm climates of the South where insects, fungi, and weeds naturally grow faster, longer, and larger (see Figure 1).

Crop Producers Benefit But Livestock Producers Lose. Certainly, some special interest groups representing crop producers may have to swallow hard to accept this conclusion. Yet no pressure to

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Considerably worse off (see Figure 2). Other big gainers included landlords (land being more limiting and valuable with no chemicals), while other big losers included chemical companies, feed manufacturers, and other agribusiness firms associated with the transporting, warehousing, and exporting of crops.

Consumer Surplus Falls. The food price component of the CPI accelerates rapidly under both scenarios. Consumer surplus would fall approximately $35 billion below baseline levels over the 1995-1998 period under the “no chemicals” scenario (see Figure 2). Consumer surplus would also decline under the “no pesticides” scenario by some $18 billion.

Response to Criticisms

Conflict of Interest. The most serious charge leveled against us by Ayer and Conklin was the existence and/or appearance of an inherent conflict of interest. The argument is that private capital corrupts a study to the extent that its results are rendered useless and irrelevant to the policy debate. This argument only makes sense if it is determined that the results (the numbers themselves) are somehow in error. This requires more than an attack on our clearly stated assumptions, for which the reader can draw his or her own conclusions regarding their reasonableness. Conklin and Ayer erroneously imply that because private interests are involved, the numbers themselves must be cooked! We reject this view. In this case, the funders themselves had conflicting interests regarding the issue of chemical use reduction as seen from the results. While crop producers benefited, livestock producers and chemical companies lost. If the funders had set out to cook the results, they likely would not have come to land grant economists; nor could they have agreed upon how the aggregate results should look!

Ayer and Conklin state that economic research should not be treated any different than biological research in terms of private interest involvement. Land grant agronomists and animal scientists regularly do studies supported by private interests. They assist in validating the safety and efficacy of pesticides and/or chemicals. This procedure is inherent in the EPA/FDA approval process. Is biological policy research any less likely to be biased than economic research? Why, then, shouldn't agricultural economists involved in privately supported studies having policy implications? Is society better off if we aren't involved? Certainly not!

If private interest funding is tainted by the perception of bias and should be rejected by land grant institutions, where should the line be drawn? Would Ayer and Conklin suggest that USDA funding taints the research results because of the “Administration’s” influence? Would they suggest that EPA funding taints research results due to its environmental mission? Would studies resulting from special interest (public or private) requests be tainted because of the perceived philosophical position of the requestor? Would research results reported by the Leopold Center for Sustainable Agriculture at Iowa State University be tainted because of the ideological philosophy of its namesake? We think not.

In the end, the results of any study speak for themselves and depend on the integrity of the researchers. We will take the heat on that score with a clear conscience.

Usefulness of Quantitative Modeling Analysis. Issues such as chemical use reduction cannot be analyzed on an individual firm or commodity basis and then summed to determine their aggregate economic impacts. The effects of chemical use reduction sweep throughout agriculture, food, and even the macroeconomy in a series of complex relationships and interactions. The scope and magnitude of these effects can only be fully appreciated by quantitative analysis utilizing relatively complex models. To imply, as Doering does, that a person can think through the complexity of general equilibrium relationships without the aid of a relatively sophisticated model is naive.

Doering’s comments about models suggest that he has absolutely no understanding of the AG+GEM model used in our study, whose dynamics are similar to his diagram of price and quantity adjustments. Linear programming models can “turn on a dime”, but the models used in all three chemical ban studies we are aware of are econometric in design, and not subject to this criticism. Ayer and Conklin appear to have a better basic understanding of the general modeling approach taken; however, their criticisms regarding model specification appear to be based upon

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nothing more than speculation. Certainly, none of these individuals requested documentation of the model (AG+GEM did not exist prior to this study), nor did they ask for clarification prior to publication of their criticisms. We openly encourage constructive criticism, as such criticism allows us to improve the model, but we have trouble accepting criticism about the properties of a model that is based upon idle speculation!

Methodological Flaws. Given the results of our study, we agree that a ban on chemical use in agriculture is unrealistic. We assert, however, that our study gives considerable insights as to why such a ban is unrealistic. We also agree that further research is essential to determine the impacts of intermediate points between current practices and a total ban on specific groups of chemicals. We are not certain that Doering holds this view.

Having said this, we disagree with several of the other charges of methodological flaws leveled by Ayer and Conklin which we contend are based on speculation with little or no knowledge of (1) how the scientists made their initial crop and yield estimates, or (2) how the model handled particular issues or relationships. Particular points we feel must be stressed are as follows:

• The yield and cost estimates do account for price-induced changes in nitrogen-fixing crops and the utilization of the available limited supply of manure. Increased crop rotation, including green manure where feasible, was utilized by the crop scientists. The yield, cost, and land use impacts were captured by the model.

• The model assumes that technological change continues to progress at basically the same rate as in the past, with departures from trend influenced by input/output price ratios.

We did not assume any big increase in appropriations for agricultural research because there was little basis for such an assumption.

• We did not go out of our way to speculate about what might happen concerning scientific developments in the future. Those scientific advances that are likely to be available for application over the next 10 years were presumed to be general knowledge among our leading crop scientists. With today's regulatory approval process, 10 years is not an unreasonable time period from discovery to application.

• Doering suggests that the use of a delphi process is flawed because it does not account for the interactive effects associated with chemical use reductions. Yet some of the lead scientists in our study were IPM specialists. Who is in a better position to make judgements regarding interactive effects of chemical use reduction impacts?

• Conklin and Ayer make a substantial issue out of our assumption that imports were frozen under the chemical use reduction scenarios. From our analysis, it was concluded that without a freeze, imports of commodities produced with the aid of chemicals would flood the U.S. market for all commodities except feed grains and soybeans. In these commodities, the United States is a sufficiently dominant producer that significant imports are less likely—although in soybeans even this conclusion may be debatable.

The alternative proposal by Ayer and Conklin is to embrace the Big Green strategy of curbing imports where residues are found. We explored this option. We found that in commodities such as rice, where agricultural chemical use is substantial, there is no difference in chemical composition between organically produced rice and commercially produced rice. Therefore, the Big Green assumption would allow unlimited use of some chemicals abroad but none in the United States. With the United States producing only 2 percent of the world rice production, a potentially fatal economic blow would be dealt to the domestic rice industry. Shouldn't the elected representatives of California, Arkansas, Texas, Louisiana, and Mississippi be made aware of that consequence?

• Ayer and Conklin also apparently believe that animal and green manure could/would be produced/utilized in sufficient quantities to offset current applications of inorganic nitrogen. We also investigated this proposition. Total organic nitrogen in the form of animal/human waste represents only 10 percent of the total nitrogen currently used! In addition, there are substantial areas of the United States where increased use of green manure is not economically viable. Finally, it is not clear that nitrogen in the groundwater from organic sources is any less of a problem than nitrogen from inorganic sources.

Summary

As agricultural economists, we treated this study no differently than any other study we have conducted. To do otherwise would jeopardize our reputations as scientists. It is important that we recognize that a large share of the money required to do research on land grant universities is supported directly or indirectly by private interests. Without the support of these organizations, agricultural research and extension would be much smaller in scope, and the agricultural land grant concept of research, extension, and teaching would likely be severely reduced. To keep the strong support provided by these organizations requires the agricultural economics profession to research relevant issues in a timely way. Due to the great diversity of agricultural interests, this support would certainly be lost in due time if we lose our objectivity, or fail to address major issues.

To quote Randy Green, member of the Minority Staff, Senate Agriculture Committee: "Be unfazed by controversy because agricultural policy is full of it these days. You should, of course, steer clear of partisanship or naked ideology, but your objectivity ought not paralyze your ability to make judgements and reach conclusions." Scientific input after political decisions are made has little value. As Barry Flinchbaugh so aptly puts it: "Christmas trees are a dime a dozen on December 26th." These statements are not and should not be an excuse for shoddy analysis. But there is no excuse for avoiding issues when called upon by a respected broad-based constituency representing U.S. agriculture.

For More Information


Penson, John B., and C. Robert Taylor, Modeling the Interface Between Agriculture and the General Economy, AFPC Policy Working Paper No. 90-13, Department of Agricultural Economics, Texas A&M University, College Station, Texas, 1990.