A DISCUSSION OF WATER QUALITY AND FOOD SAFETY ISSUES

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We are indebted to Roy Carriker and Amy Purvis and to Carol Kramer for providing excellent perspectives from which agricultural economists might consider the importance of water quality and food safety issues. Neither paper represents a "call to action" or presents a "challenge to the profession" to go forth and solve these problems. Perhaps their lack of challenge reflects a realistic appraisal of the complexity of the issues and the role of economics in their solutions. There are no easy answers. Considerable interdisciplinary skill and institutional change will be required to deal effectively with both water quality and food safety problems. My comments are directed first to the Carriker and Purvis paper and then to Kramer's paper.

Carriker and Purvis make several key points. First, given the discovery of agricultural chemicals in groundwater in a number of states, there is clear and unrefutable evidence that agriculture is contributing to groundwater quality problems. Also, sediment movement and nutrient loading represent a critical agricultural water pollution problem. Most persons involved in agriculture today understand that agricultural practices contribute to point and nonpoint-source pollution, even if they do not fully understand the causal relationships. This point requires little discussion.

Carriker and Purvis focus considerable attention on an interesting historical review of water quality concerns. It is clear from their review that many persons anticipated the problems that have emerged or become visible in recent years. All of us are aware that the agricultural research establishment has focused its primary energy on discovery of new yield-increasing technology. In times of declining real financial support for agricultural research, the agricultural research establishment failed to reallocate resources to attempt to solve difficult environmental problems. There are many reasons for this failure. Our disciplinary organization, research specialization, and reward system are contributory factors. Regardless of the reasons, we can only plead guilty as charged.

Carriker and Purvis wonder why we sense that much of society is dissatisfied with the pace and direction of the USDA/land grant response to emerging water quality concerns. They do not cite evidence that much of society feels this way, although certainly a large number of vocal critics do. Perhaps some of the dissatisfaction arises because of our success in producing agricultural commodities. We have achieved the goal of providing adequate supplies of food and fiber. Recent surpluses of many agricultural commodities are evidence of our success. This success has been achieved with less environmental degradation than in many countries, perhaps because of the size of the U.S. and the distribution of agricultural production. Millions of acres of highly erodible lands have been taken out of intensive production. We have assisted other nations in becoming self-sufficient in agricultural production. Yet, these successes have not been achieved without cost to society. Direct government payments to agricultural producers have been high, particularly during the 1980s. Subsidized credit programs, such as those offered by Farmers Home Administration, have also increased substantially. Environmental degradation, underway for decades, has surfaced in numerous locations. Point sources of pollution were merely the first and easiest to identify. Nonpoint sources are much more difficult to identify, isolate, and control. We have dealt with some of the easy problems—the difficult problems are being grappled with today. Effective cooperation among industry, USDA and other government agencies, and university researchers from inside and outside the land grant system will be required to solve many of today's water quality problems. As Bonnen argues so effectively, we must find an appropriately balanced investment in disciplinary, subject matter, and problem-solving capability to deal effectively with water quality problems.

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Invited paper presented at the annual meeting of the Southern Agricultural Economics Association, Little Rock, Arkansas, February 3-7, 1990. Invited papers are routinely published in the July SJAE without editorial council review but with review of the Editor (as per Executive Committee action June 25, 1982).

Carriker and Purvis state that a few universities have started programs to generate and disseminate information on systems of farming that reduce chemical use, use less energy, reduce soil erosion, and reduce the likelihood that farming will contaminate water supplies. I believe the authors underestimate the current effort in this area, although not much of the current research is being conducted under the LISA banner. Many universities are currently involved in interdisciplinary efforts with teams of scientists from the appropriate fields of study—agronomy, soil physics, hydrology, chemical engineering, agricultural engineering, agricultural economics, and others—focusing on groundwater and surface water quality problems. Financial support is coming from traditional and nontraditional sources.

My own research on groundwater quality involves funding from the Oklahoma Agricultural Experiment Station; the Oklahoma Water Resources Research Institute; Cooperative State Research Service, U.S. Department of Agriculture; and the U.S. Geological Survey, U.S. Department of the Interior. The relationship between agricultural practices and groundwater quality involves a complex set of technical relationships, including interactions among cropping and tillage practices, fertilizer and pesticide use, rainfall and irrigation levels, and movement of chemicals through the plant root zone and toward groundwater aquifers. Rates of movement are dependent upon soil type and structure, existing organic matter, crop and tillage practices, rainfall and irrigation amounts and timing, the specific chemicals applied, their application rates and methods, and other factors. Farming systems and practices that will generate an acceptable level of environmental degradation are likely to vary from soil to soil, chemical to chemical, climatic situation to climatic situation, and aquifer to aquifer. Much of the current research is being conducted with computer models that simulate soil erosion, nitrate movement, and movement of specific agricultural chemicals through the plant root zone. Verification of these models for specific sites will be time consuming and expensive. Recommendations will be crop specific, soil specific, chemical specific, and, therefore, area, farm, or site specific.

The decision by the Environmental Protection Agency to encourage development of state plans and local solutions to water quality problems is to be applauded. However, increased Federal funding is needed, not only to assist with state plans, but to support basic and applied research on water quality problems. We may well have enough legislation and sufficient regulations at present. The next set of regulations, if needed, should be based on technical and economic research being conducted today. Changes in institutional arrangements, implementation of cost sharing to encourage adoption of environmentally safe production systems, widespread dissemination of information about specific chemicals and their impacts on water quality, and demonstration of new production systems and technology appropriate for specific crop/soil/tillage/groundwater situations are needed more than comprehensive legislation. Many nonagriculturalists, and some agriculturists, would not agree with this viewpoint (Batie).

Carriker and Purvis call for environmental quality and a viable agriculture. They indicate that our best bet is to foster communications among groups and individuals who disagree. For such efforts to be successful, we must have better technical information to communicate. The public will quickly lose patience if we allocate much time to seminars about our contrary views of water quality problems. However, I do agree with the fundamental theme of Carriker and Purvis that education and problem-solving research are needed to address agricultural and water quality issues.

I wish that Carriker and Purvis had allocated more attention to discussion of agricultural water quality policy alternatives. Much of the controversy surrounding water quality regulation, particularly groundwater legislation, focuses on the appropriate goals of Federal policy, with prevention of pollution and cleanup of contaminated water as the most frequently-mentioned alternatives. Cleaning of contaminated surface water is often feasible. For groundwater, an effective argument can be made for prevention based on cost-effectiveness. If prevention is the desired policy alternative, modification of agricultural practices will be necessary.

If prevention of contamination and modification of practices are essential, another important policy choice centers on use of voluntary versus mandatory controls. Many in agriculture, as Batie indicates, feel that if farmers received information on water quality problems and had the needed technical and cost-sharing information, they would voluntarily improve their efforts to protect water quality. Others, and many nonagriculturalists are included, feel that the existing policies and property rights lead to groundwater contamination, and that regulation rather than education or cost sharing is needed (Batie). Recent Federal policies dealing with nonpoint-source pollution and groundwater quality protection emphasize voluntary rather than mandatory controls (Crutchfield). Design and implementation of control measures have been left to state and local officials under both the 1987 Water Quality Act's nonpoint-source pollution provisions and EPA's pesticides-in-groundwater strategy. The decentralization of decision making and policy implementation has important implications for policy analysis and institutions involved in protecting groundwater quality.

Since the vulnerability of groundwater to agricultural pollutants depends on specific soil conditions, production practices, and other site-specific characteristics, local, rather than national, regulatory standards seem feasible. State and locally-designed regulations have the advantage of flexibility and may ensure higher levels of voluntary compliance. A possible disadvantage is wide variation in permissible agricultural practices across similar resource situations in different states. These differences greatly complicate our analytical problems in studying the issues and in advising policymakers.

Little is known about the allowable level of concentration of pesticides in groundwater. Current laws regulating pesticides are not uniform. Drinking water legislation calls for "no unreasonable risk" of exposure to hazardous chemicals, while the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandates a risk/benefit approach (Crutchfield). There is considerable debate over the concept of "reasonable" exposure as an acceptable environmental goal.

Finally, soil conservation programs and modifications of government commodity programs, including a flexible base for commodity program acres, an expanded 0-92 program, expansion of the Conservation Reserve Program (CRP), and other alternatives, are being discussed as viable policy options to control or reduce agricultural nonpoint-source pollution. Traditional conservation programs have not focused on reducing transport of pesticides, but could be modified to reduce environmental damage. Adoption of "best management practices" developed by the Soil Conservation Service (SCS), including crop rotations, conservation tillage, and nutrient management, may reduce nonpoint-source pollution. The CRP has been expanded beyond highly erodible lands, and eligibility rules could be further modified to include land with a high "groundwater quality degradation index." This index might be constructed based on soil type and structure, recent cropping history (including past fertilizer and pesticide practices), and the depth and permeability of groundwater aquifers under the area. Sandy soils, intensive cropping practices, heavy chemical use, high rainfall or irrigation levels, and shallow aquifers might generate a high index and eligibility for what could become a rather expensive CRP program.

I wish that Carriker and Purvis had explored the potential costs and benefits of some of these policy alternatives. Agricultural economists have a definite role to play in both the technical aspects and policy analyses of water quality issues. Our contributions will be much more valuable if they stem from multidisciplinary efforts to solve existing and potential environmental problems.

One must "shift gears" somewhat for Kramer's paper on food safety, although many of the issues are the same whether solving food safety or water quality problems. Kramer has done a commendable job of presenting the consumer side of a number of food safety issues. Kramer's comments center on four main points, and I find it difficult to argue strongly with any of the points. First, Kramer suggests that consumers are increasingly concerned about food safety and pesticide residues. This observation is confirmed in consumer surveys that appear in the literature. Zellner and Degner report results of a survey of consumers regarding willingness to pay for food safety. Pesticide residues in food were reported as the highest food safety concern, with nearly six of ten respondents expressing a high level of concern. Only one in three stated a high level of concern about bacterial contamination, and even fewer expressed significant concern about additives and preservatives (Zellner and Degner).

Kramer's second point is that food safety experts consistently rank pesticide residues in foods as a much less important problem than food-borne illness due to microbial contamination or naturally-occurring toxicants. This point is corroborated by Roberts and van Ravenswaay, who report Food and Drug Administration (FDA) estimates that from 6.5 to 33 million Americans become ill each year from microorganisms in their food, with 9,000 of these cases resulting in death. In contrast, the EPA estimates that pesticides in food cause about 6,000 cases of cancer each year (Roberts and van Ravenswaay).

Consumer perceptions of risks inherent in food consumption apparently differ substantially from actual risks. It is consumer perceptions of risk that generate their reactions to food safety issues and concerns. Consumer reactions to concern over the use of Alar on apples illustrates this point vividly. Consumers are generally unaware of risks associated with contamination in the food chain, regardless of the source of the hazard. As the amount of information about food safety is increased, we might expect consumers to react initially with alarm, but eventually for consumer perceptions of the problem to align more closely with actual risks from bacterial versus pesticide contamination.

Kramer's third point is that this divergence of consumer and expert opinion is very significant and needs to be addressed explicitly through policy measures. Kramer argues that consumers' misperceptions of public risks may cause them to emphasize less important risks at the cost of neglecting more important risks. The example cited is the possibility that consumption of fruits and vegetables might be eliminated, along with their nutritional benefits, to eliminate exposure to pesticides. Smallwood also indicates that a risk label can have the adverse effect of raising concerns about the safety of the product. I was somewhat skeptical of these arguments upon first reading of Kramer and Smallwood. However, while attending a recent research meeting in Florida, I picked up a bag of grapefruit in a supermarket. The label on the bag identified a very impressive list of chemicals applied to the grapefruit. The label did not provide information regarding the purpose served by each chemical or the level of application. No information was provided on the percent of USDA recommended daily allowances of pesticide residue supplied by the consumption of a grapefruit! The consumer was left to wonder whether the chemicals had been washed from the surface of the fruit or could be avoided by simply not eating the peel. What was the risk of ingesting some quantity of pesticide residue while consuming a Florida grapefruit, if any? It was impossible to tell from the information provided. Rather than purchasing the labeled grapefruit, I bought some unlabeled bananas, probably imported, and possibly contaminated with higher levels of unknown chemicals! My actions probably gave a new or distorted meaning to the concept of the rational consumer!

The point is that consumers and experts may have different perceptions of food safety risks partly because they have quite different information about pesticide use on fruits and vegetables. Consumers are unable to detect the level of pesticide use, but would react if labels contained information on levels of use, toxicity, potential danger, or other quantitative or qualitative assessments of risk. Pesticide information is rarely provided, either because it is not available or because of concern over consumer reactions. Eventually, consumers will either demand this information, or demand label certification that all pesticide residues are well below safe tolerance levels. Research must be undertaken to establish safe levels for all chemicals used in food production. Equally important, educational materials must be provided to inform rather than frighten consumers about food safety issues.

Kramer points to evidence that consumers respond positively to produce appearance, quality, and availability throughout the year. Many consumers do not understand, however, that many of these attributes have been facilitated with the use of pesticides. Consumers know very little about the acceptable level of exposure to pesticides in fruits or other foods. It would be interesting to conduct consumer preference research in which two of the alternatives were bags of oranges of the same size and quality, but with different surface appearances. The "bright" oranges might contain a label indicating that the appearance was due in part to use of several specific chemicals. The "not-so-bright" oranges might contain a label indicating that they were produced without use of chemicals. Price differentials might be varied in controlled experiments to determine the level at which consumers are indifferent to pesticide-enhanced or pesticide-free oranges.

Retailers will increasingly be forced to provide more information on pesticide use and to display more products as consumers demand a greater variety of chemical-free products. Many supermarkets, particularly on the West Coast, have begun to supplement Federal pesticide residue monitoring programs with private residue testing. Others have added organic sections to provide customers with fruits and vegetables grown without chemical pesticides (Greene and Zepp). These approaches, to some extent, play on consumers' fears over pesticide residues and may increase the level of concern. In most cases, dangers from pesticide residues are extremely low.

Kramer indicates that consumers tend to overestimate the probability of small risks, such as those represented by pesticide residues, while underestimating the likelihood of higher risk events, such as an auto accident. Consumers react differently to events in which they participate voluntarily and those in which they are unwilling participants, such as exposure to pesticide residues. Furthermore, some risk research indicates that many persons have little understanding of probability concepts. To many persons, any exposure to pesticide residues is high risk. Consumers, producers, and others react to perceptions of risk, or to their subjective assessment of the likelihood of uncertain events, rather than to historical probabilities associated with uncertain events. If their subjective assessment is that the likelihood of exposure is high, or that the consequence of that exposure is dire, their actions are predictable.

Kramer's final point is that policy proposals need to be evaluated for cost effectiveness in reducing food safety and environmental risk, and performance under uncertainty, evolving knowledge, and external effects. Many important questions need to be resolved, and the concerns about food safety and chemical contamination of surface and ground water overlap. If farmers are applying pesticides that exist later in foods, what are the control alternatives? Are voluntary or mandatory controls likely to be the most effective? Who is to bear the costs of control? Are the existing institutions adequate for implementing the preferred controls or policy instruments? If the major problems are related to microorganisms in foods, which foods can be inspected more carefully and what changes are required to implement that inspection? How often can careful preparation of food adequately reduce the likelihood of sickness or death? What changes are needed to ensure that consumers are adequately informed about the dangers and appropriate actions? What are the benefits and costs of providing adequate safeguards for consumers? What are the impacts of these safeguards for consumers, processors, and food costs throughout the food chain? How must policy proposals to reduce food-borne microorganisms differ from those to reduce pesticide residues in foods? What is the role of agricultural economics in solving food safety problems?

As in the water quality area, it is difficult to design general solutions to solve specific problems. It appears that specific proposals could be developed to deal with some of the expanding food safety problems. Included among the proposals might be greatly increased funding for food safety research, improvements in the food inspection system for poultry and seafood, development of a system for food safety labeling similar in concept to nutritional labeling currently in widespread use, and creation of educational materials and programs for producers, processors, policymakers, consumers, school children, and the media regarding facts and shibboleths about food safety.

In summary, it will be very difficult for the traditional agricultural research establishment, and agricultural economists are included in this group, to provide solutions to food safety and water quality problems. Colleges of agriculture and agricultural experiment stations tend to be organized into disciplinary or subject matter departments in which scientists have very narrowly focused areas of expertise. The evaluation system rewards disciplinary contributions. The important national journals in each discipline publish disciplinary contributions. Multidisciplinary research is more likely to have a problem-solving focus, and less likely to be publishable in national disciplinary journals. Outside funding for strictly disciplinary research on water quality and/or food safety issues will be difficult to obtain. Perhaps that difficulty is appropriate, given the nature of the problems.

Water quality and food safety research that is to be relevant for problem solving and policy formulation will by necessity be multidisciplinary. It will require imagination, cooperation, and a willingness of those in research and extension to learn the languages of their colleagues from other disciplines. It will likely require modifications in the evaluation and incentive systems traditionally used in the land grant system. It will require creation of national journals willing to publish applied or problem solving research, or a reorientation of our colleagues who, as reviewers and editors, determine what will be published in disciplinary journals. The public expects much from those performing research on water quality and food safety. As Batie indicates, the new agendas of a concerned public should not be seen as a threat to the land grant tradition, but instead as challenges and opportunities to serve the needs of society better. We must act quickly and constructively if we are to satisfy society's food safety and water quality concerns.

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