Pesticide Risk: Making Decisions

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Decisions about pesticide risk—the balance between the costs and the benefits of using a material to control pests—would at first seem to be individual choices about the use of private property. Yet the impacts of pesticides are not restricted to individuals and their own property. Whatever my decision on whether or not to use pesticides on my farm, business, forest, or lawn, I will also be affected by the decisions made by my neighbors on whether or not they use pesticides. Such interactions occur from the personal to the international level. We are discovering, for example, that decisions to use pesticides in other countries may have impacts on consumers and producers in the United States. Because the costs and benefits of pesticide use are externalized (i.e., not borne or received solely by the person or group using the pesticide), collective decisions must be made about the degree of risk to be tolerated by society and the mechanisms necessary to control that risk.

Because of the public consequences of private decisions, the public sector is involved in considerations of pesticide risk. The result is an increasing number of laws regulating the use of pesticides at local, state, and national levels, as well as an increasing number of government agencies at all these levels charged with regulating pesticide use—and, belatedly, with monitoring pesticide presence. Philosophically, the propriety of public involvement is therefore justified. The sociological question is when and why concern about public consequences overcomes our nation's general reticence to interfere with what are defined at the individual level as property rights.

Assessment of the risks of pesticides varies according to the disciplinary background of the individual or group and the system level considered. It is instructive to lay out the criteria used by groups with different intellectual backgrounds for assessing pesticide risks, as well as to analyze the consequences of considering different system levels of risk impact when undertaking such assessments.

Levels of Decision Making

When assessing an intervention into biological systems (one way of conceptualizing pesticide use), we tend to focus on what our training has made easiest to evaluate. The plant pathologist might assess a pesticide according to its impact on plant disease: What proportion of the pathogen population dies when treated with a specific pesticide? An entomologist might assess a pesticide according to the proportion of the insect population eliminated by its application. A farm management economist might assess a pesticide according to the profits a farmer derives from treating a crop compared with not treating it. An agronomist might assess a pesticide according to its impact on yield. A consumer economist might assess the benefits in terms of increased crop production and the resulting price and availability benefits to consumers. An ecologist might focus on the impact of a pesticide on the interactions between organisms, including maintenance of biological diversity in a particular ecosystem. A philosopher might assess a pesticide in terms of conflicting ethical considerations. And a sociologist might assess pesticide risks in terms of power relationships: Who pays and who benefits?

These assessment criteria direct attention to different system levels. The plant pathologist and the entomologist might focus on a single field as the relevant system. The farm management economist might look at a partial budget of farm income and expenditures related to the crop in question. A consumer

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economist might focus on the food system of the United States. An ecologist might focus on the watershed. A philosopher might address ethical issues in terms of the relative impacts on society as a whole, now and in the future. Shrader-Frechette (12) suggests examining duties to the ecosystem, duties to future generations, and duties to present individuals. A sociologist could focus on the farming system (landowners benefit and farm workers pay the cost in terms of risk), the community, the nation, or the world system.

Just as different disciplines have different sets of variables they define as important, so do the large number of regulatory agencies dealing with pesticide risk. As Menkes and Frey (8) point out, "Functions can be defined in such a way that an agency is not allowed to consider risks occurring outside of its domain. In effect, there is a tendency to view these risks as someone else's problem. The result . . . may lead to an increase in overall risk." For example, although there are guidelines for acceptable levels of individual pesticides in groundwater, pesticide mixtures have not been considered.

In the evaluation of a risk, it is important to ask, "Risk relative to what?" Are we comparing the costs of a particular pesticide with the costs of doing nothing and, for example, seeing the Mediterranean fruit fly destroy an agricultural industry? Or are we comparing alternative measures of pest control that might result in some loss (lower benefits) but less risk (lower costs)? Generally, the polemicists on either side of the pesticide issue set up a scenario of all or nothing, which leaves no room for compromise and also ignores the complexity of pest problems and the variety of solutions available or potentially available. As Batie (1) points out, one of the reasons we consider the risk of pesticides is because damage to the food supply has been substantially reduced, "partially due to the great successes of agricultural science, agribusinesses and producers"—those most often linked to increasing pesticide risk.

Decision making regarding pesticides may be aimed at eliminating the risk (banning the use of the pesticide) or reducing risk through regulation and/or research on alternative treatments, often subsidized through incentives for substitution.

Control of pests has proved to be a highly profitable offshoot of the chemical industry. Because the profits from chemical pest control can be easily captured by the private sector, the development of chemical pest treatments has occurred in this sector. Chemical pesticide research has a constant commercial market and a relatively reliable flow of research and development funds. For methods of pest treatment the benefits of which cannot be captured (e.g., some forms of integrated pest management and some biological controls), on the other hand, development tends to be relegated to the public sector and funded only when heavy public pressure is brought to bear.

The results of a research bias toward chemical solutions to pest problems have been evident even in the public sector, where much research done heretofore at the state level by land-grant universities has been chemical-based and funded in part by major chemical companies. These privately oriented, cofunded projects were often viewed as necessary to keep research programs functioning.

As Dietz et al (6) make clear, "All technologies generate impacts—costs and benefits borne by people and the environment. Often large numbers of individuals experiencing little or no benefit from a technology must bear the risks associated with it. At the same time, much smaller groups, such as investors in chemical stocks, experience great benefit and little cost." Because the same individual or group that pays the costs (is harmed by the pesticide) often does not reap the benefits, the assessment of risk is often highly controversial. If I see you getting all the benefits (increased income) while I pay the costs (finding the water in my well unfit to drink), I will view your pesticide use as not only damaging to the environment but possibly also immoral. It is not simply that I am facing a risk but that I am facing it involuntarily. The ethical issue of equal protection from risk becomes, in a democracy, a political question. In such cases, if political mobilization occurs, which is generally sustained more by emotional claims than scientific arguments, government at a local, state, or national level may be pressed to act.

When the profits of a few are subsidized by health risks for the many, government may step in to make it unprofitable to do what is politically defined as immoral. A substance is banned, fines are levied for its unauthorized use, its authorized use is taxed, special permits are required for its application, etc., as the political system becomes the arena through which different system levels resolve the cost-benefit dilemma. The cost of eliminating risks often is borne by a few, while the benefits are enjoyed by the great mass of the population.

Just as the risk incurred is not always voluntary, so are the politically determined solutions involuntary. When the public presses the government to act to reduce the risks associated with pesticides, one cannot assume that programs to educate applicators (or users) of pesticides will be enough to solve the problem. Indeed, unless the controls are mandatory, those who are educated to act with a conscience vis-a-vis pesticides may be at an economic disadvantage compared with the individual who ignores the externalized risk while in search of short-term profit. Only government regulation ensures a "level playing field" for those with moral conviction and a desire to stay in business against less principled competitors.

The Process of Decision Making

Risk analysis of pesticides involves three stages, according to Dietz et al (6):

1. Risk identification, or the selection of potential hazards or threats to human health and the environment to receive attention;
2. Risk estimation, or estimating the probability of the adverse health or environmental effects identified; and
3. Risk assessment, or determining the severity of possible effects.

Generally, the smaller the system level under examination, the less likely it is for health or environmental costs associated with pesticide uses to be identified. The scientists most intimately involved with pesticide development and testing did not discover groundwater contamination associated with pesticide use, identify health problems among field-workers using pesticides, or document the declining prevalence of such species as the peregrine falcon as a result of pesticides in the environment. These were costs that appeared in systems outside the scope of plant or field and, as externalities, did not enter into the calculations until public pressure forced such matters into scientific discourse.

Rachel Carson, with her publication of *The Silent Spring* in 1962 (3), is credited (or blamed) for drawing public attention to the hazards of pesticide use, yet such use continued to increase throughout the 1960s, 1970s, and well into the 1980s. The increasing visibility of hazards, presented by members of the environmental movement rather than the scientific community, changed pesticide risk from a technical problem into a social problem. In the face of increased public concern, "the initial Land Grant-USDA system response was, in the main, denial and neglect" (1).

Thus, evaluation of the externalized costs of pesticides shifted away from scientists, with their neatly limited systems and clearly defined criteria of cost and benefit. Politicians filled the vacuum to evaluate the externalized cost. They did so with no clear system definitions but with criteria for risk assessment that focused more on public salience than on systematic scientific evidence.

Risk estimation may be one of the most controversial areas of risk decision making. The rules of evidence for health risks vary enormously among disciplines, based in part on the degree to which they view themselves as controlling rather than understanding nature (9). A good example of differing criteria for acceptable evidence is the controversy over the safety of dichlorophenoxyacetic acid (2,4-D). This herbicide has been a material of choice for weed control for nearly 40 years. Some salesmen in the early days of 2,4-D would end their sales pitch by drinking a glass of water into which the pesticide had been stirred. Farmers and weed scientists alike responded to the criticism of the herbicide by recalling that bit of product hype. ("By gosh, don't tell me it causes cancer—I'd drink the stuff.") Indeed, the rules of evidence concerning pesticide safety for those engaged in recommending its everyday use (often the weed scientists and the farmers had hired hands actually apply the pesticide) seemed to be that if it didn't kill you or at least knock you over within 15 minutes of ingestion, it could not hurt you.

Determining the cause-effect relationship between any substance and a disease that it causes in animals is often difficult. Chemical companies traditionally rely on toxicological studies of laboratory animals in order to determine what dosages affect the animals in various ways. Animal-rights concerns aside, these studies have certain advantages. Researchers can deliver measured dosages of chemicals in a controlled manner by several exposure routes. A principle of toxicology is the establishment of dose-response relationships. Under controlled conditions, the cause-effect reationship, including both long-term (at least for the life of the animal) and short-term effects, can be noted. Because other animals differ in many important (and often incalculable) ways from humans, however, extrapolating animal results to human response to a toxin is of questionable validity (5). Validity is further compromised because test animals receive relatively large doses compared with those anticipated for humans. According to the Council for Agricultural Science and Technology (CAST), in a review of toxicological studies, "evidence that feeding 2,4-D to laboratory animals causes cancer remains very weak" (5).

Epidemiological studies have been used, primarily by public health personnel, to link exposure to a purported cause and the incidence of the resultant disease. Those from the sciences that attempt to control rather than simply understand nature find it difficult, however, to accept epidemiological evidence in lieu of experimental evidence. The possibility of confounding variables is considered too great, the possibilities for systematic scientific control too small. The advantages of the epidemiological approach are that the organism under study is the human being, not another animal, and useful information can be obtained without long-term experiments. In the case of human cancer, the time between exposure and diagnosis may be very long, which nearly precludes experimental studies, even if ethical considerations were absent. And for many environmental chemicals, there has been no systematic monitoring of their prevalence.

Since many of the costs of pesticides are long-term and become identified only long after particular pesticides have been introduced, causality cannot be attributed absolutely, and assessing the severity and magnitude of adverse effects is difficult.

The lack of readily available data on the distribution of past exposure has led epidemiologists to resort to the case-control research method. This method identifies those with the disease in question, then matches them with controls that share key characteristics but are free from the disease under study. This was the method used in the "Kansas study," an effort of the National Cancer Institute to determine if the 20–30% increase in certain kinds of cancer in the United States since 1975 was related to the introduction of herbicides into general agricultural use after 1946. Deaths recorded by cause by county showed higher rates of such cancer deaths in agricultural areas of Iowa, Nebraska, Minnesota, and Kansas (10). There is also a sizeable literature on cancer mortality among farmers in Iowa, Nebraska, Minnesota, Texas, and Washington (2,7,13). By locating persons with lymphoma and soft-tissue sarcoma and matching them with controls (persons lacking these types of cancer) of similar age, sex, race, and vital status (living or dead) and asking either the individual or close relatives about past pesticide use, the investigators were able to link high exposure to 2,4-D to one of the three suspected cancer types. Use of retrospective or recall data regarding pesticide use habits for the previous 20 years was necessary because pesticide use had not been monitored. Nevertheless, this technique outraged weed scientists, and such a methodological substitute for systematic monitoring was faulted in the CAST report (5). A Swedish study linking 2,4-D to several types of cancer was also attacked for "bias in the recall of exposure, and lack of a clear dose relationship" (5). Interestingly, while the CAST report concluded that "inadequate human and animal evidence exists for classifying 2,4-D as a possible carcinogen for humans," the report contained no call for more systematic monitoring of exposure to pesticides. More epidemiological and toxicological studies were recommended.

A problem with scientifically linking pesticide exposure to cancer in humans is that there is no systematic monitoring of that exposure. As a result, no study can conclusively link pesticides to cancers or other adverse health or environmental effects.

Many of those who defend current pesticide practices as resulting in acceptable risk use a *de minimis* argument. This is a decision tool for dismissing minor risks. According to one version of this rationale, the problem is not in the increasing prevalence of pesticides in the environment (particularly in water and the workplace), but in our increasing ability to measure hitherto undetectable levels of chemical presence. As Batie (1) points out, "Our current ability to detect pesticides and nitrates in groundwater far exceeds our understanding of their significance. . . . (The) origin, relative toxicity, and pervasiveness of different contaminants are not separated in the mind of the public."

Legislation in California that made it illegal for businesses employing 10 or more people to contaminate water beyond scientifically stated levels with any chemicals known to cause cancer, birth defects, or other reproductive problems, and the Delaney Clause of the Federal Food, Drug, and Cosmetic Act, which states that "no additive shall be deemed safe if it is found to induce cancer when ingested by man or animal," are viewed unnecessary responses to our increasing awareness of the small levels of pesticide residue that have long been present. As Menkes and Frey (8) point out, however, "such a position assumes the legitimacy of the political, economic, and social relations that underlie extant patterns of risk." Particularly in the use of chemicals in agricultural production and lawn and turf care, those applying the pesticides (the workers) and those living near the fields (generally the rural poor, particularly children) assume the risks, while the benefits tend to accrue to owners of the enterprises. In such a case, the *de minimis* argument reinforces class inequalities.

Shrader-Frechette (12) has a cogent presentation of good reasons for allowing exceptions to the principle of equal treatment. She cites John Rawls (11), who reasons that inequalities ought to be allowed only if there is reason to believe that the practice involving the inequity will reduce unequal treatment in the long run. If one could show that the use of pesticides is good for the economy and what is good for the economy will promote equity in the long run, such long-term benefits would justify current inequitable distribution of pesticide-related risks. Shrader-Frechette (12) contends that while such an argument would be quite persuasive if the data on income distribution supported it, in fact, inequality has *increased* in the United States during 40 years of pesticide use, despite an increase in the overall income level. She concludes that "there are few grounds for believing that permitting the inequities arising from current uses of pesticides will enhance equal treatment in the long run" (12).

Conclusions

The growing concern with pesticide risk can no longer be met by circling the covered wagons of production science and claiming a utilitarian view that the benefits achieved by pesticide use obviously outweigh the costs for society. As researchers, we must expand our system levels of analysis and take off our disciplinary blinders. We must reconsider our mechanisms of problem identification and relax our rules of evidence to deal with probabilities rather than causal certainties. We must insist on a wider range of indicators of health and safety as dependent variables, just as the type of research we undertake must become more system-oriented and holistic. Interdisciplinary dialogue must increase.

As Christenson (4) makes clear, the inherent controversial nature of critical social issues and the complexity of interdisciplinary efforts needed to address them present an environment most scientists wish to avoid. Our systematic training has prepared us neither to engage in public dialogue nor to defend our working assumptions to "ignorant" laypersons. The easiest stance is to dismiss the controversy over pesticide risk as one that is solely politically motivated by those who reject the norms of science. Yet to isolate ourselves through a stance of scientific superiority does little to resolve the conflict or to educate the public—or ourselves. Although we may not reach a solution that is optimal for all actors, a realistic evaluation of who pays the costs at which system level and who benefits will improve our problem choice while we improve the quality of public risk decisions.

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