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KEY POLICY ISSUES IN THE FARM USE OF CHEMICALS:

WHERE ARE WE AND WHERE DO WE GO FROM HERE?

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KEY POLICY ISSUES IN THE FARM USE OF CHEMICALS: WHERE ARE WE AND WHERE DO WE GO FROM HERE?

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ABSTRACT

Local and regional risk management programs imply different results than the existing emphasis of public management on a chemical by chemical, source by source basis for social control. Local multi-hazard risk management programs are beginning to be encouraged, are complementary to existing policy and, on the whole, are desirable. Indeed such local risk management programs could play a key role in preserving the integrity of rural ground water resources. The issue of the triage problem, or whether contamination of some waters from agricultural chemicals is inevitable and therefore should be planned for rationally, is examined from the point of view of general administration of pollution control.

A recent report of the National Research Council on the responses to ground water contamination from pesticides in four states discusses the need for better knowledge to undergird the choice of policy alternatives for monitoring, identification of vulnerability, health assessment, and the design of use restrictions. The discussion at this conference quite closely supports the findings of that study.

A challenge is to identify possible directions for the evolution of integrated pest management programs as well as more general community-based toxics risk management. Results from a review of chemical control alternatives that lend themselves to economic analysis through simulation modelling show some important differences in net income for Long Island farmers depending upon the form of control that is chosen. Local controls may move in such directions in order to maintain a basis for agriculture while protecting ground water.

The issues considered in recent attempts to amend FIFRA provide a different and contrasting agenda of policy issues. They arise from the current pressures on the stake holders in the existing regulatory process. However, participation in the FIFRA review is changing and a different mix of reforms can be expected. How the need for an improved information base will be treated is uncertain. A caution is raised with respect to the concept that institutional arrangements must wait until sufficient information is available to rationally design and operate them. There is a good case for creating institutions before we know what we are doing. That is one way we find out what we need to know. The motivations and thus the questions are different before and after the creation of an institutional arrangement.

INTRODUCTION

While flying into Kansas City to attend this meeting I read a passage that seemed to pose the right introduction for my assigned topic -- where are we and where are we going in the development of policy for the protection of ground water from contamination by agricultural chemicals. It was on my beverage container:

> "This pure natural artesian spring water has been stored in deep underground reservoirs protected by nature for thousands of years. This is the finest water on earth . . . water from when the earth was pure." (Heilman Brewing Co., Lacrosse, Wisconsin)

A similar yearning for a pure earth but in a quite different context is found in the popular television reruns of M*A*S*H -- the anti-war surgeons in the Korean conflict. A frequent setting for their work is the triage -- the sorting out of the wounded into those with minor wounds, and those with no hope from those who can be saved. These, according to some, are like the decisions that face the nation in ground water protection. How explicit should the triage be? Recognize that for some participants in the public management process we give away part of the position to save the environment if we recognize the legitimacy of the triage question. It is seen as compromising the advocate for protection.

Rational Versus Holistic Points of View

The choice appears to be between "we can't save it all, so we should be rational about it" and "whether we can save it all or not, we should try -- perhaps we don't know enough to be rational." Such a choice, in many forms, runs through the history of water quality controls and of environmental concerns; indeed through the history of our national debate over natural resource policy. The current version can be put as the clash between the rational analytical position and an ethical holistic position, or rational and holistic for short.

Consider the difficulty in defining contamination. Is it any intrusion on native impurity? There are many carcinogens in nature but perhaps we have developed resistance to them. Or is water not contaminated until it is officially declared unfit or unwholesome? That is, when the levels are biologically significant. But what standards should we trust. Any? Whatever the normative answer, what is the practical political significance of those who will not trust any standard, neither its science nor its administration?

A previous speaker pointed out that Abel Wolman, the patriarch of water quality management, recently announced that he had left the rational analytic camp to join the ethical holistic position. This has a great deal of symbolic significance. Recall the impact of Earthday on the concept of classification by use. Classification systems project uses for each stream stretch and then apply the requirements of those uses to the permit specifications for dischargers. In state after state the newly strengthened environmental movement in the 1970's had the least demanding classifications eliminated. A great deal of the nation's waters were reclassified to standards that much more nearly approached those for drinking water.

The use of classifications by intended use, or what was essentially a planning approach to water quality management, began when DO or dissolved oxygen was believed to be an adequate proxy for water quality levels. Also public support for controls was weak at best. Classifications fit our understanding and capacity. Did the strength to raise standards in this way just coincidentally come at the same time that we had an explosion in knowledge that helped the nation know better what it didn't know?

Drinking water standards, for example, are being changed to go beyond a few dozen potential water constituents that are fairly common such as suspended solids, bacteria, or heavy metals. Current attempts are to address the

problem of a large number of potentially very dangerous substances usually thought to have a very low probability of exposure. The list of potential candidates threatens to grow from the hundreds to the thousands with more being introduced every year. Should we consider them to be potential threats everywhere? How do we differentiate between threats of different probability? Complications include the very high cost of testing for the toxicity of any one chemical at even high doses, much less the assurance of low dose effects, cumulative or long term effects, and synergistic effects. The high cost and uncertainty of monitoring and the very high cost of correcting contamination to a drinking water standard gives pause to the acceptance of any policy. Can we expect to save any water that is not obviously needed for drinking purposes? Can we afford not to try? Do we know how to pick the waters to save or how to concentrate our attention so that what we choose to protect is in fact saved? The answers are not obvious. But answers to such questions will come much faster with the development of institutional arrangements that can implement the answers. In other words, our answer to the ground water triage problem is to be found in the institutions we develop to protect it.

Reform Energized by an Ethical Position

Note that the politics of institutional reform are often energized by an ethical position. Unlike the politics of regulation where group stakes are reflected in a bargaining process, reform is characterized by the application of values articulated by national leaders that in setting goals, if not in implementation, must rise above the interests of particular interests. Otherwise the broad coalitions needed for significant reform which clearly shifts the burdens and rewards within society cannot be formed. Either position, the rational analytic or the ethical holistic, will in fact produce the most protection of the resource. The one that can muster the vigor for a reform movement is most likely to provide the basis for rule changes.

The deregulation movement of the last decade has been a part of the continuing process of redefining the relationships between our several levels of government. This history suggests that while the question is not settled in fact, Federal regulatory positions have not shifted greatly in most environmental programs. Either point of view, rationalist or holistic, serves as the basis for reform an energetic federal role seems to be supported.

In the case of ground water there is a measure of agreement that a strong state role is desirable due to the importance of site specific features in the development and execution of control measures. The debate comes in the strength of the encouragement that should be provided by the federal government. It appears that the reformist strength of the ethical holistic position to initiate change assures that there will be a diversity of responses in the fifty states whatever the strength of the federal encouragement.

The history of P.L. 92-500, the 1972 Act that Senator Muskie and others used to reform water pollution control is instructive. The holistic approach led to a structural shift in the bargaining positions of regulator and polluter. At the superficial level, the declaration of zero discharge plus fishable and swimmable as goals made best available technology and best practical technology seem more workable and achievable than if more modest goals had been set. More to the point, the burden of proof shifted. Rather than re-

liance on an ambient standard, and the more rational notion of linking a particular discharge to a violation of that standard, it was only necessary to show that hardware driven discharge standards had been violated, i.e., the hardware wasn't in place or didn't work. The rationalist counter is, of course, that many investments in hardware have thus not been cost-effective.

Proposals for vendable discharge rights and the like are an outgrowth of such reactions about cost-effectiveness of hardware standards. Again implementation of rationalist arrangements awaits the development of institutional mechanisms to carry out such concepts. The very slow evolution of such mechanisms in the past is probably the best basis for predicting what the future may hold. Perhaps the evolution of water marketing and pricing mechanisms will provide an experience base for more such arrangements in water quality management. If true, that would appear to be well into the future.

THE FIFRA AMENDMENT PROCESS

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) has not been seriously amended in 14 years. Its amendment process may be a bellwether for where we are going. FIFRA like the water quality legislation was given a major overhaul during the explosion of environmental interest and reform in the early 1970's -- when ground water was too poorly understood to serve as a focus for reform.

Background for the Evolution of FIFRA

Some background is important to understanding the current situation. FIFRA began as a farmer protection program to insure that what the label said on the outside of the package fit the ingredients on the inside. It was administered by the U.S.D.A. alone. Farm chemicals were few in number and less exotic in formulation. Before the modern synthetic chemicals became so widely available in the late 1940's and 1950's, pest control involved management options and physical as well as chemical treatments. The needs for close observation and early response were well understood. Some of the early uses of radio and telephones in rural areas were to quickly share information about pests that had just appeared in the area. County spray services were organized to help with the response, and in some states districts were formed to bring extra social pressure to bear on the community approach to pest controls. Obviously with the chemical revolution these community institutions and many of the non-chemical means of control no longer were necessary. They have been revived in the recent use of Integrated Pest Management or IPM. While early chemical formulations were not always very effective, the margin between having a crop or not at all appeared much narrower. Sound advice on the choice and use of a chemical was more important. Improper labelling whether knowingly or unknowingly done posed a substantial economic loss to the farmer.

In several stages, protecting the environment from the chemicals whose use and effect was described on the label became a major objective. With the advent of the U.S. Environmental Protection Agency it was given a cooperative role in the review of label registration. Eventually EPA became the lead agency. Worker safety was soon more of a problem with the new chemicals and

is probably still the dominant orientation to the process of reviewing the label for registration. The label specifies with what crops and in what locations the product may be used.

This is not the place to delve further into the complex process of label registration. But it should be intuitive that there are limits to how fine grained a management process can be loaded on the label registration device. For example, differences in ground water vulnerability and value for drinking water have been hard to reflect. Hazards from other chemicals, farm and non-farm, cannot be fully taken into account. Supplementation with applicator training and integrated pest management is done, but there can be only limited recognition of associated risk reduction measures in the process itself. Minor crops and minor regions have problems getting recognized for consideration and approval -- the process is not cheap.

Development of Risk Analysis

Risk analysis has become much more sophisticated in about the period since FIFRA was last amended. This is the process that allowed the food industry to live with the Delany Clause to the Food and Drug Administration's legislative authority. In that the Congress declared that any detectable amount of a foreign chemical that causes cancer in humans was unacceptable in most foods. Testing for a cancer response in humans was out of the question and so was waiting for enough human exposure information to develop.

Animal testing and projecting dose response curves to try to understand the possible effect on humans of very low concentrations of chemicals has come into its own. There appear to be some 30 to 40 points in the process where judgements about acceptability of risk enter into the risk analysis process. These are becoming more and more routinized as scientists debate the process. For example, the standard of 1 in 1,000,000 as acceptable death risk, plus a variety of safety margin multipliers are now widely accepted and standardized in the protocols of the several agencies that do risk analysis for chemicals. Just as is true for many other user classes of chemicals, few of the farm chemicals in common use and their carriers have had a full evaluation by today's standards for an acceptable risk analysis. Of course those standards can be expected to get more complex as more is learned about the fate and transport of chemicals in ground water.

Agricultural chemicals pose their own unique attributes that have to be taken into account because they are purposely spread on the land. Leachability, for example, is now known to differ greatly from chemical to chemical and soil to soil. Root and worm channels have been found to be the freeways of the unsaturated zone confounding estimates of diffusion. And the variability in the breakdown processes in different soils is also just being understood. There are many sources of variability to be taken into account in the review of the labelling about which much less was known 14 years ago than today.

Consideration of FIFRA Amendments

More important to the policy process is the fact that these ground water-related concerns were not the only issues or even uppermost in the minds

of some of the groups dealing with FIFRA day to day. They also had an agenda derived from other concerns. Note too that this legislation is not the province of the environmental committees of the Congress where ground water has been a lively issue, but rather the agricultural committees. Hence those that have worked together fending off the Watt and Gorsich-led onslaught on environmental programs and the subsequent catharsis and rebuilding, have been quite separated from those concerned with FIFRA. Thus when coalitions began to form in the process of hammering out amendments, many of the groups that had taken an interest in ground water protection in Superfund or the Safe Drinking Water Act were not included.

In a complex program or issue the informal delegation process by which agreements and support for reform is worked out can include dozens of groups. Typically there is a process of sub-delegation where some staff of the Committees or the interest groups represent the interests of others and agree to keep those less active informed of the progress of negotiation. What holds interest representatives at the bargaining table is a combination of factors. For example, there has to be a perception that if a minimal level of agreement is reached changes will be enacted. And any single interest has to expect that without their participation the process will go on without them to the disadvantage of their interest.

A bill was introduced into the House of Representatives that according to key informants captured many of the concerns of the interests close to the program and some of those who were eventually attracted to the process. As it was already fairly late in a crowded and already contentious session, it would have been difficult to find a workable level of agreement in the best of circumstances. But more participants late in the process slowed proceedings down and meant that the space in the agenda was lost to legislation that either had more steam behind it or where there was agreement. The new Congress is now taking up the question again, and the interested parties are meeting to see if they can find agreement. They may be overtaken by the consideration of a comprehensive ground water bill which will deal with the risk from chemicals used in agriculture. Several have been offered. Senator Durenberger (Republican of Minnesota) has offered a comprehensive bill with an emphasis on prevention rather than remediation which contains a non-degradation goal and minimum program elements for 14 classes of sources, four of them agricultural. The overall approach is tailored after the general water pollution control program in its emphasis on acceptable practices. Levels of enforcement are to vary by levels of risk. Senator Moynihan has also offered a comprehensive ground water bill.

Issues Considered - Some Examples

Some of the issues addressed in the House bill in the Fall of 1986 to amend FIFRA and the concerns reported about them tell a little about where we are and where we may be going. The elements which are used to deal with the various issues on the table become the trading material by which agreement is hammered out. For example, how many chemicals should be retested. The House bill proposed that 600 of the 1625 chemicals used in 50,000 products be tested. Note that several hundred chemicals make up the bulk of the usage but that the number is growing. In 1978 it was estimated that there were 1500 chemicals in 35,000 products. Apparently for the first time the "inert" in-

gredients would be reviewed. Fees of $50,000 to $150,000 for each action chemical suggest that some $60 million would be involved. At recent rates of accomplishment it would be many years before these would all be worked through to the re-registration of the labels involved. Concern for the number and the criteria for selection of those to be tested exists on both sides of this issue.

Another proposal was the preemption of the States' right to have stricter rules for pesticide residues in food than the federal standards. Only a few of the larger states such as New York, California, Ohio and Pennsylvania need to respond to a call for stricter acceptable risk levels and they effectively set the standard for a product that uses the offending chemical. There was hot opposition to this proposal but also strong support. Some were attracted to oppose preemption because of a general commitment to protect this avenue to innovation.

Many chemicals are patented to protect the developmental costs borne by the manufacturer. Extensions of the period for which patents could be enforced through the courts was proposed. Such a measure should have had value as compensation for increased burdens on the manufacturers that were being considered.

Registrants were to be required to share information with the public about the behavior of a chemical in the ground and the results of ground water monitoring. This takes on more significance when it is realized that this is an industry where firms have been reluctant to release information of almost any kind because of its value to their competitors. Also more ground water monitoring in the areas where the chemical was used would be expected. Controls were to be put in place by EPA when triggered by predetermined levels of concentration in the water in order to prevent build up to more seriously biologically significant levels. Critics were concerned that such information would come too late and not be sufficiently systematic to really protect aquifers. DBCP, one of the major pesticide contaminants, was not discovered until years after the chemical was withdrawn from use.

The Liability Issue

The final example of a proposal on the table would have exempted farmers from liability for damages and for clean up costs if they followed the provisions of the label at the time of use. The difference between this treatment of liability and that for Superfund sites would have been substantial if enacted.

Inconsistent treatment by public programs is not inconsistent if it is justified by the circumstances surrounding those involved. Sometimes one way to insure different results is to treat everyone alike. There is no shortage of cases to wonder about. The treatment of firms that produce tobacco and asbestos, and the history of automobile airbags and atomic reactor core protection devices are examples.

Many programs provide differential treatment for farmers. From workers compensation and child labor laws to wetland protection and the definition of point pollution the debate has been necessary. Arguments for differentiating

the treatment of farmers have included a wide variety of considerations. The family farm has a special place, and for many farms the only thing a farmer who died a generation ago would recognize today is who is doing the work. The advent of more corporate farms and particularly the lobbying by large farms for such things as protected water costs in the recent Reclamation Reform Act proceedings have cut into the power of that image. Many accept, however, that farmers are disadvantaged by the rush of new technology, by a propensity to grow more of their own replacements than society needs, by a lack of economies of scale because of the seasonal nature of their work, and their cycles of over investment and failures. With price supports and some aspects of the industry regulated a dependency notion can creep into a concern for an issue like pesticide use.

There is a long tradition of recognizing the different circumstances of farmers. But will the "outsiders" attracted to the FIFRA reform process be willing to go along with an exemption of liability for farmers? The history of the role of conservation measures in the farm bills over the years and some other related events may give some further clue to where policy is heading.

OTHER STRAWS IN THE POLICY WINDS

Note that in the passage of the last farm bill some key informants felt that urban votes were attracted to its support because they could rationalize to their constituents that they had won major soil conservation concessions. For the first time very different treatment in the form of rental payments to take land out of production is available for land that is more erosive. Likewise for the first time compliance with conservation plans is a prerequisite for continued eligibility for price supports. Some feel that these measures were more attractive to the urban Congressmen than food stamps. Could ground water protection have that kind of trading appeal in four or five years when negotiations on the next farm bill are underway? Exchanges that cut across major legislative areas are much more difficult than within an area, and the timing in this case cuts the chances even further. But the indication of the continuing bargaining power of agriculture is significant.

The recent renewal and revisions of Superfund to clean up hazardous waste sites has some interesting features. Authority for an award of up to $50,000 for assistance to the localities around the sites should facilitate the development of local institutional arrangements to prevent future occurrences of the problems being cleaned up. This also suggests that more communities will be encouraged through technical assistance to adopt risk management measures that take a multiple hazard approach.

An interesting pair of questions suggest themselves about Superfund and agriculture. Should Superfund be used to clean up aquifers contaminated by farm chemicals? And if so, should farmers be exempted from its polluter pay provisions?

Recent amendments to the Safe Drinking Water Act require states to develop wellhead protection programs and provide for demonstration grants for aquifer protection activities. Both embody the multiple hazard approach to risk management. The Office for Groundwater Protection in EPA is drawing up rules for the wellhead program. A wide diversity of state responses is ex-

pected. As yet no funds have been appropriated for the demonstration aquifer protection projects.

An interesting straw in the wind may be the results of the passage of California's Proposition 65. A tradition of complex issues put to public referenda continues. Liability is shifted to the releaser of the chemical to the environment and thus away from manufacturer, technical advisor and regulator. But farmers and small businesses are at least partly exempt. Advisors and manufacturers may end up with a relationship similar to that of an architect or engineer or doctor. California has used public districts as imaginatively as any state. Weed control districts were in use there at one time. Perhaps Proposition 65 will push for the creation of a public pest control district to spread the remaining risk and otherwise manage chemical use. How should the management and effectiveness of FIFRA or other federal programs be affected by such complementary state actions?

THE NEED FOR BETTER INFORMATION

Many incidents of ground water contamination, particularly those involving pesticides, came as a surprise and not only to the farmer who applied them and whose drinking water was probably the first to be affected. A 1986 report written for the Board on Agriculture of the National Research Council by Patrick W. Holden details information needs to reduce these surprises in the future. Holden's findings were based upon interviews in New York, California, Wisconsin and Florida. They seem to have been confirmed by the discussion at this symposium. They need to be pushed a bit further.

Understanding the Nature and Scope of the Problem

Screening and analytical techniques, sampling protocols, leachability factors, characterizations of how differences in soils and farmer practices affect fate and transport, are high priority information needs. Other technical areas with a high priority include speeding up the process of risk analysis and identifying health standards. Also cost-effectiveness of treatment techniques is of concern. The current national pesticide survey by EPA and the ground water quality survey by the U.S. Geological Survey will certainly put our knowledge of some of these topics to a rigorous test and should stimulate more focused research. This will only be part of the process of sensitization and issue development that will be achieved by those survey results.

Defining the characteristics of susceptible sites and actually delineating vulnerable areas on maps that are of use to community leaders and public officials would seem to be an important next step. A few states have started such a process. USGS has made important contributions as has the Soil Conservation Service. Budget increases for both should be considered.

Likewise pesticide use data is not adequate for almost any purpose but is particularly deficient in most states for the needs of any kind of local risk management program. The sample design of the EPA survey of pesticides in ground water has already come under fire because of such inadequacies.

Point source contamination from manufacturing, formulating, mixing and transporting chemicals is pinpointed as a different aspect of hazard from agricultural chemicals. Different measures to identify and reduce this source of risk are needed.

Institutional Capacity to Respond to the Problem

The report points out that since ground water contamination from farm chemicals is a newly recognized problem institutional capacity to deal with it has not had a chance to develop. It lacks "a developed body of law, established institutions and formal administrative procedures." Moving away from ad hoc responses will require the resolution of some underlying issues. Who should act, and how and who should pay for accommodations to existing and future contamination? How should the lack of health standards be dealt with in the short and long run as well as the lack of acceptance of those standards? How can the uncertainty with respect to different roles be removed? And since it is clear that in some areas major reductions in the risk of contamination appear to be achievable only if there are major changes in the mix and level of agricultural activity and practices, how are these changes to be identified and brought about in an equitable and effective manner?

Holden states that "many of those interviewed believed that case-by-case, site-by-site restrictions are feasible and warranted, although there are concerns regarding the feasibility and administrative costs of such an approach in light of the generally complex and cumbersome regulatory tools currently available at the state and federal levels." Research can speed the process of capacity development especially if it is organized to be in response to the process of institutional evolution.

Income Effects on Long Island Farms Due to Pesticide Cuts

A recent study of Long Island Agriculture by Brian Baker at Cornell University highlights some of these points. He built a model that simulates the 29,000 acres which includes most of the crop and vegetable farming on the Island. This includes the 26,000 acres that had received applications of aldicarb, the most widespread of the pesticides found under these productive sandy soils. The model started with the economic return relationships of the various production enterprises and then refined the effect on those returns of different combinations of pesticide use. This involved a substantial effort to characterize the production responses of the crops including the development of resistance to chemical controls on the part of the pests. This analytical tool was then applied to different restrictions on the use of chemicals. Like any such tool it did not fit all alternatives equally well, but it does provide some useful insights.

Aldicarb, oxamyl and carbofuran were featured. All used to control nematodes on potatoes, all are now banned from use on that crop. The cost per pound was $20, $22.50 and $12.50 respectively. The tax on each that would be necessary to take it out of use would have been $125, $70 and $65 respectively.

If a tax on potatoes was used to reduce the acreage of that crop and thereby reduce risk, it is worth noting that a tax up to $80 per acre had no effect on the amount of potato acreage grown by the model. And there was only a small replacement with other crops by the model with taxes up to $583 per acre of potatoes. At a tax of $1000 per acre they are cut from about 16,000 acres down to 2400. Capitalized values of the losses due to such taxes would be significant but not unmanageable. This is indicated more directly by looking at the effects on present values of the farm income associated with different chemical restrictions.

Take potatoes out with a tax or some other device and the model makes a net income of $22.5 million, lowest of any of the options considered. About $3 million is added if pest control is achieved by rotation with other crops. $6 to $8 million is added to the base by either a moratorium on growing potatoes, or a ban on the three pesticides (the current situation), or simply a ban on aldicarb. No restrictions on the use of the three pesticides yields a return of $32 million. If the right to use chemicals was purchased from the model at the amount they were worth to this simulation of Long Island agriculture the comparable net return to the model would be $34 million.

The purchase of chemical rights is more than an option of interest because it fits the analytics of the model. The County of Suffolk has had a program of purchasing development rights from farmers as a way to shape urban growth and preserve the amenities of the Island. The purchase of chemicals use rights with or without development rights is under some discussion.

A case can be made that with current controls on the use of toxics by industry, commercial and residential land uses, the risk of contamination may be less from continued agricultural use than the likely alternative for at least some of the land now farmed. Techniques for comparisons of risk between different chemicals and other methodological elements of the problem should be improved before this judgement can be carried as far as needed. But the point is that until local governments were ready to start making choices between the risks of different land uses with and without other complementary management enhancements, the comparative question was not likely to be asked.

Not very many rural localities have a history of purchasing development rights from farmers upon which to build a ground water protection program. But do many have local programs of Integrated Pest Management? What incremental steps might be taken where that is the case?

BUILDING UPON INTEGRATED PEST MANAGEMENT

Recent research into community reactions to ground water contamination incidents has indicated that local institutional capacity may be critical to successful prevention. One convincing hypothesis is that by operating within strong cultural norms of individualism, those affected by contamination favor sources of information that are either reinforced by their own observations or at very least reinforced by an accepted local authority figure. For example, when there is prior trust of local government officials there may be more expectation that a problem will be reasonably dealt with if they are involved. In a similar vein, building upon an existing institutional arrangement is usu-

ally more feasible and cost effective than creating a new arrangement when there is fairly widespread agreement that something should be done.

IPM is of interest on both counts. It is a cooperative approach between state and county level applied scientists and farmers. It is oriented toward the use of an analysis that is holistically appealing. IPM is driven by an ecologically based production system analysis to minimize the use of chemicals within economic constraints that are informal but nonetheless subject to community influence. An intuitive sense for the processes of risk analysis and risk management should be had by the more experienced practitioners and should be growing among the recruits. Group use of the specialized skills of a pest scout is a well accepted feature of the program. Sometimes the scout is provided as a private fee service, sometimes provided by a public jurisdiction.

Concern for holdouts, antisocial risk adverse behavior, plus free rider behavior should already be present in the IPM network. In other words, those who stay out of the program and who don't take adequate steps to control pests soon enough endanger their neighbors from the spread of the pests. They may get a free ride because they have fewer problems to deal with if their neighbors did cooperate and paid for the scout, etc. At the other extreme are those who overuse chemicals as a kind of insurance policy. They don't want to take the risk that the scout will miss the early infestations, or they just want to be defended from variability in returns at any cost.

These and similar arguments such as the sharing in the cost of an expensive skill or equipment item may encourage more working together. Some aspect like the risk of ground water contamination may justify working through a local governmental entity to provide stability over time, financial support or to encourage wider participation. In other words, others in the community may benefit from a more effective IPM program and thus consideration should be given to whether they should pay a share of the cost. Obviously something like a tax on drinking water might not be easily accepted, but a contribution from the general municipal fund may be not that hard to achieve.

Part of a Three-Tiered Approach

IPM fits into a three-tiered approach to the management of risk from chemical contamination. The first level is driven by the technical choices which will reduce risk available to the chemical users. Best management practices are those which cut the possibility of contamination and still achieve the production goals of the enterprise. Costs may be higher, returns a little lower, but there is not likely to be a very large sacrifice in income in exchange for the reduction in risk unless there is strong social pressure or other incentives.

The regular use of standards and monitoring is not relevant to the concept of the first tier. However, comparative risk assessment information would be very useful even if it were not enough for standards to have been formally set. As we have seen for many situations the information base for standards is not present and is not likely to be for many years. If the resource is either valuable enough or the risk of contamination is great enough or some combination then more than the first tier is called for.

A second tier would involve moving beyond practice choices still with only modest effect on cost and returns, but could also imply larger gains in risk reduction. Greater incentives and greater justification would be needed. Standards and monitoring may have to play a role in order to justify the imposition of those incentives either to find the budget to make cost sharing payments or to provide a beginning on an enforcement process. For example, some low percentage of a drinking water standard may trigger a response. This may not be much more than an environmental risk audit of the operation from time to time. New York's watershed rules program in which over 200 community water systems participate has some features that fit into this tier.

The third tier is the use of enforcement and remediation measures more along the lines of Superfund and some wellhead protection programs. These are very much driven by standards and monitoring. Geographic differentiation of vulnerability zones are a standard feature and it is expected that as the value or replacement cost of the resource being protected goes up that the stringency of the protection program would go up perhaps disproportionately.

How can the first tier be made more effective? Should there be more recognition in the way IPM is organized and supported of such factors as vulnerability and replacement cost of the resource including future use value. Whose interests are at stake? Who should help pay? What are the options that might be considered and what do we need to know to choose between them? Are we likely to ask the right questions if we don't try a few new arrangements?

How should research be organized to support the evolution of an IPM program that was responsive to the challenges that face protecting ground water? An action research approach suggests itself. Applied scientists are already involved and at least for production oriented questions can be expected to respond promptly. Is IPM equally well supported for its institutional development needs?

REFERENCES

Abdalla, Charles W., Douglas B. Beegle, and William T. McSweeny, "Farm Economics, Policy Choices: Animal Agriculture and Groundwater Quality," Cooperative Extension Service, the Pennsylvania State University and the U.S. Dept. of Agriculture, University Park, PA, March/April 1987.

Davies, J. Clarence, "Science and Policy in Risk Control," Risk Management of Existing Chemicals, Chemical Manufacturers Association, Proceedings of a Seminar Conducted Dec. 8-9, 1983, Washington, DC, Government Institutes, Inc., Rockville, MD, June 1984.

Derouin, James G. and Rep. David Bartlett, "New Arizona Act Designed to Assure Water Quality," Arizona Waterline, Salt River Project, Phoenix, AZ, Winter 1987.

Environmental Law Reporter News and Analysis, Environmental Law Institute, Washington, DC, Vol. XVII, No. 3, March 1987.

Environmental Reporter, The Bureau of National Affairs, Washington, DC, Oct. 13, 1986, p. 1035-1036.

Ibid, March 6, 1987, p. 1862-1863.

Ibid, March 13, 1987, p. 1888-1890.

Ground Water Contamination and Protection, Hearings before the Subcommittee on Toxic Substances and Environmental Oversight of the Committee on Environment and Public Works, United States Senate, June 17, 20, and July 16, 1985.

Ibid, Oct. 24, Nov. 14, and Dec. 12, 1985.

Gruttadaurio, J., E.E. Hardy, and A. Lieberman, "An Investigation of Turfgrass Land Use Acreages and Selected Maintenance Expenditures Across New York State," Dept. of Floriculture and Horticulture, Cornell University, Ithaca, NY, 1978.

Gust, Larry, Tom Klaseus, Gregory Buzicky, and Paula Ripley, "Pesticides and Groundwater: A Health Concern for the Midwest," Freshwater Foundation, Navarre, MN, 1986.

Hallberg, George R., "From Hoes to Herbicides: Agriculture and Groundwater Quality," Journal of Soil and Water Conservation, November/December 1986, pp. 357-364.

Holden, Patrick W. "Pesticides and Groundwater Quality: Issues and Problems in Four States," The Board on Agriculture, National Research Council, National Academy Press, Washington, DC, 1986.

Olexa, M.T., A.E. McMichael, and A.H. Daniels, "Regulations Governing the Use of Agricultural Pesticides," Pesticide Impact and Assessment Project Manual No. 3, Bulletin 212, Cooperative Extension Service, University of Florida, Institute of Food and Agricultural Sciences, Gainesville, FL.

Park, Colin N., and Ronald D. Snee, "Quantitative Risk Assessment: State-of-the Art for Carcinogens," Risk Management of Existing Chemicals, Chemical Manufacturers Association, Proceedings of a Seminar Conducted Dec. 8-9, 1983, Washington, DC, Government Institutes, Inc., Rockville, MD, June 1984.

"Pesticides in Ground Water: Background Document," Office of Ground Water Protection, U.S. Environmental Protection Agency, Washington, DC, May 1986.

Pimentel, David, Carol Glenister, Sarah Fast, and David Gallahan, "Environmental Risks of Biological Pest Controls," Oikos, Copenhagen, 43(3), 1984.

Rodricks, Joseph V., "Government Data Requirements for Risk Assessment," Risk Management of Existing Chemicals, Chemical Manufacturers Association, Proceedings of a Seminar Conducted Dec. 8-9, 1983, Washington, DC, Government Institutes, Inc., Rockville, MD, June 1984.

Shabecoff, Philip, "House Votes, 329 to 4, to Toughen Environmental Law on Pesticides," New York Times, Sept. 20, 1986.

Strain, G.J. and D. Freshwater, "Options for Managing Pesticide Container Disposal in Agriculture," Extension Bulletin No. 85-2, Dept. of Agricultural Economics and Farm Management, University of Manitoba, Winnipeg, Manitoba, July 1985.

Upchurch, M.L., M.T. Olexa, and Alan E. McMichael, "Summary Guide to Regulation of Agricultural Pesticides," Circular 618, Cooperative Extension Service, University of Florida, Institute of Food and Agricultural Sciences, Gainesville, FL.

"Western Water, Proposition 65: The Toxics Initiative," Water Education Foundation, Sacramento, CA, November/December 1986.

White, Gerald B., "The Economics of New York's Pest Management Program for Tree Fruit," Dept. of Agricultural Economics Staff Paper No. 80-9, Cornell University, Ithaca, NY, March 1980.

Zecharias, Y.B. and K.S. Porter, "Groundwater, Chemicals and Risk Management Colloquium," NYS Water Resources Institute, Center for Environmental Research, Cornell University, Ithaca, NY, 1985-86.

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