Agriculture At Risk

A Report To The Nation

Agricultural Occupational and Environmental Health: Policy Strategies for the Future

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America's most productive work force is being systematically liquidated by an epidemic of occupational disease and traumatic death and injury in the face of diminishing local and federal resources.

by

The National Coalition For
Agricultural Safety and Health

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Cooperating Organizations

Because of their concern for farmers' occupational health and safety, the following organizations have endorsed the process and purpose of the conference:

American Association of Comparative and Veterinary Toxicology
American College of Veterinary Preventive Medicine
American Conference of Governmental Industrial Hygienists
American Lung Association of Iowa
National Institute for Farm Safety
National Institute for Rural Health Policy
National Rural Health Association
National Safety Council
Society for Occupational and Environmental Health

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This report represents a summary of discussions held at the conference "Agricultural Occupational and Environmental Health: Policy Strategies for the Future" on September I8-2I and 27-30, I988, in Iowa City and Des Moines, Iowa. The conference involved approximately 170 scientists, policy makers, and private citizens. Technical reports which served as the scientific basis for these recommendations will be published in the American Journal of Industrial Medicine.

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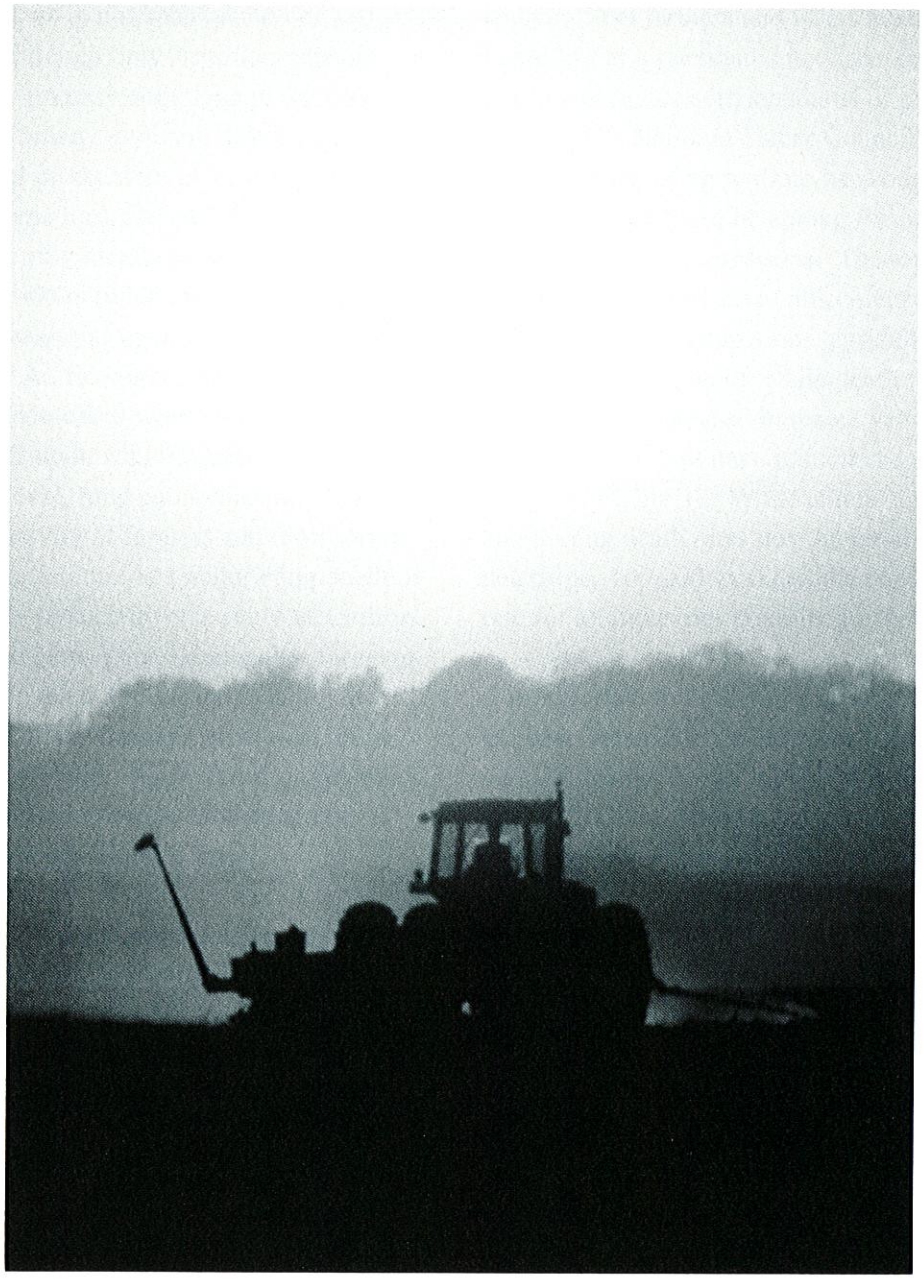
Table Of Contents

The Problem



STATEMENT OF THE PROBLEM

Any consideration of the agricultural work force must include a reflection of the vital role that agriculture plays in our society and our nation's economy. Although only 2 million persons report sole or primary employment from agricultural work, many more are directly involved in agricultural production: 3.1 million persons who claim some farm income, 6 million additional farm family members, and 2.7 million hired farm workers (which would include migrant and seasonal workers) (figures reported by the U.S.D.A., Economic Research Service in 1981). This combined work force produces the food and fiber upon which Americans depend. At the local level, rural economies rely heavily on the productivity of farmers and farm service providers. Agriculture is a major component of the economies of such diverse states as California, Iowa, and New York. Nationally, farm surpluses have enabled Americans to enjoy low food prices while avoiding a disastrous imbalance of foreign trade. Agricultural productivity has been a major impetus establishing our nation as a world economic force.

In addition to its economic contributions, America's farming population has contributed much to the social fabric of this country. Independence, responsibility, determination, self-reliance, and industry are qualities that typify the agricultural lifestyle across this country. These are societal characteristics that are clearly desirable in modern America.

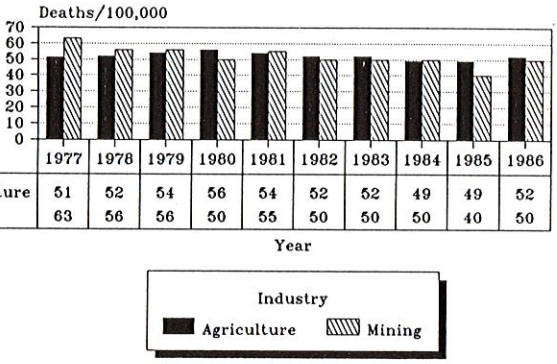
In view of the economic and cultural importance of the agricultural work force, the accelerated loss of our farmers and farm workers to work-related disease and injury must be viewed with alarm. Our farms and farmers should be recognized as potentially non-renewable natural resources. Yet farmers and farms are currently being lost at a rate that is not acceptable according to current western standards of public health. The National Safety Council's (NSC) annual survey of agriculture has consistently shown agriculture to be among the nation's most hazardous occupations. These statistics reveal a clear trend when this country's two most hazardous occupations, agriculture and mining, are compared: while death rates in mining have decreased in recent years, death rates in agriculture have remained constantly high (see Figure 1). While annual agricultural and mining death rates now hover around 50 deaths per 100,000 workers, the annual death rate for all industries combined is only 11.

It is important to note that these figures, which in 1986 were based on an estimated 1600 agricultural deaths, do not include the approximately 300 children killed each year while engaged in farm-related activities. More than half of these deaths are traumatic machine-related fatalities.

While these mortality statistics establish agriculture as a most hazardous occupation, vying with mining for first place on the death roles, the estimated 170,000 disabling farm injuries that occur each year are having by far the greatest impact on agriculture, rural communities, and the rural economy. Nearly half of all survivors of serious farm trauma are permanently impaired. These victims incur enormous hospital and rehabilitation costs (an estimated 2.5 billion dollars in 1983), which are rarely covered by

Figure 1

Comparison of Annual Death Rate
Per 100,000 Workers
Agriculture and Mining



Safety Facts, National Safety Council. **Accident Facts**, 1987 ed. National Safety Council, Chicago, IL, 1987.

worker's compensation. It should be recognized that even though NSC figures include forestry and fishing in their definition of agriculture, other epidemiological studies have indicated that NSC data underestimate farm injury rates by as much as 50%.

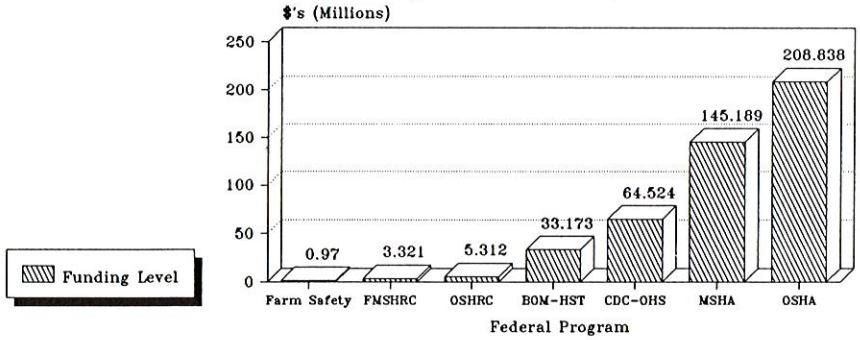
These statistics deal only with the obvious, compelling epidemic of agricultural deaths and disabling injuries. They ignore the wide range of agriculturally-related diseases that have been documented in several epidemiological studies, but for which adequate state or national statistics are not available. It is clear, however, that increased rates of work-related diseases affect nearly every body system. In addition to acute illness, farmers and farm workers suffer from increased chronic disease including chronic lung disease, certain cancers, arthritis, dermatitis, and noise-induced hearing loss. Problems such as these are intensified by the lack of occupational health and safety services available to the agricultural work force, and by the inadequacy of relevant preventive and educational programs and medical research in the field.

In addition, farmers and others dwelling in rural areas now may face the uncertain dangers of chemically contaminated drinking water. It is widely recognized that increased nitrate and certain pesticides in groundwater pose a potential threat to farm families, including children. Concern about the health effects of agricultural chemicals and the high incidence of agricultural injuries and diseases ranked high on the list of priorities of Iowa and New York respondents to a University of Iowa farm family survey.

Particularly regrettable is the lack of federal and state programs to deal with this epidemic. A double standard separates agriculture and general industry: agricultural deaths, diseases, and injuries occur at much higher rates than in industry, yet agricultural health and safety problems are largely ignored by federal and state agencies. Farmers have been systematically denied the potential benefits of a variety of programs aimed at supporting and protecting the American worker. Analysis of federal spending reveals that farm safety receives a minuscule proportion of the safety and health dollars spent (see Figure 2).

Figure 2

1986 Federal Funding Levels for Occupational Safety



Farm Safety--Farm Safety-USDA Extension Service
FMSHRC--Federal Mine Safety and Health Review Commission
OSHRC--Occupational Safety and Health Review Commission
BOM-HST--Bureau of Mines, Health and Safety Technology Research
CDC-OHS--Centers for Disease Control, Occupational Safety and Health Research, Training, and Scientific/Technical Services
MSHA--Mine Safety and Health Administration
OSHA--Occupational Safety and Health Administration

Purschwitz M.A., Field W.E.: Federal Funding for Farm Safety Relative to Other Safety Programs. In Proceedings of the 1987 National Institute for Farm Safety Summer Meeting, NIFS, Columbia, MO. June 14-18, 1987.

When funding levels (excluding the small amount of National Institute for Occupational Safety and Health (NIOSH) agricultural safety support) are calculated on a per-worker, per-fatality, and per-disabling injury basis, the striking differences in funding between agriculture, the hazardous mining sector, and all employed workers are obvious (see Table 1).

This gap between federal funding of programs for agricultural safety and programs for other workers is growing. While all occupational safety programs have suffered significant funding cuts in the last decade, federal support for agricultural safety is less than half the meager appropriation of 1976 (see Table 2).

Table 1.
Federal Dollars Spent on Occupational Safety*

Industrial Sector	$/Worker	$/Death	$/Disabling Injury
Agriculture	0.30	606.25	5.71
Mining	181.68	363,366.00	542.00
All	4.34	39,769.57	230.66

*as estimated by NSC for 1985

Purschwitz MA, Field WE: Federal Funding for Farm Safety Relative to Other Safety Programs. In **Proceedings of the 1987 National Institute for Farm Safety Summer Meeting**. NIFS, Columbia, MO., June 14-18,1987.

Table 2.
Federal Funding for Occupational Safety*

Year	Farm Safety	Mine Safety	Total Occupational Safety
1976	$ 1.02	$ 170.41	$ 331.53
1987	0.49	100.67	255.42

*millions of dollars, based on inflationary reductions in the dollar's value since 1976 and on changes in federal funding of safety programs.

Purschwitz MA, Field WE: Federal Funding for Farm Safety Relative to Other Safety Programs. In **Proceedings of the 1987 National Institute for Farm Safety Summer Meeting**, NIFS Columbia, MO., June 14 - 18, 1987.

The Occupational Safety and Health Act states that every working man and woman in this country should have a safe and healthful working environment. The figures quoted above demonstrate that this mandate has not yet been extended to the agricultural work force. Despite documentation of the epidemic of traumatic death and disabling injuries, the widely recognized increase in acute and chronic diseases among farm workers, and an array of toxic and hazardous exposures on the farm and in rural groundwater, the well-being of American agricultural workers has been largely omitted from state and federal governmental agendas.

Reasons for this omission are multiple (see Table 3), but are nevertheless regrettable. Other industrialized countries, including Canada and many western European nations, have developed health and safety programs that have effectively reduced the risks of agricultural work. Yet, in this country, there is no federal agency with a clear mandate to address the health, safety, and environmental risks faced by agricultural and rural populations. Research, education, and training funds to address this rural epidemic are few and are decreasing in the face of inflation and federal budget cuts. Health services also are shrinking with the rapid loss of

Table 3.
Reasons for the Lack of an Agricultural Safety and Health Agenda in the United States

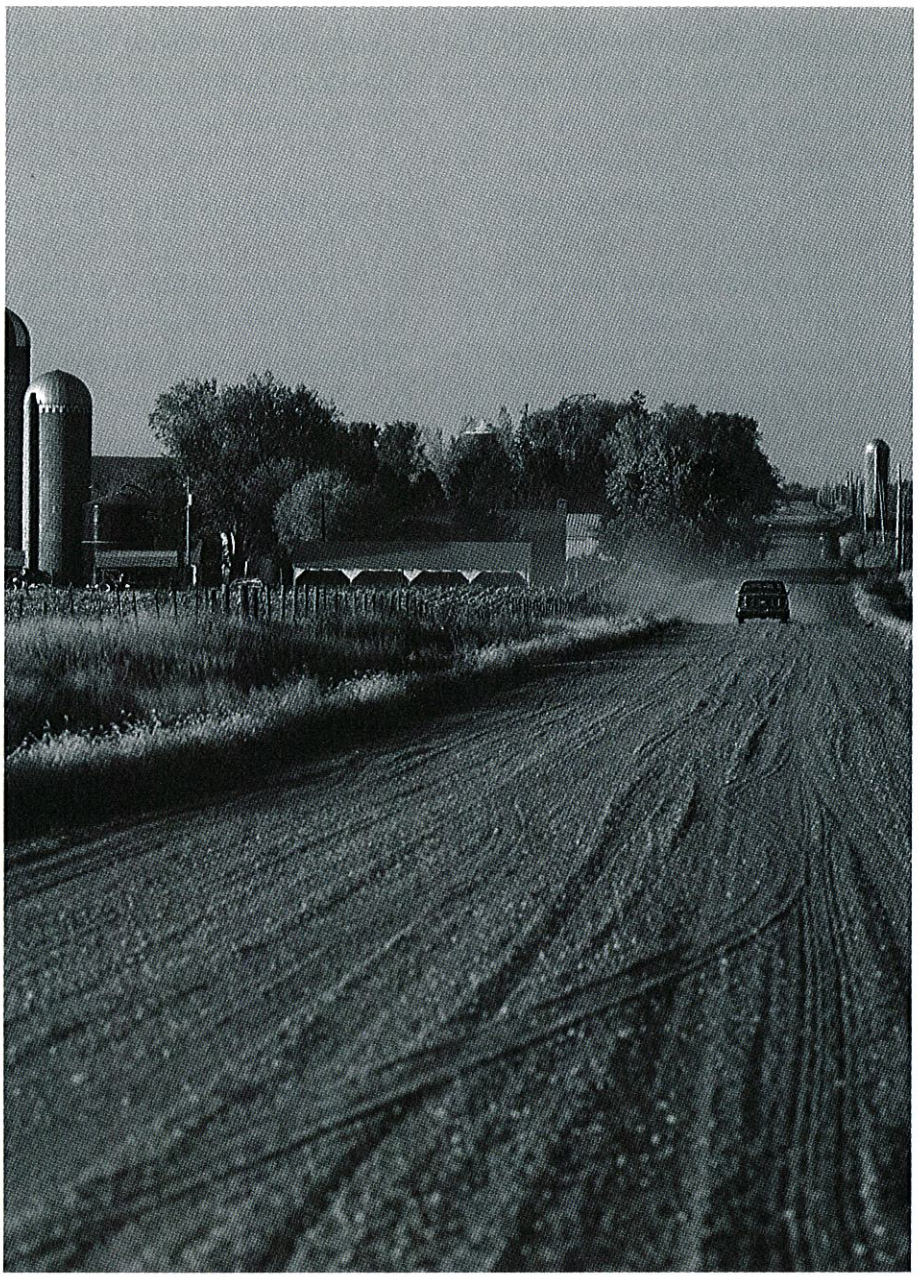
1. General public is unaware and therefore unconcerned.
2. Not recognized as part of the larger rural health agenda.
3. Farm population has not raised the issues.
   - Accept responsibility and blame themselves instead.
   - Concerned, but do not know what to do.
   - Independent by nature.
   - No broad-based organizations or unions to represent farm families and workers.
4. Farm constituency groups have not raised the issues.
   - Economics predominates, not health.
   - Concern about restrictive regulations.
5. Federal/state agencies have not become involved.
   - Lack of leadership.
   - Agricultural concerns divided among many agencies.
   - Deterred by farm groups.
   - No mandate.
6. Academia has not become involved.
   - Few research dollars, and therefore few incentives to work in this area.
   - No broad-based scientific forum (professional organization or journal) to discuss the issues.

rural community hospitals and their emergency, diagnostic, and rehabilitative services.

The result is that America's most productive work force is being systematically liquidated by an epidemic of occupational disease and traumatic death and injury in the face of diminishing local and federal resources. This largely unrecognized epidemic is endangering the health and safety of both American agriculture and the rural communities that rely so heavily on agribusiness.

In order to document these problems for the public record and to stimulate activities leading to formation of a national policy addressing agricultural health and safety problems, a four-part, action-oriented conference was held in September, 1988. This Report to the Nation describes the conference organization, summarizes the scientific papers presented at the conference, and lists the wealth of policy recommendations that were produced by conference participants.

The Conference



THE CONFERENCE

An eight-day conference, involving a total of approximately 170 scholars and policy makers, was held in Iowa City and Des Moines, Iowa, in September, 1988. This conference was named "Agricultural Occupational and Environmental Health: Policy Strategies for the Future".

Conference Goals and Objectives

Conference planners initiated the planning process with several major goals in mind. Primary among these was the desire to avoid the traditional conference structure, focused on presentation and publication of scientific information. Instead, a conference on agricultural and rural health and safety issues must have a life after the initial meetings, a life capable of instigating policy development in the future.

Other goals incorporated into conference plans included invitation of grass roots input from the agricultural community. This input was included from the start, and was continued throughout the planning process. Scientific information would be reviewed, summarized, simplified, and passed on to the general public and persons in policy making positions. The conference structure would encourage policy makers to utilize technical information and farmer input to suggest effective policy. The bipartisan nature of the issues would be emphasized.

The five specific conference objectives were as follows:

1. To summarize state-of-the-art knowledge about research and programs that help create a safe and healthy agricultural work environment, and that encourage safe agricultural chemical use.

2. To integrate the viewpoints of farmers and farm workers, the private sector, and public institutions into formation of a policy agenda for agricultural occupational and environmental health.

3. To identify research and service needs and pertinent policy issues, emphasizing the family farm, for the following topics:

    - Environmental health strategies for agriculture
    - Occupational health and safety hazards in agriculture
    - Delivery of agricultural occupational health and safety services

4. To formulate policy strategies and implementation methods in the three topic areas.

5. To communicate results of policy strategy discussions to key legislators, policy makers, staffs of pertinent federal and state agencies, farm constituency groups, farm families, and the general public.

Conference Structure

A unique four-part conference structure enabled the welding together of grass roots input from the farm community, current scientific information, and ideas suggested by the general public into a public policy agenda. The unusual structure and flow of the conference are outlined in Figure 3. Each of the four conference segments is briefly described below.

Farm Community Views

Farm Advisory Panel

A 13 member farm advisory panel assured that the conference objectives and process were realistic, and that the conference included the views of the farming population and farm constituency groups. The panel also reviewed the Farm Family Survey questionnaire. This panel was organized early in the planning process so that input into formation of conference strategies was assured. Names and affiliations of Farm Advisory Panel members are listed in Appendix I.

Farm Family Survey

An in-depth (14 page) telephone survey of nearly 1,200 randomly selected farmers and their spouses was conducted in Iowa, New York, South Carolina, and Washington. The survey was designed to obtain detailed information on farmer and farm family concerns about health and safety hazards, attitudes and perceptions about health and safety hazards, related behaviors, and ideas about prevention. The survey required five scientists dedicating an average of 10% of their time for 12 months, approximately 5,600 hours of staff time, and $30,000 to complete. It was the first systematic, in-depth survey of its kind ever to be completed. These survey results were integrated into both the technical and policy working groups and were utilized in formulating the policy recommendations seen in this report.

Technical Working Groups

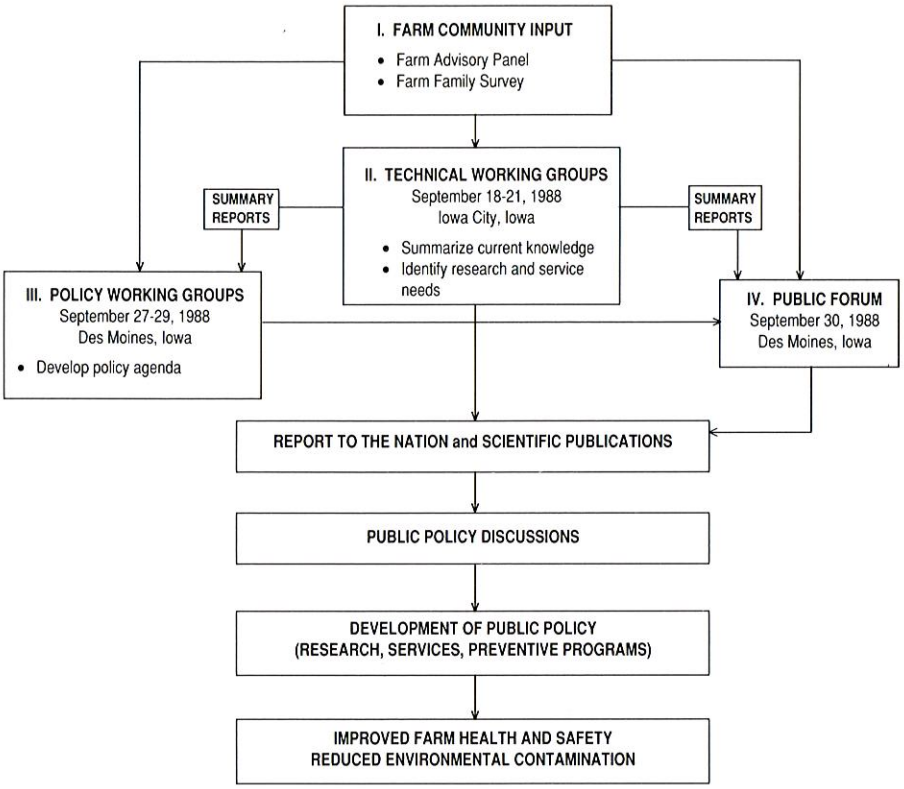
The Technical Conference involved 64 invited health scientists from the United States and five foreign countries, all of whom had interest and experience in agricultural health and safety issues. Participants formed a multi-disciplinary group of epidemiologists, biostatisticians, veterinarians, physicians, engineers and other scientists, and nurses, who represented a broad background of institutions including those of academia, health care systems, industry, and government. These specialists spent 43 hours each, over a three and one-half day period, delivering 70 papers and participating in group discussions with the intent of developing recommendations to present to policy makers in the following segment of the conference. Appendix II lists the names and affiliations of technical working group members.

Policy Working Groups

The Policy Conference consisted of 118 policy makers and scientists, including representatives of state legislatures, federal legislative offices, industry, state and federal health agencies, farm constituency groups, the agricultural community, and academia. These individuals spent 30 hours each, over a three day period, discussing the results and recommendations of the technical group and developing a report and policy agenda to address the issues identified by the technical group. The names and affiliations of policy working group members are listed in Appendix III.

Figure 3.

Agricultural Occupational and Environmental Health : Policy Strategies for the Future



Public Forum

The results and recommendations of the working groups are summarized in the following sections of this report. Health and safety issues and recommendations (including those concerning research and education) are presented first, followed by a discussion of environmental issues. Although the two types of issues are distinctive, they both affect the health and safety of the agricultural work force and those living in rural areas. Both issues must be incorporated into a fully developed agricultural health and safety policy agenda. The full report of the technical session is to be published in The American Journal of Industrial Medicine.

Following the policy conference, a public forum was held. This forum allowed transmission of the conference results to the public, with an opportunity for public commentary and input into the final proceedings. The day-long forum was attended by 105 individuals, eight of whom presented formal testimony which emphasized certain aspects of the results of the technical and policy work groups. Persons testifying represented the agricultural community, farm constituency groups, farm commodity groups, industry, the health care delivery system, and environmental groups. The testimony was entered into the conference record.

Conference Results

Farm Family Survey

Six major conclusions of the survey, based on results from Iowa and New York, were especially helpful to policy working group members in formulating recommendations. These six points are outlined below.

1. Farmers recognize that they work in a very hazardous occupation. Approximately 73% said that their occupation was more hazardous than most other occupations (see Figure 4).

2. Farmers are quite concerned about health and safety issues. Between 57% and 84% of those interviewed rated farm health and safety concerns equal to or higher than other concerns such as farm commodity prices, soil erosion, and general environmental concerns (see Figures 5 and 6).

3. Farmers' major family health and safety concerns are related to problems with stress, agrichemicals, trauma, and respiratory diseases (see Figure 7). Nearly 50% of farmers reported experiencing serious occupational stress. Nearly 40% of farmers reported animal-relatedtrauma and 20% reported breathing problems. An equal percentage reported musculoskeletal conditions.

4. Farmers want occupational health and safety services made available to them, and farmers are willing to help pay for these services. Farmers are particularly interested in a service that can provide a telephone hot line as well as screenings and prevention programs to detect exposure to pesticides and drinking water contaminants, and to identify respiratory conditions. (See Figure 8).

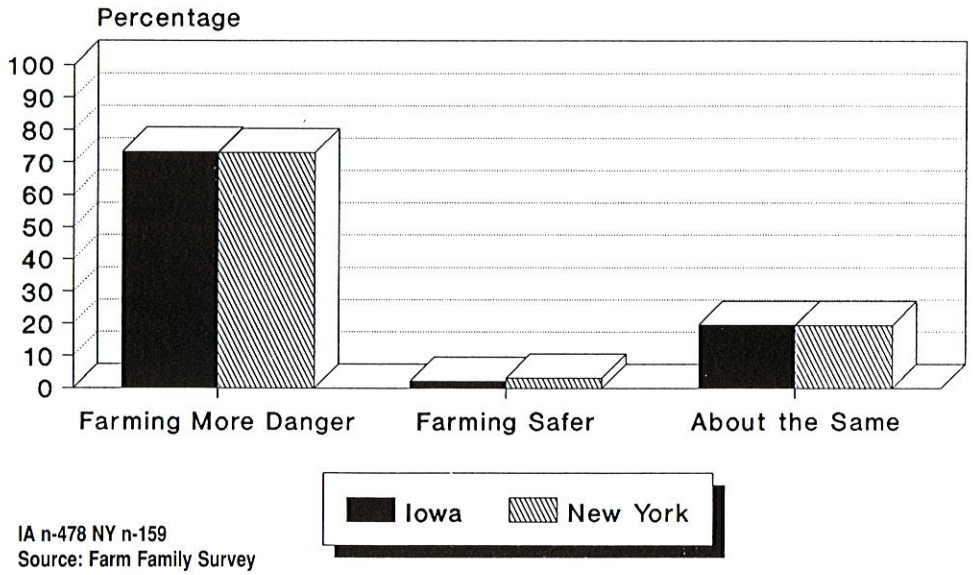
5. Farmers commonly turn to farm magazines and the Cooperative Extension Service for information on agricultural health and safety issues. However, medical centers and veterinarians are given a high rating for value and validity of information.

6. A videotape of on-farm interviews with farmers was produced for educational purposes. Many of the farmers' views expressed in the videotape represent views held by the larger farm population. Farmers interviewed for this video felt strongly that any new or proposed agricultural health and safety programs must be practical, and should take into consideration the unique requirements of farming.

This brief sampling of results is limited to a small portion of information coming from the ongoing analysis of the survey. Survey results were used in preparing the policy recommendations coming out of this conference.

Figure 4

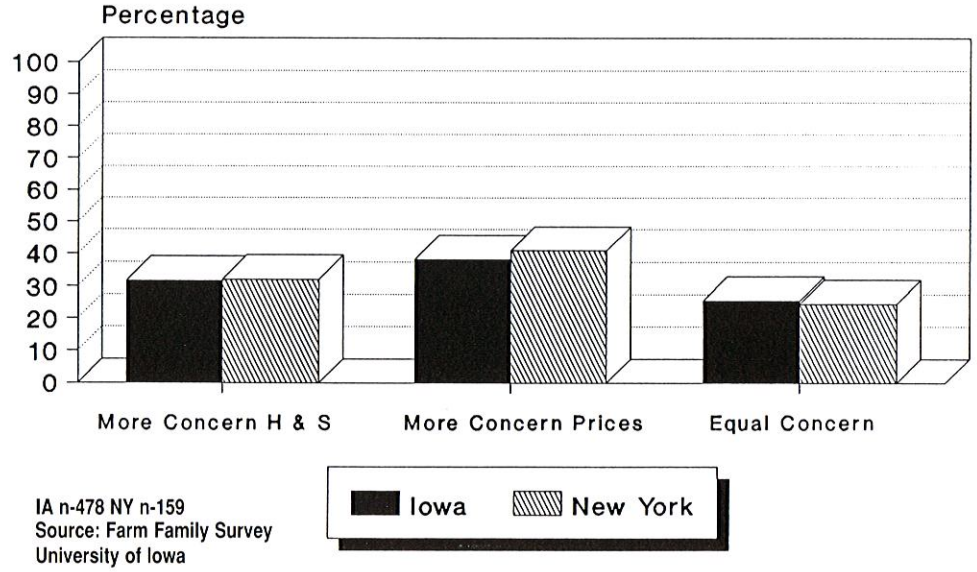
Farming & Other Occupations
Perspectives on Relative Hazards



IA n-478 NY n-159
Source: Farm Family Survey
University of Iowa

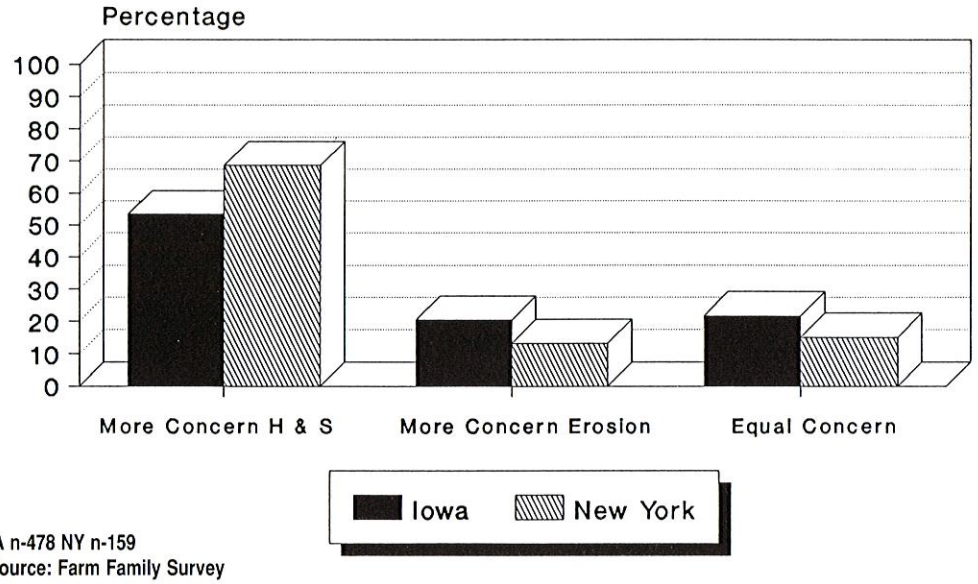
Figure 5

Concern About Farm Health & Safety vs.
Concern for Farm Product Prices



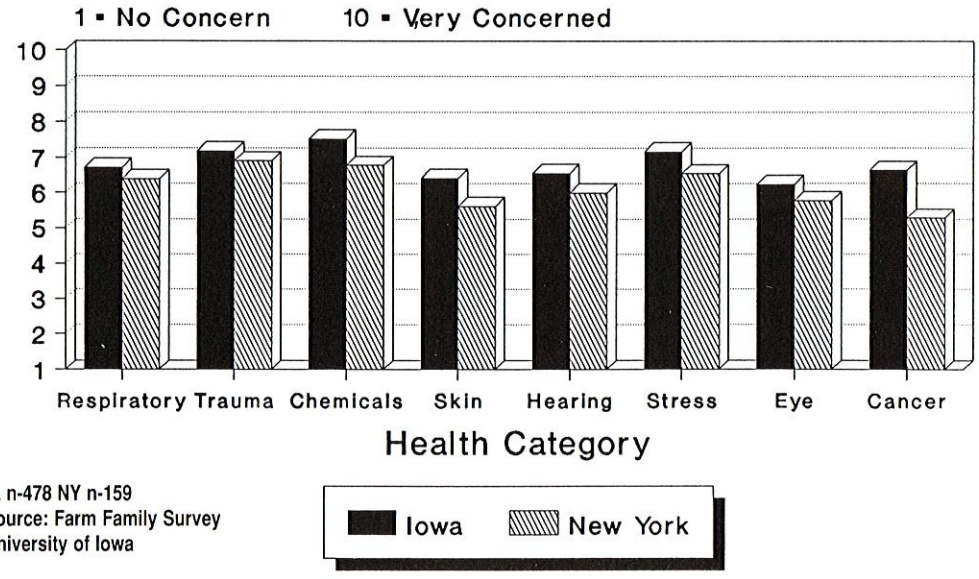
IA n-478 NY n-159
Source: Farm Family Survey
University of Iowa

Figure 6 Concern About Farm Health & Safety vs. Concern for Soil Erosion



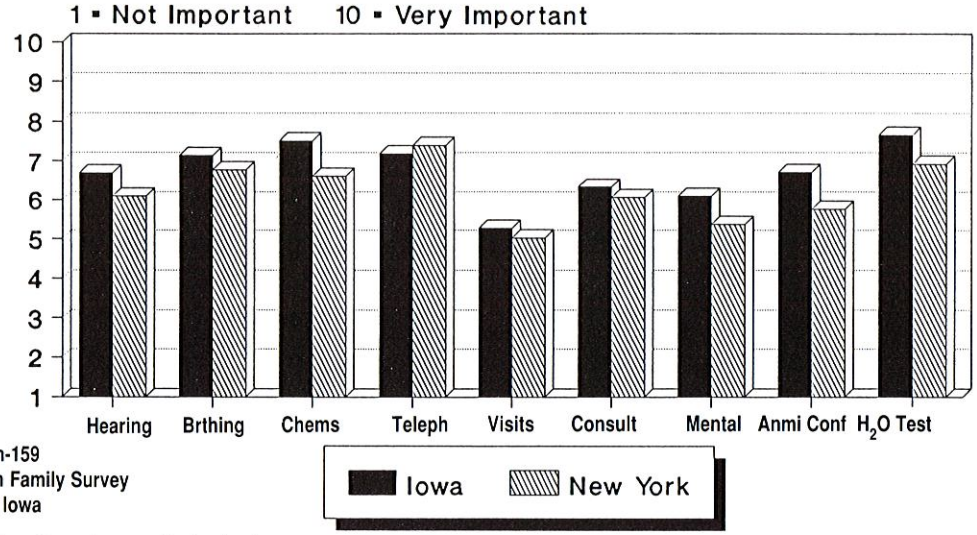
IA n-478 NY n-159
Source: Farm Family Survey
University of Iowa

Figure 7 Mean Values of Farmers' Ranking of Family Health Concerns



IA n-478 NY n-159
Source: Farm Family Survey
University of Iowa

Figure 8 Mean Values of Farmers' Rating of Farm-Related Health Care Services



IA n-478 NY n-159
Source: Farm Family Survey
University of Iowa

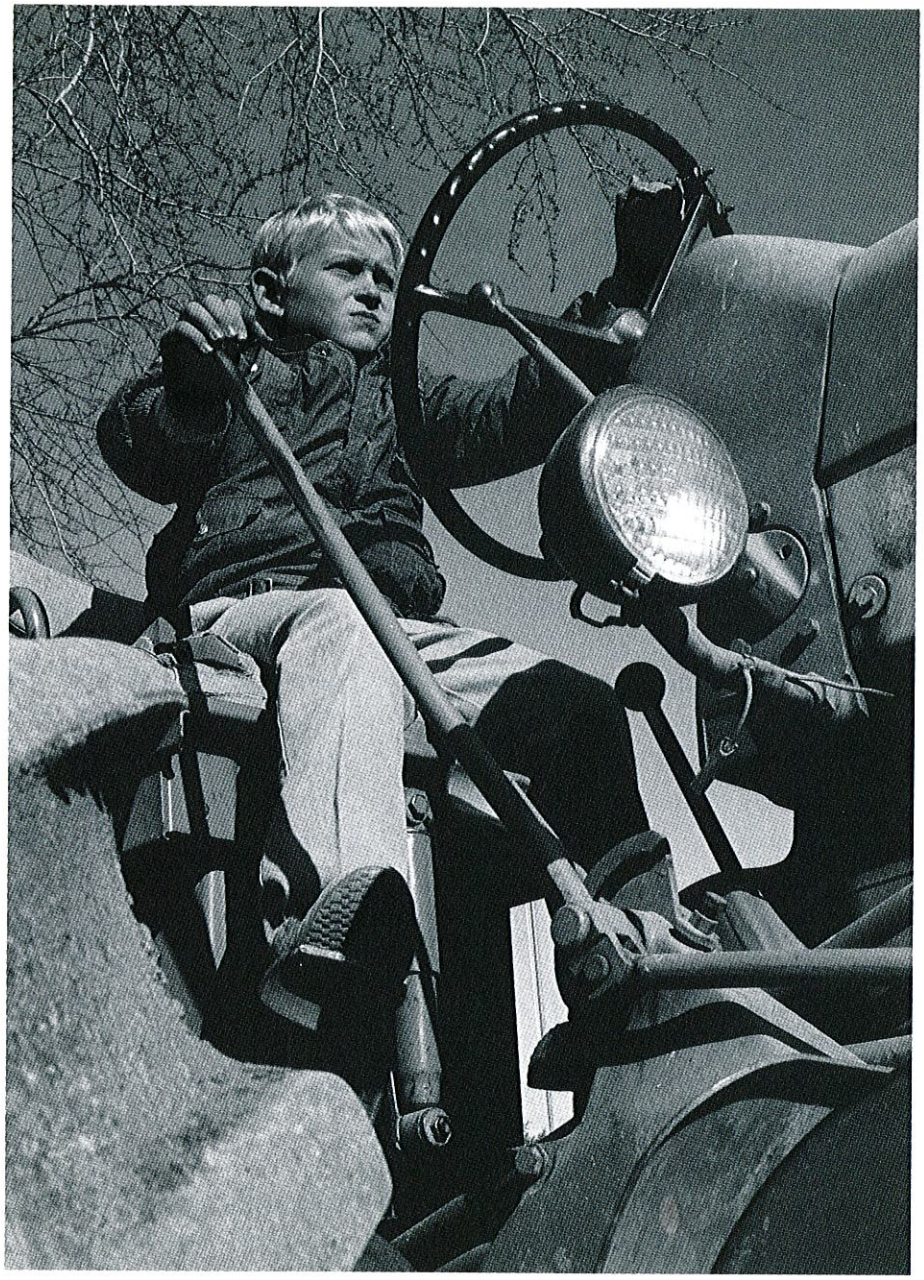
Hearing--Screening tests for hearing loss
Brthng--Screening tests for breathing problems
Chems--Screening tests for chemical exposure
Teleph--Telephone information hotline (specifically ag.)
Visits--Visits by health and safety expert (on farm)
Consult--Consultation by a health and safety expert after an accident
Mental--Mental health counseling
Anmi Conf--Air testing in animal confinement buildings
H_2O Test--Private well water testing for chemical contamination

Formation of the National Coalition for Agricultural Safety and Health

Conference attendees felt that a working group of professionals dedicated to improving the agricultural health and safety situation must be created if the conference's spirit and goals were to be carried forward. This sentiment induced the formation of a new committee which was named the National Coalition for Agricultural Safety and Health. This ongoing coalition consists of 29 individuals who were primarily members of the conference policy working group. These individuals have accepted the tasks of disseminating conference results and developing a coalition of professionals and organizations to articulate and carry out conference goals. The coalition also intends to promote the policy recommendations raised at the conference, until these issues find their own life in policies and programs that reduce health and safety hazards in agriculture. Members of the National Coalition are listed in Appendix IV.

In recognition of the need for grass roots, farmer-based involvement, the National Coalition will support the efforts of a growing, active organization -- Farm Safety for Just Kids. The group is led by its founder, Marilyn Adams of Earlham, Iowa. During the coming years, the volunteer members of this organization will provide important links with the farm community.

Agricultural Safety and Health Issues



Photograph courtesy of Successful Farming Magazine,
Meredith Corporation, Des Moines, Iowa

AGRICULTURAL SAFETY AND HEALTH: THE ISSUES

Occupational Injuries and Diseases of Farmers and Other Agricultural Workers

Agricultural and environmental hazards resulting in increased deaths from traumatic injury and disease and increased morbidity from acute and chronic disease were reviewed by a group of invited national and international authorities under six headings:

- Health and Safety Surveillance
- Agricultural Injuries
- Respiratory Conditions
- Acute Chemical Toxicity
- Cancer
- Other Agricultural Health Conditions

Traumatic Injury and Death

As summarized in Statement of the Problem, traumatic death and injury dominated many conference discussions. A sense of urgency among participating scientists arose mainly from the recognition of the unabating epidemic of traumatic death and injury in American farming, an epidemic about which we know too little and for which we have no defined public health policy and therefore no prevention strategy. Agricultural injuries affect, in substantial numbers, children under the age of 16 and the elderly 65 and older.

Traumatic death and injury arise primarily from interaction with farm machinery, which accounts for over one-half of the agricultural traumatic deaths. The tractor has been identified as the predominant instrument of traumatic death and disabling injury, accounting for over three-quarters of the deaths in the best documented national study of agricultural traumatic death. Most of these deaths were the result of tractor overturns. Data from Sweden documented a linear decline (to an extremely low rate) in tractor roll-over fatalities following mandatory introduction of roll-over protective structures (ROPS) on all new tractors, and retrofitting of ROPS on all old tractors. ROPS safety devices are available on newer models of tractors produced in this country, but ROPS could be retrofitted, in most instances, to older equipment.

In addition to tractors, other farm machinery including power take-off drive shafts, gravity-flow grain wagons, augers, and grain storage structures contribute significantly to traumatic death and injury. Other injuries result from inadequate farm building design and livestock handling. Again, injury-reducing design technologies are often available but are not widely used because of a lack of hazard recognition or because of economic constraints.

Acute and Chronic Disease

A less obvious but also serious problem is that of occupationally-induced acute and chronic disease, which affects nearly every body system. Farmers and farm workers suffer from increased rates of respiratory disease, certain cancers, cumulative repetitive trauma syndromes, acute and chronic chemical toxicity, dermatitis, noise-induced hearing loss, and stress-related mental disorders including increased rates of suicide.

Respiratory Disease

Numerous respiratory exposures found in farming may result in acute and chronic lung disease. Potential exposures include: high levels of organic dusts that are frequently contaminated with pathogenic fungi, bacteria and their toxins (including endotoxin from bioengineered bacteria being tested for agricultural use), irritant gases including ammonia, oxides of nitrogen, hydrogen sulfide, a vast array of toxic pesticides, solvents and fuels, welding and diesel fumes, sensitizing plants and insects, and feed additives including antibiotics.

Agriculturally-related respiratory disease affects over 40% of certain high risk groups, such as persons working in swine confinement units. Dairy farmers are more likely than other farm subgroups to contract farmers' lung and organic dust toxic syndrome, which are induced by high concentrations of fungi and bacterial toxins found in agricultural dusts. Farmers are clearly at a significantly higher risk for acute and chronic airway obstruction from occupational asthma and chronic bronchitis. Farm spouses and children, who share the farm work, are also more likely to contract these lung diseases. This is of particular concern among children, whose developing lungs may carry lung impairment into adult life.

Cancer

Farmers and farm workers have a low to normal mortality for all cancers combined, a factor attributed to significantly lower smoking rates. However, epidemiological studies of farmers have uncovered consistent excesses of hematologic cancers including leukemia, Hodgkin's disease, non-Hodgkin's lymphoma, and multiple myeloma, as well as cancers of the lip, skin, stomach, prostate, and brain.

Causative agricultural exposures have not been conclusively identified, but agents of concern include nitrate, pesticides, viruses, antigenic stimulants, and various fuels, oils, and solvents. Excess cancers of the lip and skin are linked to increased exposure to ultraviolet radiation. Associations that may provide clues to the causes of farm-related cancers include an excess of hematologic malignancies and soft-tissue sarcoma among butchers and slaughterhouse workers, an excess of soft-tissue sarcoma and non-Hodgkin's lymphoma in forestry workers, and increased rates of non-Hodgkin's lymphoma among persons with drinking water contaminated by nitrate. Several epidemiological studies have focused on the effects of pesticides, particularly phenoxyacetic acid herbicides. These studies are beginning to provide evidence for links between these herbicides and non-Hodgkin's lymphoma, although not all investigations have shown this association.

Pesticide Toxicity

Acute toxic reactions and, more recently, chronic neurologic health effects have been linked to the widespread use of modern pesticides, in particular to the organophosphate pesticides. Exposure to pesticides constitutes an important chemical exposure worldwide. While the routes of occupational exposure are usually dermal or respiratory, effects of exposure are most often systemic. Children are often exposed, and they represent a significant proportion of those suffering acute and chronic pesticide poisoning.

The widely used organophosphate pesticides, which have largely replaced the persistent, ecologically damaging organochlorine pesticides, have been found to be associated with some cases of central nervous system damage in

addition to the well recognized acute toxic injury. Many pesticides, especially the pyrethrums, are respiratory irritants that can induce acute or chronic lung disease. Other long term, chronic effects of pesticides in the environment are discussed in a later section of this report.

Dermatitis

Agricultural workers are exposed to a wide variety of physical, chemical, and infectious agents that can cause or exacerbate dermatitis. Examples include ultraviolet radiation, plant materials, soils, fertilizers, pesticides, and agents causing zoonotic infections. Epidemiological data indicate that occupational dermatitis is very common among United States farm workers. In 1984, skin disorders comprised over two-thirds of the occupational illnesses reported by the Bureau of Labor Statistics among crop production workers. Skin disorders in this group were over five times more common than among all private sector employees combined, and nearly three times that of manufacturing employees.

Musculoskeletal Syndromes

Degenerative musculoskeletal syndromes are pervasive among farmers and other agricultural workers. These syndromes result from chronic vibration from the tractor and other farm machinery, and from other repetitive trauma associated with farm work. The most commonly reported musculoskeletal syndromes include low back pain, hip arthrosis, and degenerative arthritis of the knee and upper extremity. Swedish agricultural medical clinics report arthritic conditions to be among the most common complaints of their farmers.

Noise-induced Hearing Loss

Hearing loss is a well documented result of exposure to the noise of farm machinery, especially the tractor. Noise-induced hearing loss has been found to affect a quarter of younger farmers and fully one-half of older farmers. Significant numbers of those affected have been found to develop a communication handicap by age 30. Sweden and Australia have introduced hearing conservation programs for farmers to prevent this form of impairment, which so often results in social isolation.

Mental Disease

Stress-related mental disorders, especially depression, are increased among farmers, farm family members, and other rural inhabitants. Some of these disorders appear to be related to isolation, and others result from agricultural stressors such as economic hardship and weather conditions, which play an important role in crop production. In addition, farm families are not immune to domestic violence, separation and divorce, and drug and alcohol abuse. These multiple stresses often interact in the agricultural setting.

The Need For Occupational Safety and Health Services

The diversity, severity, and high prevalence of work-related health and safety problems stress the magnitude of these problems among farmers and farm workers. Given the compelling needs, what efforts are being made to address the occupational health and safety service (OHSS) needs of this important group? The answer is

disappointing. While the federal government has attempted to deal with one important segment of the agricultural work force by establishing and recently re-funding migrant health clinics, little is available for the family farmer and rancher.

Over the years, The National Institute For Farm Safety (NIFS), the American Society of Agricultural Engineers, the American Conference for Governmental Industrial Hygienists (ACGIH), and the Cooperative Extension Service, among others, have made efforts to draw attention to agricultural occupational health and safety problems. Efforts to document agricultural health effects have been made by a handful of groups including The University of Iowa, the Marshfield Clinic (Wisconsin), the Bassett Hospital (New York), Clemson University and the Medical University of South Carolina, and Colorado State University. Because of the magnitude of the problem and the lack of funds to provide long term programs, none of these efforts begin to address the needs of the current agricultural work force.

The needs of this work force are not being ignored in other countries. Sweden and Finland have developed specific OHSS systems for agricultural workers. The systems are voluntary, subsidized by the government, and receive an annual fee from farmer participants. While the focus of these services is clearly preventive, diagnostic and rehabilitative services are included. In Sweden and Finland, about 30% of all farmers have joined the system. The OHSS clinics perform screening, health and safety education, farm visits, ergonomic analyses, counseling, and work practices modification. Farmers have come to enjoy and respect these systems, and participation is growing in both countries. Ontario, Canada has a well-developed farm safety program that includes environmental hygiene and safety consultation. Similar services are delivered through France's well-developed insurance system. The Netherlands and Australia are rapidly developing similar programs.

Could similar occupational health and safety services for family farms and farm workers be developed in the United States? The tenuous economic situation of American agriculture and the absence of a consolidated national farmer's organization suggest that attempts to copy other countries' programs may be difficult. For example, Sweden's preventive health services are provided by a system that is separated from the curative care system. Such separation may be difficult in our current economic climate. At the same time, attempts to establish an industrial model with a clinic at the work place seem unlikely to succeed, given our many disbursed, small family farms with few employees. Clearly, new models of OHSS need to be developed here.

One suggestion for America is a rural health-OHSS hybrid. This hybrid would graft OHSS onto existing rural clinics, hospitals, and service systems, which would provide services in local facilities to the neighboring farm community. A referral system to regional centers would assist with difficult medical problems, industrial hygiene and safety consultation, and educational programming. Agricultural extension agents, community mental health centers, and other local services could be networked and focused to provide a broad range of services. In such a model, everyone would win. The farmer and farm worker would receive comprehensive OHSS, the patient would be taken care of in a local hospital by local practitioners, and the local health care delivery system would be supported and strengthened.

At present, the greatest threat to this proposed system is the precarious situation of rural hospitals, which are closing at a very high rate. In 1987, 40 rural hospitals closed. This is double the average number for the past decade, according to the National Association of Health Centers. One of the factors affecting this closure rate is gross underfunding. At present, rural areas receive an average of 42% fewer dollars per capita than urban areas. Under the new prospective payment system (DRGs), the federal government pays rural hospitals 36% less than their urban counterparts. This disparity resulted in an urban hospital average profit of 10% for 1987, and a rural hospital average loss of 0.7%.

At the same time that rural hospitals are underfunded, rural private physicians receive less under Medicare for treating patients with identical diagnoses. This urban-rural disparity makes rural practice far less attractive than urban practice to physicians. The lack of availability of a hospital also serves to drive away patients from rural health care. It is apparent that these problems with rural health care delivery and financing must be addressed if farmers, farm families, and other agricultural workers are going to receive the medical care and services they need and deserve.

The Need For More Education At All Levels

Dealing effectively with the health and safety problems of farmers and agricultural workers requires a well-founded knowledge of the problems, their causes, and preventive mechanisms. However, educational programs for delivering this knowledge are low in number and often of questionable effect. More and better programs are needed for all involved -- from the agricultural workers and their families to the professionals who deliver health and safety services.

The dearth of educational programs results in part because health and safety problems remain largely unacknowledged. The general public, our public institutions, and our government remain largely unaware and unconcerned about the plight of farmers and agricultural workers. Thus an increased level of awareness and acknowledgement of the hazards faced by this work force is needed.

Programs for the farmers and agricultural workers would best start among the youth. Given the facts that the farm is one of our most dangerous workplaces, and that children routinely play and help with farm chores in this workplace and thus are constantly at risk, such programs are critically important. Although farm-centered groups such as FFA (formerly Future Farmers of America) and 4-H make efforts to educate rural youth about health and safety, there are few programs that deal with the issues intensely and on a continuing basis, or that integrate farm health and safety education into the rural school curriculum.

Educational programs for farmers and farm workers and their spouses are equally important, given the severity and omnipresence of agricultural dangers. Farm wives in particular, who are constantly aware that they, their husbands, and their children are being exposed to toxins, infectious agents, and the like, are typically eager to learn how to protect their families. Every opportunity to encourage safer work practices must be taken. In general, few efforts are being made to expand health and safety education. USDA Cooperative Extension Service efforts have suffered from a decrease in funding (in constant dollars) over time and consequently a

decrease in the number of farm safety specialists. Programs presently offered by organizations across the country need to be evaluated. Their likelihood of altering unsafe work practices needs to be assessed.

All levels of professionals who are in training to work with agricultural populations, such as vocational agriculture teachers, extension workers, and physicians, need preparation to deal with health and safety problems unique to these populations. However, such training is rarely integrated into the curriculum. Continuing education efforts are equally rare.

This void in training is especially obvious when one considers the number of professionals who could be fruitfully employed in dealing with agricultural health and safety. For example, as agricultural production and its use of complex machinery and chemicals becomes more industrial in nature, the need for agricultural hygienists (similar to industrial hygienists but focusing on farm processes) expands. The agricultural work force could justify the services of 500 to 1,000 such hygienists, as well as 1,000 physicians and 8,000 nurses dedicated to agricultural occupational medicine. Yet only a handful of these professionals is available.

Educational efforts often are stifled by the lack of training materials. When training materials are developed by one of the small programs sprinkled across the country, these materials are often not known or available to other institutions, resulting in meager financial resources being wasted on duplicated efforts. A clearinghouse for agricultural health and safety information, similar to those that have proven successful in disseminating information about AIDS and cancer, is clearly needed.

The Need For More Research and Professional Coalitions

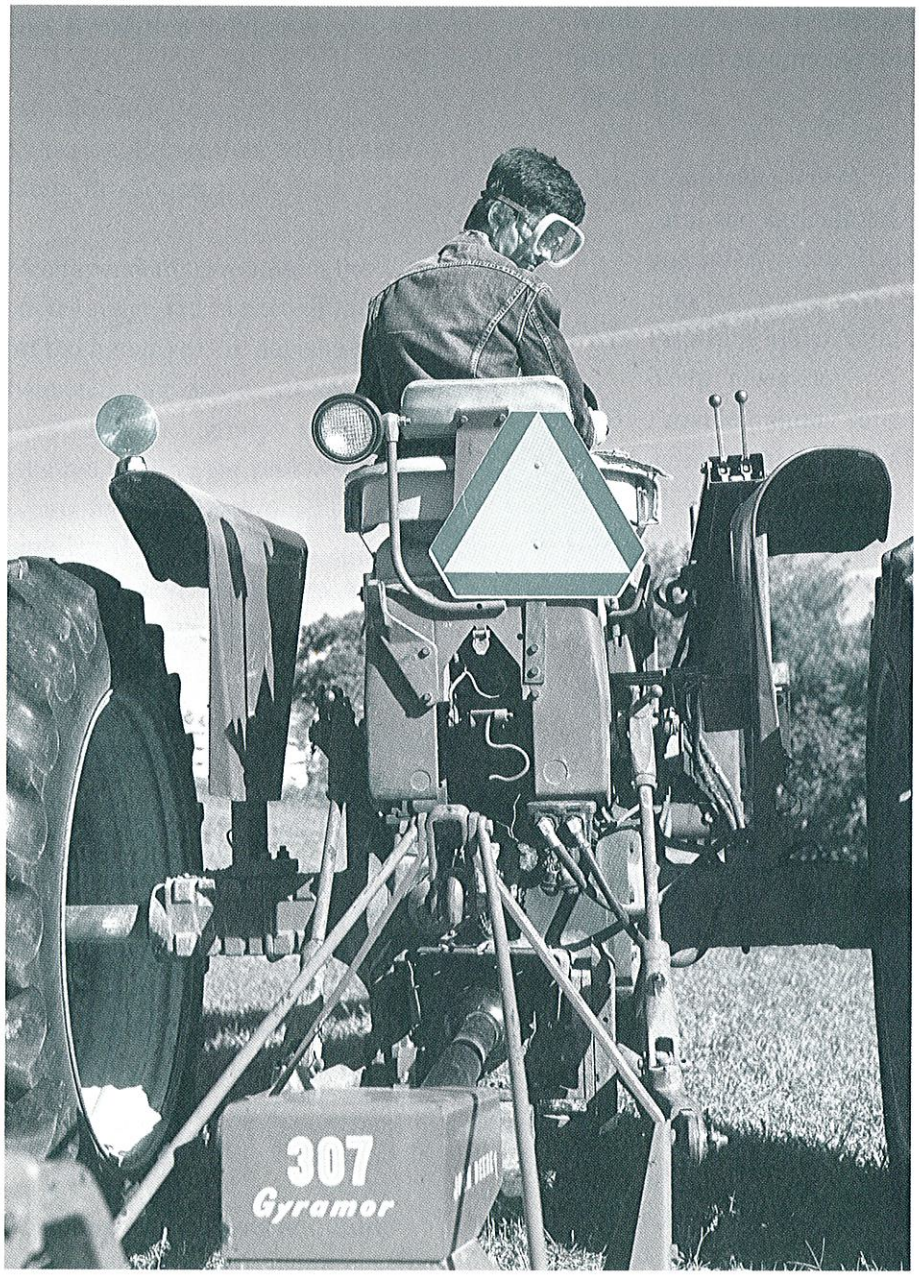
Although available studies document the epidemic of traumatic death, injury, and disease among America's agricultural work force, there is insufficient research to fully assess the extent of these health problems. Also, risk factor definition is needed for development of prevention programs. There are no national or statewide agricultural injury and disease surveillance programs designed to document the extent and determinants of agricultural health and safety problems. Similarly, there are no targeted federal research initiatives for either agricultural injuries or diseases.

No federal agency has been identified as the lead agency to deal with rural and agricultural health and safety, and as a result there is no focused or coordinated federal approach for research. A few agricultural safety and health research projects are supported by the Public Health Service (PHS). NIOSH and the Center for Environmental Health and Injury Control (CEHIC) within the Centers for Disease Control (CDC) support some projects and grants dealing with agricultural hazards. The National Institutes of Health (NIH) provides grants dealing with some agricultural populations, but these have rarely focused on hazard identification or prevention. While NIOSH would appear to have the mandate to deal with agricultural safety and health, NIOSH is poorly funded and could not address associated family and community health and safety concerns or general environmental contamination. These areas appear to be most appropiate for CEHIC within CDC, the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The CDC, together

with ATSDR, appears to be the agency with the technical resources, the organization, and the prevention orientation most appropriate to address these issues.

In addition, there is no common forum within the scientific community for discussions of agricultural and rural health and safety research. No scientific journal has been identified as a vehicle for publication of agricultural safety and health research findings. Instead, research findings tend to be presented within narrowly defined disciplines dealing, for example, with farm injury, with occupational respiratory disease, or with occupational cancers. This lack of focus diffuses efforts to deal with agricultural health and safety problems and their interconnections to the rural environment. As a result, the epidemic of agricultural injury and disease remains largely unrecognized by both federal and state agencies, and by much of the scientific community. There is therefore an urgent need to provide at the federal level an agency, center, or institute with a clearly defined mandate to support and coordinate federal research.

Agricultural Safety and Health Policy Recommendations



AGRICULTURAL SAFETY AND HEALTH: POLICY RECOMMENDATIONS

Conference policy groups concerned with agricultural injury and disease and their prevention addressed four areas of concern:

- Occupational Health and Safety Services
- Education
- Health Evaluation and Research
- Hazard Evaluation, Prevention, and Health and Safety Promotion

The following recommendations represent the composite of policies suggested in each of these four areas. All of the initiatives are dependent on greater involvement of the private sector, the government, farm constituency groups, and academia in an attempt to solve the problems stated in the previous section. Governmental involvement includes legislative initiatives, targeted appropriations to several agencies, and programmatic initiatives of agencies.

Legislative Initiatives

Certain of the health and safety problems of the agricultural work force can only be addressed by a comprehensive legislative agenda. A rural coalition of dedicated federal and state legislators is needed to produce this focused agenda. Legislative proposals for initiating such an agenda are outlined below:

Federal Legislation

1. Passage of a National Agricultural and Rural Health Act to bring about the following actions:

1.1. Define a comprehensive national plan for agricultural and rural health.

1.2. Create a National Center or Institute for Agricultural and Rural Health within the Public Health Service, which would assume the following functions:

1.2.1. Coordinate federal programs of rural and agricultural health and safety research and education.

1.2.2. Prioritize agricultural and rural health research.

1.2.3. Provide training support for agricultural and rural health at all levels.

1.2.4. Provide a national clearinghouse and health information network for agricultural and rural health.

1.2.5. Assist states and communities in addressing common agricultural and rural health goals.

1.2.6. Create a program for developing community-based centers and demonstration projects designed as research models providing comprehensive occupational health and safety services, including screening, educational, and preventive services to the rural community.

1.2.7. Create a National Advisory Committee for agricultural and rural health.

1.3. Mandate the installation of roll-over-protection structures (ROPS) on all new tractors sold in the United States, and provide economic incentives to persons who retrofit ROPS on their tractors within the next five years, while requiring ROPS to be installed on all tractors within 10 years. Economic incentives may include tax incentives and private sector initiatives such as insurance rate modification schemes or low or no interest loans from rural lenders.

1.4. Provide funding to the PHS to develop a program for comprehensive, university-based Centers for Agricultural and Rural Safety and Health to include programs in research, educational development and training, technical services, information dissemination, and promotion of integrated demonstration programs.

1.5. Provide targeted appropriations for several federal agencies in order to promote research, education, information dissemination, and other programmatic initiatives:

1.5.1. CDC/NIOSH/CEHIC/National Center for Health Statistics (NCHS): Research, surveillance, training and education, information dissemination, and recommendation of health and safety guidelines and standards.

1.5.2. USDA: Research on safety considerations for agricultural building and machinery design; enhancement and expansion of agricultural extension farm safety program.

1.5.3. Department of Labor (DOL): Agricultural worker education, consultation, and (when necessary) standards.

1.5.4. EPA: Increased support for agricultural chemical research, education, registration, and groundwater standard development programs.

1.5.5. ATSDR: Assessment of agricultural chemical toxic waste exposures and associated health effects.

1.5.6. NIH: Targeted appropriations to institutes to address agriculturally-related diseases including lung disease, cancer, noise-induced hearing loss, musculoskeletal syndromes, and neurological/psychiatric diseases.

2. Mandate equitable reimbursement under Medicare for rural and urban health care providers and hospitals.

State Legislation

1. Mandate, by state law, reporting of agricultural diseases and injuries through state health departments.

2. Mandate, by state law, the development of university-based agricultural and rural health and safety resource centers to provide research, training, continuing education, information dissemination, and community-university linked demonstration projects.

Research Initiatives

The following research initiatives are needed to assess agricultural health and safety hazards, and the health status of farmers, farm workers,

farm family members, and others working in rural areas. An attempt has been made to identify the federal agency best suited to develop the proposed initiative. It is assumed this research will be carried out by the federal agency in cooperation with and through funding of state health departments, universities, and private contractors.

The CDC, in conjunction with ATSDR, was recognized as the agency best positioned to mount an initiative to address the many research needs. Several other federal agencies were also identified for other needed research initiatives.

1. CDC/NCHS

   1.1. Completion of a targeted agricultural/rural National Health Interview and Examination Survey to provide population-based measures of occupationally-related disease and risk factors in rural America.

2. CDC/CEHIC

   2.1. Development of model population-based surveillance programs for occupational disease and injuries, targeting farms, farmers, farm workers, and farm families.

3. CDC/NIOSH

   3.1. Completion of a National Occupational Hazard Survey for Agriculture.

   3.2. Enhancement and wider use of the National Traumatic Occupational Fatality (NTOF) data base, for determining specific causes of agricultural deaths.

   3.3. Assessment of targeted high risk populations including migrant and seasonal agricultural workers, to determine the full extent of health effects of their occupational exposures, to assess risk factors, and to develop dose-response relationships. High risk groups include:

      3.3.1. Agricultural chemical formulators and applicators for acute and chronic chemical toxicity including neurological manifestations.

      3.3.2. Agricultural field workers for dermatitis.

      3.3.3. Agricultural machine operators for noise-induced hearing loss, whole body vibration, and machine-related trauma.

      3.3.4. Agricultural workers exposed to organic dusts and toxic gases for acute and chronic lung disease.

      3.3.5. Agricultural workers exposed to certain pesticides to document mental disorders and suicides, their determinants, and interactions of occupational and other risk factors.

      3.3.6. Agricultural workers exposed to repetitive trauma for overuse syndromes and degenerative osteoarthritis.

      3.3.7. Agricultural workers exposed to certain pesticides, nitrate, certain viruses, and various fuels, oils, and solvents for site-specific cancers.

   3.4. Development and application of more detailed industrial hygiene techniques for assessing agricultural exposures, with an emphasis on both collection and analytical methods.

3.5. Development of health and safety guidelines, and in some cases standards, to promote and insure the use of technically and economically feasible control technologies. Guidelines or standards should include the following:

3.5.1. Development of specific health examination guidelines for several agriculturally related diseases.

3.5.2. Development of specific industrial hygiene guidelines for assessment of the agricultural working environment.

3.5.3. Development of standard warning labels and hazard notifications for agricultural operations.

3.5.4 Development of guidelines for recommended work practices for hazardous agricultural operations.

4. ATSDR

4.1 Assessment of existing and development of new disease registries of agricultural and rural populations exposed to toxic chemicals in relation to patterns of illness, injury, and death.

4.2 Development of exposure registries based on agricultural chemical sales and registrations, existing environmental surveys, or other data sets.

5. NIH

5.1 National Institute of Environmental Health Sciences (NIEHS): Development of an initiative to systematically examine the toxicity of agricultural chemicals including their potential carcinogenicity, neurotoxicity, and reproductive toxicity.

5.2 National Heart, Lung, and Blood Institute (NHLBI): Development of an initiative to assess lung disease arising from exposure to organic dusts and agricultural chemicals.

5.3 National Cancer Institute (NCI): Development of an initiative to systematically examine risk factors responsible for certain cancer excesses among agricultural workers.

6. EPA

6.1 Assessment of the consequences of pesticide exposure, particularly long-term, low-level exposure among farmers, agricultural workers, and others living in rural areas.

6.2 Assessment of the consequences of pesticide exposure in children.

7. National Center for Health Services Research (NCHSR):

7.1. Development of an initiative for agricultural and rural health services research.

7.2. Sponsoring of regional conferences on agricultural and rural health services research.

8. National Safety Council (NSC):

8.1. Continuation of the annual farm survey to provide continuity in regard to estimates of traumatic deaths and injuries.

Development of Occupational Health and Safety Delivery Initiatives

It is strongly recommended that the federal government, in conjunction with the proposed Centers for Agricultural and Rural Safety and Health, sponsor the development of a phased system to provide comprehensive OHSS to agricultural communities, involving state lead organizations and local projects. The initial phase of the system would be the establishment of a number of pilot projects across the country to test several models of agricultural occupational health and safety service delivery. In these pilots, farmers and agricultural workers should be considered to be a special occupational group, and farming should be considered as an occupation as well as a way of life. Pilot projects should be developed keeping the following recommendations in mind.

1. Funding of pilot projects through the Department of Health and Human Services (DHHS), with concerted efforts to involve the DOL and USDA in the project development.

2. Incorporation of cost sharing arrangements, with farmers, farm groups, insurance companies, and local hospitals and communities assuming some of the responsibility for the cost of the pilot projects whenever possible.

3. Incorporation of advice from farmers, local health professionals, agricultural groups, and involved communities at each step of service development.

4. Establishment of linkages with emergency services, the Cooperative Extension Service, and educational resources as a routine part of program planning.

5. Recruitment of health care personnel to staff the pilot projects from pre-existing community providers, and use of pre-existing rural facilities as physical plants, to the greatest extent possible. This is necessary to assure that access to specialized services (such as industrial hygienists and safety engineers) is available through referral to a higher center or by contract.

6. Incorporation of a major evaluative component, to allow useful models to be retained and ineffective models to be set aside.

7. Identification of a lead agency in each involved state early in project development, to assure coordination and best use of state and local resources, to assist in project evaluation and modification, and to develop a system of program dissemination. The state agency also could provide clinical, environmental, and preventive back-up services. The lead agency could be a university, health department, or other organization with appropriate capability and interest.

8. Provision of tertiary-level back-up and support to states and to community programs by regional referral centers, namely the above-proposed Center for Agricultural and Rural Safety and Health. Support would include clinical back-up for difficult cases, industrial hygiene and safety referral, development of health and safety education programs for the farm community and health care provider, research, evaluation of pilot programs, and dissemination of projects.

Education Initiatives

If efforts to improve the health and safety status of the agricultural work force are to be successful, occupational risks and preventive techniques must be well understood by the at-risk population, community members who routinely deal with this population, and professionals who treat ill and injured workers, or who work with the farming population as educators, agricultural hygienists, and health care providers. Suggestions for improving agricultural health and safety will fare best if they are supported by an aware and concerned general public. The following recommendations address techniques for assuring that educational needs are met at all levels.

1. Heighten awareness of the tremendous loss of life and productivity among the agricultural work force, and of the implications of this loss for the nation, among the general public.

    1.1. Bolstering the impact of National Farm Safety Week through efforts of the Surgeon General in conjunction with the NSC.

    1.2. Creation of a well publicized Agricultural Death Watch for one month prior to National Farm Safety Week.

2. Development of an agricultural health and safety clearinghouse that will identify, collect, store, and disseminate information on educational resources and training materials, and on organizations and institutions involved in this field; the clearinghouse also will provide a listing of these resources and materials.

3. Development and evaluation of a comprehensive set of agricultural health and safety materials, for use by kindergarten through high school aged youth as part of the public school curriculum, and as part of the programs of rural youth groups.

4. Incorporation of agricultural health and safety into the educational curriculum and into continuing education programs of targeted professionals who are, or will be, working with rural populations. This could be accomplished at several levels simultaneously, by incorporating new content into existing courses, by creating new courses, by creating new focus areas within existing curricula, by creating new degree programs, and by offering new continuing education programs.

    4.1. Agriculture-related occupations:

        4.1.1. Development and sharing of multi-lingual educational materials.

        4.1.2. Incorporation of questions relating to agricultural health and safety into licensure exams and certifying criteria.

        4.1.3. Requirement of agricultural health and safety course work.

        4.1.4. Development of graduate training programs in agricultural industrial hygiene.

        4.1.5. Provision of federal fellowships and traineeships in areas related to agricultural health and safety, and targeting of federal vocational education monies for agricultural health and safety programs.

4.2. Health and safety professional education and training:

4.2.1. Adoption of agricultural health and safety as a priority issue/area by professional organizations.

4.2.2. Mandating of Bureau of Health Professions monies to support agricultural medicine/health training programs, course work, and continuing education.

4.2.3. Inclusion of agricultural health and safety components in board certification requirements and licensing examinations.

4.2.4. Incorporation of agricultural health and safety course work and training experiences into health professional programs at targeted institutions.

4.2.5. Development of group and independent study CME opportunities in the field.

5. Development of rural community-based task forces by Cooperative Extension Service offices and rural hospitals to ensure that all rural communities have an adequate agricultural health and safety training program for community professionals and rural leaders. Suggested improvements in training activities should be funded at the grass roots level by donations from local businesses and concerned groups.

6. Improvement of educational programs for at-risk populations.

6.1. Evaluation of methodologies used to date to educate at-risk populations, and initiation of new educational programs for farmers, farm workers, and their families based on the results of these evaluations.

6.2. Use of set-asides from worker compensation funds for health and safety training of agricultural workers.

6.3. Increase the number of training programs immediately through currently established mechanisms.

Initiatives to Assist the Development of Coalitions

None of the above can occur without expanding communications among all parties involved in agricultural and rural health. Communication between public and private sectors, and among the various groups within each sector, must be increased. Coalitions must include professionals in the diverse fields related to agricultural and rural health. The following are recommendations on how such coalitions may be promoted.

1. Development and promotion of collaborative university/private sector/community demonstration and education projects, which interface research results with intervention and education programs and with the provision of diagnostic services.

2. Identification and promotion of an annual scientific forum and a primary journal for the exchange of scientific information regarding agricultural and rural health.

3. Development of state agricultural and rural health commissions, task forces, or committees to define a state legislative and programmatic agenda for agricultural and rural health composed of legislators, agency representatives, agribusiness representatives, farmers

and their representatives, and university health professionals. This initiative could be organized by the National Governors' Association, Council of State Governments, and the National Conference of State Legislators.

4. Development of grass roots agricultural organizations modelled after Mothers Against Drunk Driving (MADD) to promote all aspects of agricultural and rural health including surveillance, education, interfacing with the private and public sector to promote the use of safer farm technology, counseling, and rehabilitation.

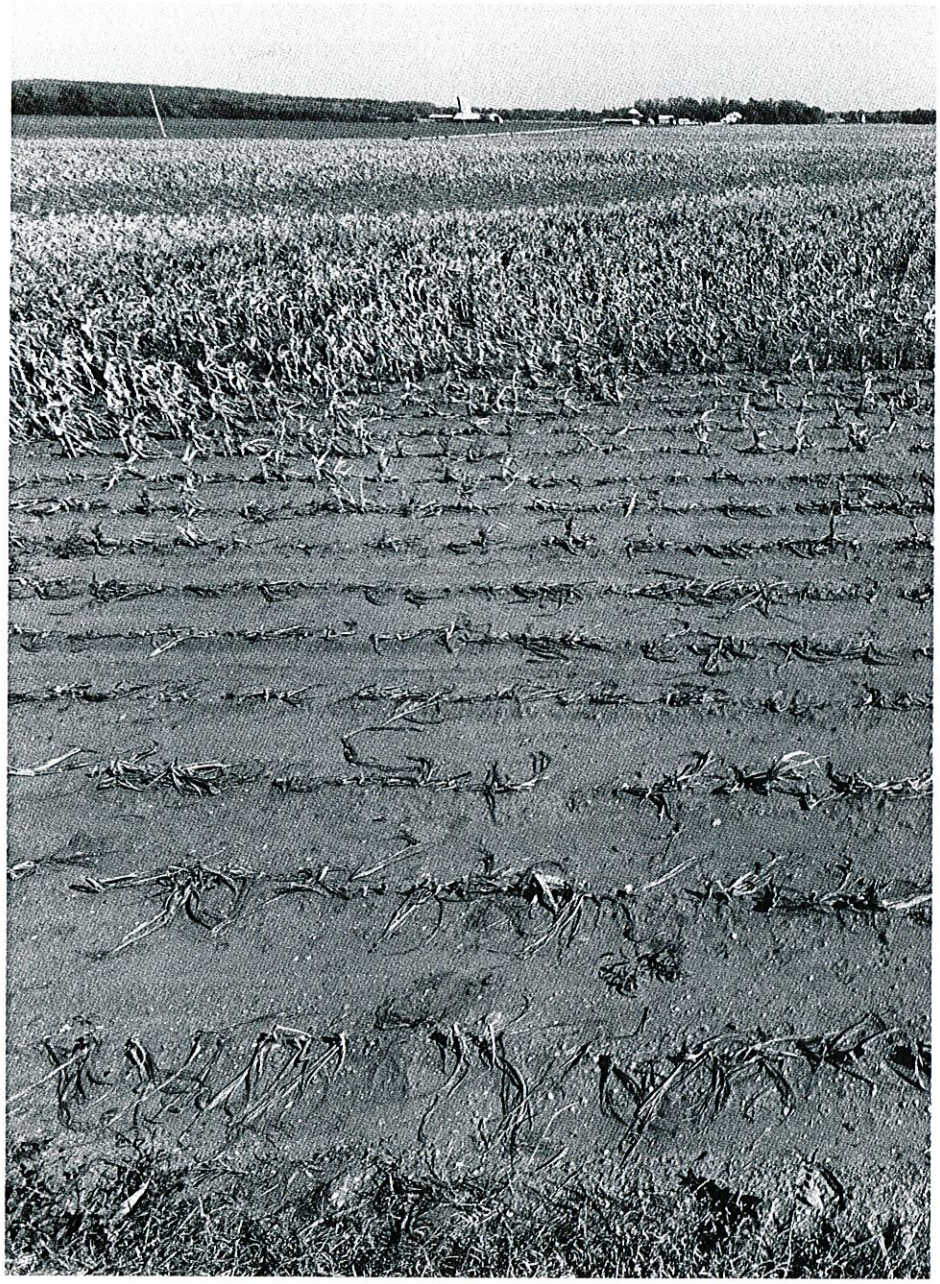
5. Involvement of the agricultural private sector working with rural community health care providers, state agencies, and universities to develop private sector initiatives, including the following:

5.1. Development of insurance rate modification concepts for farmers to encourage participation in occupational health and safety programs and installation of safety equipment.

5.2. Discounting by equipment manufacturers and dealers of farm implement parts designed for safer farm machine operation.

5.3. Participation of rural lending institutions, rural utilities, and other agribusinesses in farm safety programs which include assistance in financing prevention programs and safer farm equipment.

Environmental Health Issues



ENVIRONMENTAL HEALTH: THE ISSUES

Previous sections of this report have addressed health and safety issues of farmers, farm families, and farm workers. Farmers are quick to recognize that in addition to affecting their own health, agricultural chemicals applied to crops are a source of pollution, affecting the air, water, and food consumed by them, their neighbors, and the public at large. Clearly, improved management of agrichemical use will directly benefit both rural and urban populations and the surrounding environment. Consequently, agricultural health problems and solutions are linked to the broader issue of environmental health protection. This linkage is very evident for groundwater protection strategies.

Groundwater pollution stemming from modern agricultural practices is generally recognized as an important factor in a national environmental protection strategy. At the present time, several states have enacted groundwater protection laws, while at the federal level draft groundwater legislation has been introduced in both the House and Senate. A number of environmental action groups and coalitions are very active in promoting the need for national groundwater protection. Likewise, several federal agencies (EPA, USDA, the United States Geological Survey (USGS)) and the Congressional Office of Technology Assessment (OTA) have advanced groundwater protection strategies that recognize potential agricultural sources of groundwater contamination. Given the advanced state of groundwater policy development, technical results and policy recommendations presented in this report are quite specific and detailed, and differ in format from those of the previous section.

Agricultural pesticides and fertilizers may create occupational health problems for persons who handle, mix, and apply these chemicals. They can also leave environmental residues, which may affect the health of rural and urban residents alike. This workshop report considers the potential risks posed by nitrate fertilizers and pesticides in the environment, by attempting to answer three questions:

1. Is human health being affected by agrichemicals at the concentrations that are currently being detected in the environment?

2. What control strategies are available to limit the environmental residues of agrichemicals?

3. If environmental standards are needed to limit groundwater contamination by agrichemicals, how can these standards be effective and not overly restrictive?

Nitrogen-Containing Fertilizers and Manures in the Environment

This discussion focuses only on nitrogen-containing fertilizers. Through natural processes, applied nitrogen (N) in fertilizer is converted to nitrate (NO_3). Other components of fertilizer, like phosphate and potassium, may have ecological and environmental consequences, but this report is limited to nitrate effects when ingested in water and food.

Nitrogen is a naturally occurring element. However, it is not normally present in sufficient quantities to support profitable cereal grain production. Nitrogen fertilizers placed on fields

can be converted to nitrate that dissolves in rainfall runoff and leaches downward through the soil to groundwater. Nitrate in groundwater can originate from animal manures, human wastes, nitrogen fixing bacteria and plants, and geological formations, as well as from nitrogen fertilizer.

Current levels of nitrate in groundwater vary extremely. Monitoring data from private, rural drinking water wells in a number of states indicate that levels often exceed the safe drinking water standard for nitrate, 10 mg/l of N (or 10 parts per million - ppm). The trends in nitrate contamination of ground and surface waters are not fully understood, but both the geographical extent of contamination and the concentrations of N are thought to be increasing.

Human Health Effects

Nitrate in drinking water has been clearly linked to cases of methemoglobinemia (blue baby syndrome) and resulting infant deaths. The extent of infant mortality from this condition is not known. The condition may be misdiagnosed, and reporting its occurrence to health officials has been required only recently, and in only a few states. The actual number of cases of infant methemoglobinemia is likely to be higher than that currently reported in the literature.

Nitrate in water and food also can produce chronic effects in adults. Here concern is focused on the body's transformation of secondary amines into nitrosamines, which are known to be powerful cancer-causing agents and mutagens. Some epidemiologic studies indicate an association between nitrate and non-Hodgkin's lymphoma, stomach cancer, and possibly birth defects. Others fail to show any elevated chronic risk for these or other diseases. Additional studies are necessary.

Control Strategies

When discussing agricultural chemicals, prevention of groundwater contamination at the source is the most effective and least costly control strategy available today. Thus, most of the discussion of control strategies focuses on improved agricultural management practices, which reduce amounts of agrichemicals available to leach into groundwater or run off into surface water.

Applying the proper rate of N in the field is the primary method for reducing nitrate contamination of the environment by agriculture. The rate to be applied must be based on a realistic yield goal. Farmers simply cannot accept popular, rule-of-thumb, or overly optimistic yield goals that are not achievable for the specific crop and field conditions. In determining the rate of N application, credits for manure and previous legume crops must be included.

Management techniques can also affect the extent of nitrate contamination of the environment. Fall application of N, nine months prior to the period of maximum N uptake by corn, is <u>not</u> a best management practice where leaching or denitrification losses from natural bacterial decomposition are probable. Placing the fertilizer 4 to 8 inches into the soil, rather than broadcasting it on the soil surface, often improves crop uptake of N by reducing its volatilization and its runoff into surface waters. Nitrification inhibitors, which keep more of the N in the ammonium form until the period of maximum crop uptake, can be helpful under certain conditions but may provide a false sense of security.

Cover crops established in the fall result in uptake of residual NO_3, as well as reducing erosion losses. In marginal wetland areas, cover

crops can transpire significant amounts of soil moisture to allow earlier spring planting. In dry years, cover crops may deplete subsoil reserves and cause lower crop yields.

Conservation tillage limits nitrate loss to surface water, but research has not determined whether conservation tillage increases or decreases NO_3 in groundwater. However, some researchers believe leaching is increased under conservation tillage.

Government farm programs and policies also affect NO_3 losses to groundwater. Of all the row crops, corn is the most heavily fertilized with N. Yet government programs reward farmers financially for keeping a large corn acreage base, both through direct payments for corn production and through the resultingly higher land val .es for farms with a high corn acreage base in the government farm program.

Pesticides in the Environment

Because of the large number of pesticides, each with its own use patterns, environmental behavior, and toxicological profile, generalizations are difficult. For purposes of this report, the term "pesticide" is used generically to cover three specific target pests: weeds (herbicides), insects (insecticides), and fungi and molds (fungicides). In the upper midwestern states, the major concern is herbicides getting into drinking water supplies. On a national scale, the National Research Council Board of Agriculture report (1987) suggests that residues of insecticides and fungicides are more likely to be found in food supplies.

Pesticides have been identified in drinking water derived from both groundwater (local wells) and surface water sources. In most cases, levels in surface water are higher than those in groundwater.

Pesticides may enter groundwater from point sources (rinsing areas, waste dumps, accidents and poor handling of pesticides by commercial and farm-producer applicators, on-farm and commercial spills during mixing, loading, measuring, etc.) or from non-point sources (that is, normal field application.) The relative contribution of these two sources is debated, but both are significant.

Human Health Effects

Non-occupational exposure of the general public to pesticides may occur through ingesting food or water with pesticide residues, through inhalation, or through dermal contact with pesticide vapors and dusts. Persons may be exposed to pesticide drift, come in contact with pesticide-contaminated dusts, or inhale volatile pesticides from treated surfaces. Few data are available on environmental exposure to pesticides via respiratory or dermal routes.

The exact level of risk posed by ingestion of pesticide residues in food and water is unknown. Based on currently available Food and Drug Administration (FDA) and USDA historical information about Americans' dietary consumption patterns (U.S. average and a few special subgroups), intake of individual pesticides do not exceed the Acceptable Daily Intake (ADI). However, these figures do not take into account possible synergistic effects of pesticides, data extrapolations (human toxicological data are not available for most pesticides), and the lack of up-to-date knowledge of current food consumption patterns or of special populations (e.g., infants or children).

In a handful of cases in the United States, illegally high pesticide residues have caused non-fatal, acute illnesses in individuals consuming treated crops. Aside from these cases, there is no persuasive, direct evidence that pesticide residues in food or drinking water at legally permissible levels have led to any human illness or death in the United States. However, good evidence to prove that such health effects do not occur is also lacking.

Assessment of human health risks of specific long-term pesticide exposures should be based on dietary studies with animals in conjunction with epidemiological investigations. Animal studies cannot precisely determine human health risks for several reasons. Humans are exposed to lower doses than are animals in research studies, human exposure occurs over a longer time and includes exposure to multiple pesticides, and physiological responses of research animals may differ from human responses.

Control Strategies

It is essential to identify all point and non-point sources of groundwater contamination to develop preventive strategies and clean-up procedures. Since a regulatory framework exists for controlling point sources of contamination for surface waters (Clean Water Act), and to a lesser extent for selected types of groundwater contamination (Resource Conservation and Recovery Act), the focus of this discussion is on non-point source control strategies.

Controlling non-point sources of environmentally contaminating pesticides focuses on good farm management decisions about the use of traditional pesticides. When necessary, the choice of an alternative chemical or formulation, a reduced application rate, alternative timing, or different placement method should take environmental as well as economic factors into consideration. In most cases, if use of a pesticide is warranted, alternative chemicals or formulations are available. The choice of less persistent, less mobile, and less toxic materials would reduce the potential for environmental risk.

Since pesticide leaching losses are expected to be proportional to the amount applied, any reduction in rate will be beneficial in reducing leaching. Current application technologies, although dependable, could be described as "consistently inefficient." For example, as much as 50% of the more volatile pesticides may evaporate within one day of application.

Degradation half lives for pesticides detected thus far in groundwater are short enough to suggest that repeated annual application is necessary for continued detection. Stated another way, if pesticide application rates are significantly reduced, detection of pesticides in groundwater should also be reduced within a relatively short time.

Is There Need for Groundwater Standards?

Prevention of groundwater contamination at the source is the most effective, least costly control strategy available today. In the context of a full regulatory and enforcement framework, numerical groundwater standards are an important plank of a groundwater protection platform. An approach currently under development in Wisconsin shows considerable promise. A preventive action level is set at 10-20% of the health-based enforcement standard for each potential groundwater pollutant. The preventive action level acts as a signal that excessive contamina-

tion may eventually be observed, and that appropriate management practices at the source should be considered to prevent further contamination from occurring. Development of groundwater standards poses a number of questions, which are asked and for which answers are proposed below.

1. Should there be a standard?

    1.1. Standards for the presence of agrichemicals in groundwater are desirable in the context of a full regulatory program. Numerical standards:

        1.1.1. Provide clearly defined targets at which all interested parties can aim.
        1.1.2. Provide a defined design goal against which various agricultural and resource management practices can be evaluated.
        1.1.3. Are useful in defining areas of the state or nation where management practices may need modifying.
        1.1.4. Provide the public with an estimate of the risk of consuming contaminated water and of the relative risk of different contaminants.
        1.1.5. Help the public determine when remedial drinking water treatments are needed.

    1.2. On the other hand, setting standards may create difficulties, costs, and further questions:

        1.2.1. Costs of developing risk assessments and of monitoring to assess compliance are high. Who will pay?
        1.2.2. Should standards apply to groundwater (resource protection), drinking water (health protection), or both?
        1.2.3. When standards are violated, what type of action should be taken to ensure compliance? How will standards be used?
        1.2.4. Does a standard encourage pollution up to the level of the standard? (i.e., the license to pollute argument)
        1.2.5. Should the ultimate goal of a groundwater policy be non-degradation (zero additional level of pollution over current levels), or is achieving health-based standards a satisfactory end point for a groundwater policy?
        1.2.6. Will the toxicological database on some older compounds result in standards that are too lenient and subject to significant later downward revision?

2. How should the standard be derived?

    2.1. Health-based federal government drinking water standards should be developed. Much of the information from EPA's Health Advisories or Maximum Contaminant Level Goals could be used. The right to set stricter standards at the state level remains an option where necessary.

3. How should the standard be applied to different aquifers?

    3.1. There should be a single standard for all aquifers. The future uses of aquifers are not predictable, nor are inter-

connections between aquifers fully understood.

4. What should be the relative roles of the federal and state governments in developing and implementing standards?

   4.1. The federal government should evaluate health effects data, set standards, and provide oversight of state management plans both in the development and implementation phases. It also may require monitoring by registrants in appropriate circumstances, and has the ultimate enforcement powers of cancelling registrations of pesticides in states with unsatisfactory management or enforcement plans.

   4.2. States should conduct essential monitoring activities, develop management plans responsive to local needs and conditions, and may set standards that are stricter than federal standards when justified.

   4.3. An unanswered question which must be addressed is who will pay for the monitoring activities, which are likely to be expensive. Since the use of pesticides brings social benefits as well as risks, it would be equitable for these costs to be shared among the registrant, the agricultural producer, and the public rather than one sector bearing the entire cost.

5. Will the establishment of the proposed standards negatively impact agricultural production?

   5.1. The biggest problem is likely to be the standard for nitrate. Even the current standard of 10 mg/l for nitrate as N is very difficult to meet in many areas with current production practices. Any move to lower the standard could have a major effect on production levels and economics. When considering pesticides, there is reason to hope that evolving best management practices will allow health-based standards to be met. A considerable menu of management options -- from integrated pest management, application technologies, and cultivation practices to alternative chemicals and biological treatments -- will become available through research and development.

Environmental Health Policy Recommendations

ENVIRONMENTAL HEALTH: POLICY RECOMMENDATIONS

Initiatives to Limit Agrichemical Contamination of the Environment

To achieve the goal of preventing groundwater contamination by agrichemicals, specific initiatives will be needed from Congress, governmental agencies, agrichemical manufacturers, and farmers. The initiatives listed below will lead to changes in farm management practices that are more harmonious with the principles of sustainable agriculture and environmental protection.

1. The USDA should adopt a national goal to reduce N fertilizer use on cereal grains by 50%. This goal can be achieved through research, extension education, financial assistance, and changes in federal farm policy or tax structures, without lowering net profit per acre. Efforts to achieve this goal should concentrate on:

    1.1. Elimination of fall application of N fertilizers and manures.
    1.2. Development and refinement of soil/plant tests for available N in soil in the spring to permit use of side-dress N applications.
    1.3. Development of expert systems to enhance decision making with regard to nitrogen management and use.

2. USDA, EPA, NIEHS, or other federal government agencies should fund animal studies to evaluate the toxicology of nitrate.

3. Effective use of alternatives to N fertilizers must be encouraged. Specifically, federal policies should encourage use of legumes, provide cost sharing for manure disposal facilities in regions sensitive to groundwater pollution by nitrate, and promote research on easy methods for estimating the fertilizer value of animal manures, a procedure that would minimize over-application of fertilizers.

4. Data on nitrate concentrations in drinking water should be maintained in state-managed data banks.

5. If nitrate levels in drinking water sources are unacceptable despite adoption of the best management practices and policies, point-of-use water treatment systems should be developed for rural well water use.

    5.1. These system design and testing programs should be funded by USDA, EPA, etc. or incentives should be provided for the private sector to develop and market point of use water treatment systems for rural well users.
    5.2. Treatment methods should be tested and approved by a state agency. The testing program will probably have to be subsidized initially. The Iowa law for residential water treatment system registration is a good example (Senate File 2267, 1988, amends Section 714.16 of Iowa Code).

6. The USDA should fund multidisciplinary investigations of agricultural management and equipment systems that are more efficient and reduce the amount of agrichemicals

released into the environment, including evaluation of the following:

6.1. Increased use of mechanical weed control along with banding of chemicals during planting.

6.2. Development of new tillage systems applicable to a soil type, given crop, and climate, ranging from no tillage-high chemical culture to low chemical conventional tillage approaches.

6.3. Increased understanding of how to adjust application rates to site-specific conditions, so that existing electronic and mechanical means to deliver precisely correct amounts of seeds and chemicals can be utilized.

7. Congress and the USDA should establish incentives (such as tax credits or grants) to entrepreneurs who are trying to develop or commercialize innovative ideas or technologies to meet the needs of a changing agriculture, particularly equipment necessary to support sustained agricultural practices.

8. The Board on Agriculture of the National Academy of Sciences, or the National Science Foundation, should critically evaluate the impacts of federal farm programs on the use of chemicals and the resulting impacts on public health and the environment.

9. Congress should include provisions in the 1990 farm program that will encourage innovative management to reduce the use of agricultural chemicals, while minimizing farmers' risks of economic losses. Examples include:

9.1. Extension of the Conservation Reserve Program beyond the present 10-year period, and to a larger acreage.

9.2. Federal support for acquisition of permanent easements by local governments, to reduce acreages of annual crops and related chemical uses in areas with sensitive environmental and public health concerns.

9.3. Limitation of commodity payments on the basis of production allocation rather than on the basis of acres planted.

10. State environmental control agencies should enforce existing federal water quality and pesticide use regulations more strictly, in order to reduce point source contamination of surface and groundwater. Significant short-term reduction of pesticide contamination can occur if:

10.1. The location of mixing/loading sites, handling procedures, and transportation of pesticides are subject to stricter enforcement policies.

10.2. Education concerning pesticide spills and point sources is intensified, with tax incentives or cost sharing to construct containment facilities at larger mixing/loading sites.

10.3. Research and development concerning mixing, loading, and safe transportation of pesticides is accomplished.

11. State-enacted pesticide applicator certification programs should be improved. Exams for commercial applicators should be more comprehensive, whileexams for private applicators should test basic knowledge. Both certification and continuing education programs should include segments on health effects, calibration of equipment, application techniques, integrated pest management, best management practices, and safe disposal of pesticides and their containers.

12. The EPA and USGS should establish a framework for a national groundwater monitoring database to facilitate exchange of data among all levels of government involved in groundwater protection strategies.

13. Agricultural chemical companies should expand efforts to develop safer pesticides. The definition of a "safe pesticide" should be expanded. In addition to consideration of human toxicity, registrants of candidate pesticides should evaluate environmental impacts and potential effects on specified non-target organisms, with special consideration given to endangered species. Research on techniques for reducing pesticide usage should be expanded, and should consider application rates, timing of application, higher threshold levels, and alternatives to pesticides such as non-chemical pest control and crop rotation.

14. To address public mistrust regarding the reliability of pesticide efficacy testing, and to foster a more objective testing program, future testing programs under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) should be carried out more independently. The following procedure is recommended:

    14.1. Industry provides funds to a central clearinghouse (e.g., a research foundation or agency like EPA).
    14.2. The clearinghouse solicits and reviews proposals from universities and consulting laboratories, and distributes study funds.
    14.3. Study results are submitted to the clearinghouse, which transmits them to industry along with an assessment of the efficacy of the candidate pesticide.

15. The EPA should evaluate the scientific community's advances in testing procedures and in the areas of behavioral and immunotoxicology, and should incorporate these advances into the testing scheme for candidate pesticides.

16. The EPA should take into account all component chemicals associated with a candidate pesticide, including <u>all</u> impurities formed during the manufacturing process, inert ingredients, surfactants, and emulsifiers. Regional poison control centers should be educated about the importance of data on impurities, and should be provided with toxicological information about these components.

17. The EPA should require complete toxicological risk assessment before label-listed tank mixes are approved. Testing should be focused on potential synergistic and additive effects of pesticides.

18. EPA's interim Toxicology Laboratory Certification Process and the Good Laboratory Practices protocol should be promulgated as final regulations.

19. The EPA should require environmental fate investigations on candidate pesticides to define each chemical's potential to contaminate groundwater. Appropriate studies should be conducted on a variety of soils to determine the effect of soil and other environmental variables on the chemical's migration rate and decomposition.

20. Before issuing a Section 18 (an emergency use provision of FIFRA), the EPA should formally review and report to the public the risks and benefits of doing so, evaluating the economic loss to farmers and society, potential adverse health effects, environmental contaminants, and the availability of safer alternatives.

21. The EPA should require that pesticide labels are more complete, accurate, understandable, and readable. The following should be considered:

    21.1. Techniques need to be developed to better educate users, applicators, and their families about the importance of following the pesticide label's instructions. Manufacturers should be encouraged to include precautionary and educational statements in their advertisements in farm magazines.
    21.2. Labels should be as short as possible while still including the most important information on health precautions, first-aid, and application. Supplemental information, including impact on target and non-target organisms, could be contained in a booklet attached to the container.
    21.3. EPA should develop a standard list of signal words, and of precautionary and first-aid statements, which should then be used consistently in labels and booklets.
    21.4. EPA funds should be earmarked to allow adequate enforcement of labeling requirements.
    21.5. The American Board of Medical Toxicologists or another health professional group should review emergency medical procedures on the label to insure that recommended first aid practices conform to current clinical practices.

Initiatives to Establish and Enforce Groundwater Protection Standards

National and state groundwater protection strategies are being debated by many technical and political leaders. A general framework for establishing national groundwater protection standards with state enforcement plans is suggested in the following initiatives.

1. States should adopt a groundwater policy goal of non-degradation. To move toward this goal, numerical standards should be set to protect human health and environmental quality.
2. The EPA should establish national standards for the maximum levels of specific chemicals found in groundwater, using human health as the criterion. Based on local conditions of environmental vulnerability, states may adopt more restrictive standards.
3. Until a permanent federal standard for pesticide residues in groundwater is available, states should use current EPA Maximum Contaminant Levels (MCL's) or Health Advisory Levels for guidance and regulatory action.
4. States should initiate investigations or regulatory actions when pesticide levels in groundwater reach 10% of the EPA's Health Advisory Levels.
5. States should establish and fund a system to evaluate, monitor, and respond to findings of pesticide residues and other agrichemicals in groundwater and to monitor sites suspected of being contaminated.
6. A bipartisan, multidisciplinary approach to foster technical cooperation and to establish joint federal-state activities in groundwater

protection should be a commitment of the new presidential administration. States should attempt to coordinate efforts closely with local governmental agencies, agrichemical manufacturers, and persons who use groundwater.

Research and Monitoring Initiatives

During the past 20 years, information and research data about the impacts of environmental pollution from industrial sources have expanded rapidly. However, the fate, transport, and health effects of agrichemicals in the environment and their relationship to modern farm management practices are not as well understood. Research and monitoring initiatives are needed to provide better information for decision makers. Important components of a research and monitoring agenda are suggested below.

Health Effects of Nitrate

1. Studies to correlate levels of methemoglobin in the blood to known exposures of nitrate in humans should be conducted, particularly in infants. The protective role of ascorbic acid (vitamin C) in reducing the acute effects of nitrate should be evaluated.

2. Animal studies of chronic exposure to nitrate are needed.

3. Prospective epidemiologic studies are needed in rural populations to examine chronic effects of nitrate.

4. Continued well testing and public education regarding nitrate health effects are necessary for rural populations, including appropriate data handling for future epidemiologic and exposure assessment research.

5. Since bottled water is frequently recommended as an alternative to high nitrate water for use in infant formula, bottled water should be sampled and monitored to determine its quality and safety.

6. Systematic monitoring of groundwater for nitrosamines is suggested. However, if none are found in groundwater, this does not mean the nitrosamine issue is moot. Other mechanisms of generating nitrosamines within the body are known to exist.

Health Effects of Pesticide Residues

1. More comprehensive government surveillance of produce (both domestic and imported) for violative residues is needed, as are tests that can be conducted rapidly so that contaminated food will be prevented from entering the market place.

2. Current general food consumption patterns and special dietary subpopulations should be investigated in greater depth.

3. Methods for assessing possible toxicological interactions of trace contaminants in humans should be developed.

4. Preliminary studies are needed to evaluate the degree of exposure of rural populations by respiratory and dermal routes and by ingestion of home grown food and private water supplies.

5. Studies of total exposure of farm families and farm workers to pesticides via all exposure routes, and from both environmental and occupational sources, are needed.

6. Case control and prospective epidemiological investigations for personnel involved with the mixing, loading, and application of pesticides, and for potentially exposed persons in the agricultural community in general, need to be greatly expanded.

7. A better database of pesticide use patterns is needed nationwide.

Best Management Practices for Nitrate Use

1. Improved nitrification inhibitors, which would keep more of the applied N in ammonium form, should be developed.

2. Research is needed to evaluate conservation tillage practices under specific soil and climatic conditions, particularly related to the potential trade-off between groundwater and surface water contamination.

3. Research is needed to develop corn genotypes that utilize N more efficiently.

4. Because of the known health effects of nitrate and the likelihood of continued groundwater contamination from fertilizer application, at least in the short term, inexpensive and reliable point of use nitrate removal technology will be needed. Research must focus on point of use systems, in addition to the more commonly funded, public water supply treatment systems for nitrate removal.

Best Management Practices for Pesticide Use

1. Continued refinement and advances in the information base, application technology, available pesticides/formulations, and crop genetic stock are needed. In particular, in integrated pest management (IPM) programs, more information is needed in order to establish economic thresholds not only for insects but also for weeds, crop diseases, and the like relative to the need for use of pesticides.

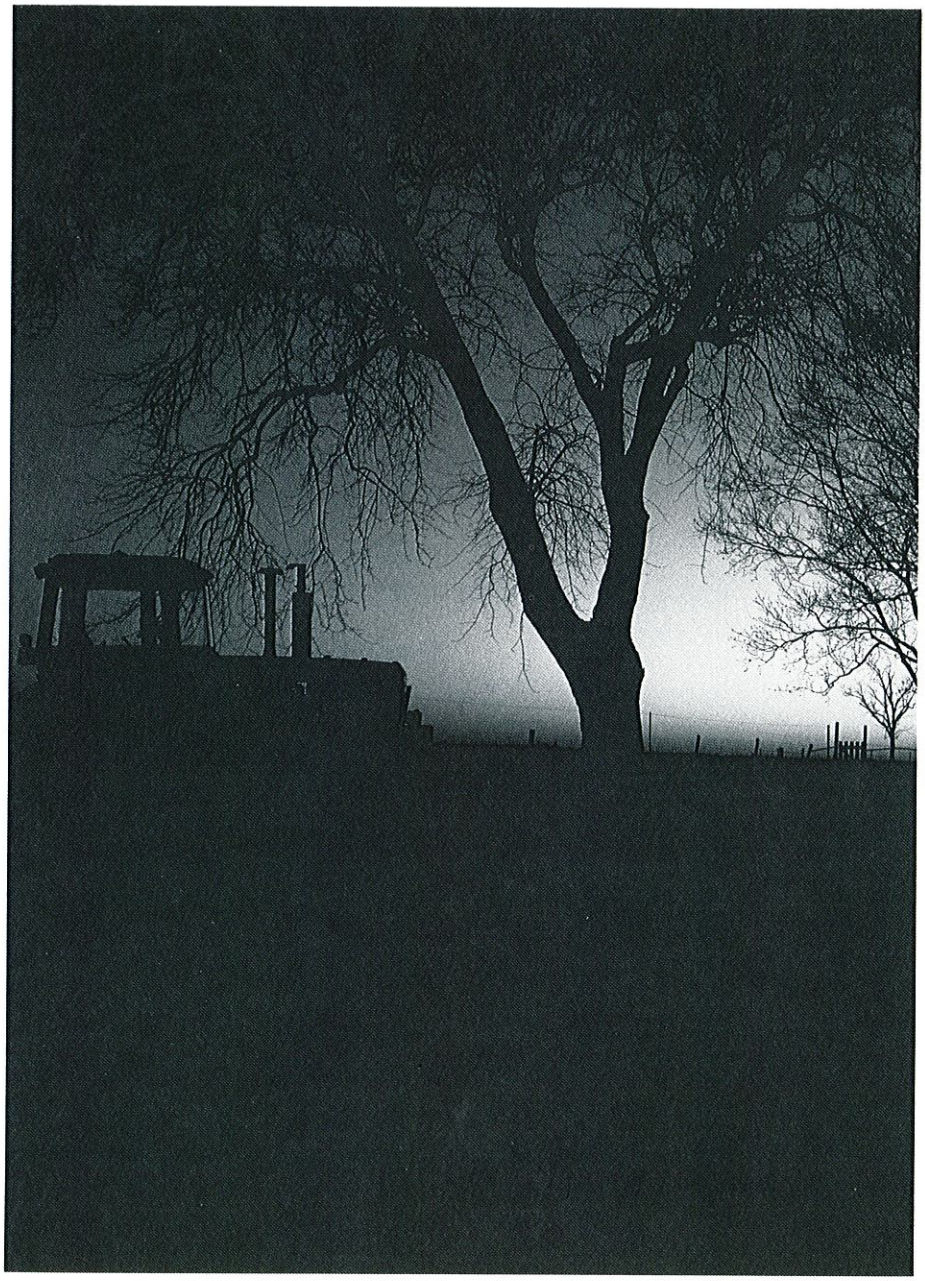
2. Equipment capable of successfully incorporating pesticides into croplands on which conservation tillage is being used, without destroying soil - protecting crop residues, is needed. New and innovative application technologies need to be developed if efficiency of pesticide use is to be greatly improved. New equipment needs to be tested sufficiently to assure that its use will be adopted by the agricultural work force.

3. Improved chemicals that are more specific to the target pest, less toxic to non-target organisms, less mobile, and possibly less persistent continue to be needed. In addition, formulations that result in more efficient use such as slow-release formulations should be developed, keeping in mind the possible negative effects of the "inert ingredients."

4. Development of production systems that substitute other pest control strategies for pesticide input would be useful. In addition, genetic engineering of plants to resist pests could significantly reduce reliance on chemical pesticides, as would the development of biological pest control agents.

5. More information is needed about the mechanisms of agrichemical transport and degradation in the environment, particularly in the soil. Data on toxicity and environmental stability of pesticide degradation products are needed in order to focus attention on those residues that are of greatest environmental consequence.

Appendices



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