
National Occupational Safety and Health Program in Agriculture

NIOSH Intramural Research

National Institute for Occupational Safety and Health

**Report by the Sub-Committee for
Agricultural Review**

NIOSH Board of Scientific Counselors

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ABBREVIATIONS

DRDS	Division of Respiratory Disease Studies
DSHEFS	Division of Surveillance, Hazard Evaluation, and Field Studies
DART	Division of Applied Research and Technology
DSR	Division of Safety Research
HELD	Health Effects Laboratory Division
OECSF	Office of Extramural Coordination and Special Projects
EID	Education and Information Division
NORA	National Occupational Research Agenda
NASC	NIOSH Agricultural Steering Committee
EAT	External Agriculture Team
SENSOR	Sentinel Event Notification System for Occupational Risk
FFHHS	Farm Family Health and Hazard Survey
CPHF	Community Farmers for Healthy Farming
NTISF	National Traumatic Injury Surveillance of Farmers
USDA	U.S. Department of Agriculture
NAWS	National Agricultural Workers Survey
NEISS	National Electronic Injury Surveillance System
CPSC	Consumer Product Safety Commission
NTOF	National Traumatic Occupational Fatality Surveillance System
FACE	Fatality Assessment and Control Evaluation

EXECUTIVE SUMMARY

In June 1999 the NIOSH Board of Scientific Counselors (BSC) was charged by the NIOSH Director to form a Subcommittee of the NIOSH BSC to review the internal NIOSH program in agricultural safety and health and to prepare a report with recommendations to the full BSC. This report summarizes the opinions of Subcommittee.

The Subcommittee reviewed a large volume of written materials and a summary of NIOSH resource allocations (funds and FTEs) for agriculture intramural projects for FY 99. The Subcommittee formulated an overall set of questions and issues to help guide meetings with Division Directors. Reviewers met with managers and researchers in NIOSH laboratories located in Cincinnati, Ohio and Morgantown, West Virginia.

Reviewers were impressed by the progress NIOSH has made in meeting the Congressional intent for the National Initiative in Agriculture Safety and Health. NIOSH personnel are committed to this important effort which includes extensive intramural and extramural components. The Subcommittee's review addresses issues affecting the overall NIOSH initiative and not any one specific project or division activity and is organized along program areas. The report provides a brief overview of the NIOSH agriculture program and six sections, which summarizes program area strengths and achievements, weaknesses and gaps, and the reviewers' recommendations. A final section reviews cross-cutting issues affecting the overall agriculture initiative with specific recommendations.

Hazard, Disease, and Injury Surveillance

Surveillance of agricultural health and safety is difficult due to the complex labor structure found in this industry which ranges from small family farms to large corporate farms and seasonal and migrant labor. Unfortunately, many of the traditional surveillance systems may fail to fully capture hazards and health events occurring in this sector. The NIOSH surveillance program for agriculture consists of intramural and extramural efforts which address some of the limitations of current agriculture surveillance efforts.

Reviewers considered a major strength of the NIOSH agricultural safety and health surveillance program to be the diversity of surveillance expertise available within the Institute and an impressive level of collaboration with other federal and state agencies and NIOSH Centers. Several weaknesses in the surveillance program for agriculture were noted, including the lack of common data elements in the Family Farm Health and Hazard Survey (FFHHS) making these data difficult to analyze and interpret and lack of a program for routine surveillance of non-fatal injuries. Reviewers' recommendations for improvements in the agriculture surveillance program include:

- 1) Inclusion of agriculture as one of the industry sectors in the planned NIOSH program on Hazard Surveillance in the Workplace.
- 2) Establishment of a systematic program for surveillance of non-fatal agricultural

- injuries in collaboration with the USDA.
- 3) Collaborating with the USDOL to expand the current efforts to collect information concerning injuries and work related morbidity of agriculture workers.
 - 4) Further collaboration with the NIOSH Agriculture Centers, especially on hazard and case based surveillance efforts.

Etiologic Research and Exposure Assessment

This appears to be the largest component of the overall agriculture intramural program and many of the projects combined intramural and extramural activities. Projects cover a broad spectrum of agriculture issues, including respiratory hazards, cancers associated with pesticide exposures, injury prevention, and laboratory based projects. Exposure assessment tools for pesticides based on immunochemical methods are being developed. Relationships among workload, work processes, stress, biomechanical demands, and injury among children in agriculture are also being studied.

A major strength is the high degree of extramural collaboration on hypothesis driven research projects. Communication among divisions, among disciplines, and between NIOSH internal scientists and external scientists funded by NIOSH remains a problem. Recommendations for improvements in the etiologic research and exposure assessment program are:

- 1) Expanded collaboration with extramural partners to make best use the available resources and expertise.**
- 2) Better use of targeted cooperative agreements to enhance collaboration on etiologic research projects between NIOSH scientists and external scientists.**
- 3) Greater participation of NIOSH scientists in agriculture conferences, workshops, and continuing education.**

Child Agriculture Research and Prevention

NIOSH conducts a large number of intramural projects concerned with children in agriculture, often in collaboration with external partners. These projects cover a spectrum of issues, including surveillance of injuries to children, stress, education and training, and exposures to pesticides. Eventually these projects propose to develop, implement, and evaluate appropriate interventions.

Reviewers concluded that NIOSH activities are all appropriate efforts aimed at better understanding of potential hazards, their effects upon children and practical methods of intervention. Traumatic injury is one of the major threats to children in the farm environment; however, other potential threats include pesticides, noise, organic dusts, emotional stress and ergonomic hazards. While the overall NIOSH program in child agricultural issues seems to be very strong, several weaknesses were noted. The research program is relatively thin in some

areas and some projects are really primarily adult projects which have been expanded to include children. Few projects are conducted by persons within the Institute who have specific expertise in child physiology, development, and learning. **There are several areas which do not appear to be receiving much attention within the child initiative, such as the effects of noise and organic dusts exposures upon young workers.**

Reviewers' recommendations for improvements in the child agriculture research program are:

- 1) A systematic study of effective education and training techniques aimed at changing behavior of young workers.**
- 2) Additional research concerning noise exposure and noise-induced hearing loss among young workers.**
- 3) Additional effort directed at understanding and preventing pulmonary injury related to chronic and acute exposure of children to agricultural dusts.**

Pesticide Research Programs

NIOSH has numerous intramural research projects that examine the effects of pesticides on agricultural workers. Examples include studies of long-term neurobehavioral effects of organophosphate insecticides, development of methods to quantitate human exposure to pesticides by antibody technology, use of immunoassays to biomonitor herbicide exposure, studies to quantify exposure of custom applicators to herbicides by immunoassay, and investigation of pesticides as endocrine disruptors.

Reviewers considered the most scientifically unique aspect of the NIOSH program to be the development of immunological tools for evaluating human exposures to pesticides. These methods could provide innovative markers of exposure useful for etiological research, exposure surveillance, and evaluation of prevention programs. An important weakness is the lack of coordination of the various programs. Also, the use of pesticides is changing rapidly in the United States and it does not appear that there is a coordinated effort of pesticide researchers to evaluate how this will affect exposures and health. The review committee recommended that a workshop be held involving NIOSH researchers (internal and external), government, industry, and labor organizations that are interested in pesticide research to determine the future direction for the NIOSH pesticide research program.

Intervention Research

The primary focus of the NIOSH intramural intervention program is the development and application of engineering controls for agriculture injury and illness risks. Reviewers considered the NIOSH engineering control projects to be exemplary because they address NORA priorities and use basic public health theory to assess priorities and assign available staff and other resources to projects. NIOSH intervention projects are typically conducted in collaboration with

external partners. Examples of research initiatives include evaluation of cabin filtration and pressurization as a control measure for prevention of pesticide exposures during spraying; developing and evaluating rollover protection systems (ROPS) for agricultural vehicles; and several intervention efforts with the Community Partners for Healthy Farming program.

The NIOSH intramural intervention research effort is modest but productive. Reviewers considered the NIOSH agricultural intervention projects to be scientifically sound. Additionally, many of the intervention projects have emanated from surveillance data indicating a compelling need. As a result, the projects selected possess clear merit for agricultural workers and other potentially affected households. Cooperative activities with the Pittsburgh and Spokane Research Laboratories are to be commended. This effort has the potential for broad development and transfer of intervention technology and methods affecting agriculture, mining, and construction.

Recommendations for improvements in the NIOSH intervention program in agriculture are:

- 1) Greater intramural-extramural collaboration on intervention efforts.
- 2) Collaboration with the mining research laboratories should be encouraged and expanded.
- 3) Increased partnerships with equipment manufacturers and suppliers for development and dissemination of intervention technologies and efforts.
- 4) Additional intervention research efforts devoted to noise-induced hearing loss and protection for agriculture workers.

Communication and Information Dissemination

NIOSH lists relatively few agricultural safety and health projects under the category of communication and information dissemination. The three main agricultural projects listed are the National Agricultural Safety Database; the Health Training Intervention for Young Workers; and a project Evaluating the Scientific Basis of the North American Guidelines for Children's Agricultural Tasks. In addition there are other information dissemination efforts, including the development and dissemination of agricultural documents, NIOSH exhibits, the NIOSH home page and the 1-800 number. Reviewers considered these activities to be highly appropriate and consistent with the Institute's leadership role in agricultural safety and health research.

The greatest weakness noted by reviewers is the apparent lack of an overall NIOSH communications strategy for developing and disseminating information on agricultural safety and health. The NIOSH Web page could better convey what is happening within the Institute on agriculture. The 1-800 number could be used to feed back information on trends in calls into an overall NIOSH communications strategy.

Reviewers recommend that NIOSH develop a communications plan specifically for agricultural safety and health information. Recommended components of this plan include the following:

- 1) Develop a mechanism to set Institute wide priorities for agriculture

- communication documents, videos, and CD-ROMS.
- 2) Coordinate the various programs with responsibility for health communications.
 - 3) Develop a better web page to convey both the intramural and extramural agriculture safety and health programs.
 - 4) Incorporate information obtained from NIOSH information calls into the communication strategy.

Overall Recommendations - Cross-cutting Issues

The NIOSH agricultural research program is large and complex with important activities being distributed throughout the Institute and to a substantial number of external collaborators. This presents a daunting communication challenge. Notable efforts have been made to enhance communication such as establishment of the office of the Agricultural Coordinator, routine meetings of the National Agricultural Steering Committee (NASC) and assembly of an ad hoc external agriculture team (EAT). Activities of the Agriculture Centers are communicated by Centers' web sites, biennial meetings, pamphlets, descriptive booklets and other materials which advertised to NIOSH divisions.

While NIOSH communication efforts are commendable, impact of these various communication efforts has been mixed. While some NIOSH staff are well informed about the agricultural initiative, the majority appeared to be relatively uninformed about agricultural projects, certainly about ones outside their immediate collaborative activities. Reviewers considered this to represent lost opportunities for meaningful collaboration.

The following recommendations are made concerning strategic planning and communication:

- 1) NIOSH should formulate a more clear-cut strategic planning process for the agriculture initiative.
- 2) NIOSH should sponsor an international workshop on agriculture health and safety research and prevention needs over the next 10 years to assist in its strategic planning effort.
- 3) Efforts of the NASC and EAT should be supported adequately.
- 4) NIOSH should consider establishing and supporting a communications function within the office of the Agricultural Coordinator.
- 5) An agriculture site within the NIOSH web site be established.
- 6) NIOSH staff working on agricultural projects be encouraged to communicate their progress at the NIOSH Agricultural Conference.

1. INTRODUCTION

1.1_ Brief History of the NIOSH Agriculture Research Program

The National Institute for Occupational Safety and Health (NIOSH) has a long history of research and prevention efforts that address specific agricultural occupational safety and health issues. Important examples of these efforts include epidemiologic and mechanistic studies of byssinosis in the cotton industry and studies of organic dust exposures in agriculture and their pulmonary effects. In addition, many cross-cutting NIOSH research programs affect many industrial sectors. These have included occupational cancer epidemiology, injury and fatality surveillance, personal protective equipment research and certification, and development of environmental and biological monitoring methods for exposure assessment.

A greater appreciation of agricultural occupational safety and health hazards emerged from a series of conferences entitled “Agriculture Occupational and Environmental Health: Policy Strategies for the Future,” held in Iowa during 1988. These conferences involved a wide variety of stakeholders including scientists, policy makers, members of the agriculture community, public citizens, and grass roots organizations. The primary product of this effort was a report entitled, “Agriculture at Risk: A Report to the Nation”. This document, in combination with a growing body of data demonstrating significant occupational safety and health risks in agriculture, resulted in Congressional action in 1990 which established a national initiative in agricultural safety and health with NIOSH as the lead agency in this effort. Congress intended that this program “...when sustained over a period of time will have a significant and measurable impact on [these] health effects among rural Americans.” The NIOSH program follows a public health model with its primary components consisting of surveillance, etiologic research, intervention development, and intervention evaluation. The public health vision for the NIOSH program was further elaborated in a Surgeon General’s Conference on Agricultural Safety and Health held in Des Moines Iowa in 1991. This conference established a vision for improving the health and safety of agricultural workers and their families and helped to raise consciousness, build coalitions, disseminate information and encourage action.

The role of children in agriculture and their special risks was further highlighted by the “Childhood Agricultural Injury Prevention Symposium” held in Marshfield, Wisconsin in 1992. This Symposium helped to develop consensus on relevant research, education, policy, and other interventions aimed at reducing agriculturally-related injuries in children. The National Committee for Childhood Agricultural Injury Prevention with broad stakeholder representation, including researchers, farmers, agricultural groups, safety and health professionals, and government officials resulted from this symposium. In 1996, this Committee published the document, “Children and Agriculture: Opportunities for Safety and Health. A National Action Plan,” which contained 13 objectives and 43 recommended action steps calling for leadership, surveillance, research, education and public policy. The National Action Plan called for NIOSH to serve as the lead Federal agency in preventing childhood agricultural injury. In 1997 the Congress extended the NIOSH mandate to include efforts directed specifically at childhood agricultural safety and health issues.

The NIOSH National Program in Agricultural Safety and Health consists of an intramural

research program and a network of extramural surveillance, research, and intervention/education programs. Currently there are 9 NIOSH Centers for Agricultural Disease and Injury Research, Education and Prevention (Seattle, WA; Davis, CA; Fort Collins, CO; Tyler, TX; Iowa City, IA; Marshfield, WI; Lexington, KY; Cooperstown, NY; and Tampa, FL). Each of the Centers is responsible for covering a specific geographic region. In addition, NIOSH funds one National Children's Center for Rural and Agricultural Health and Safety in Marshfield, Wisconsin. The Community Partners for Healthy Farming cooperative agreement program currently funds 7 intervention and 6 surveillance projects. Past NIOSH extramural projects have included the Cancer Demonstration Projects and the Agricultural Health Promotion Systems. In addition to the NIOSH Centers, NIOSH funds numerous extramural research and demonstration grants through its ongoing grant program and through requests for applications under the NIOSH National Occupational Research Agenda (NORA).

As part of its continuous improvement efforts, NIOSH has used several mechanisms for oversight of the National Program in Agricultural Safety and Health. The NIOSH extramural cooperative programs were reviewed in 1994, by a committee consisting of eight external reviewers. The report issued by this committee (Kennedy et al., 1995) identified significant program strengths and accomplishments and made several recommendations for changes and improvements. NIOSH has responded positively to these recommendations. In addition to changes in program emphasis and direction, NIOSH created the NIOSH Agricultural Steering Committee (NASC) to assist the Institute in future planning efforts related to the National Program in Agricultural Safety and Health.

In June, 1999 the NIOSH Board of Scientific Counselors (BSC) was charged by the NIOSH Director to form a subcommittee of the NIOSH BSC for the purpose of reviewing the internal NIOSH program in agricultural safety and health and to prepare a report with recommendations to the full BSC. This report describes the process used by the subcommittee and the committee's recommendations.

1.2 BSC Sub-committee for Agricultural Review

1.2.1 Committee Charge

The committee charge was contained in a letter from Dr. Linda Rosenstock, NIOSH Director, in a letter of June 3, 1999 to Dr. James A. Merchant, Chair of the NIOSH BSC. This charge is as follows:

"The Subcommittee for Agriculture Review will examine the internal NIOSH program in agricultural safety and health, reporting the program's strengths, weaknesses, gaps, appropriateness, and effectiveness. Additionally, the Subcommittee will examine the NIOSH internal agricultural program in light of the extramural programs and the Subcommittee's vision of new or future areas in agriculture that could produce yet unrecognized potential hazards to health and safety and opportunities for prevention. This effort will assist the Institute in strategic planning for the future and provide

assistance to the Director for effective allocation of resources for Fiscal Year 2001 and beyond."

1.2.2 Membership

Subcommittee membership was determined by NIOSH personnel and consisted of three BSC members and three external consultants with special expertise in agricultural safety and health. Members of the subcommittee were as follows:

John M. Dement, Ph.D., CIH
Subcommittee Chair
Associate Professor
Division of Occupational & Environmental
Medicine
Department of Community & Family Medicine
Duke University Medical Center

Curtis Klaassen, Ph. D.
Professor
Department of Pharmacology, Toxicology and
Therapeutics
University of Kansas Medical Center

Sharon L. Morris
Assistant Chair for Community Outreach
Department of Environmental Health
University of Washington

Paul D. Gunderson, M.D.
Executive Director
Marshfield Medical Research Foundation
Retired.

John J. May, M.D.
Professor of Clinical Medicine
College of Physicians & Surgeons,
Columbia University
Director, Northeast Center for Agricultural Health
Mary Imogene Bassett Hospital

Susan M. Kennedy, Ph.D.
Professor
School of Occupational & Environmental Hygiene
University of British Columbia, Canada

1.2.3 Review Process

Based on the Subcommittee charge, the following specific objectives were developed by the Subcommittee to further guide the review process:

- To review and evaluate the NIOSH internal agricultural research program with regard to the priority setting, planning, and management structure.
- To review and evaluate coordination and collaboration of the internal NIOSH agricultural program with the extramural cooperative agreement programs and the degree of collaboration.
- To evaluate productivity and impact of the NIOSH internal agricultural research program.
- To review and evaluate NIOSH's responses to recommendations made by the prior committee that reviewed the NIOSH external agricultural program.

The Subcommittee began the review process by reviewing written materials prepared by NIOSH

program staff and project officers. These materials consisted of an overview document entitled "The NIOSH National Program in Agricultural Safety and Health", summaries of intramural projects (designated as 80-100% agriculture) and annual project progress reports for fiscal years 97 - 99, copies of selected reports and publications reflecting outputs and accomplishments of the NIOSH agriculture program, and summary of NIOSH resource allocations (funds and FTEs) for agriculture intramural projects for FY 99.

Following review of written materials, the Subcommittee formulated an overall set of questions and issues to help guide meetings with Division Directors and researchers located in the NIOSH research programs in Cincinnati and Morgantown. It was stressed that the major objective of the Subcommittee's review was to address issues affecting the overall NIOSH initiative and not to evaluate any one specific project. A list of general and specific questions from the Subcommittee was provided to NIOSH prior to these meetings which were held during March 8-9, 2000. Attendance at these meetings included both program managers as well as project officers in an atmosphere which facilitated open discussion and exchange.

1.2.4 Report Organization, Preparation, and Review

Following the March meetings, the Subcommittee met to discuss the main recommendations of this report and to develop an overall report outline and process for report preparation. The Subcommittee determined that a report organized according to research area rather than by NIOSH divisions would be most informative. Initial drafts of sections of the report corresponding to research area were prepared by individual Subcommittee members. These sections were compiled and edited by the Subcommittee chair who also prepared introductory sections of the report, the executive summary, and the overall recommendations. The entire report was circulated to all Subcommittee members for review and comment prior to final submission to NIOSH.

1.2.5 Acknowledgments

The Subcommittee expresses its sincere appreciation to NIOSH staff, managers, and project officers for providing valuable written project descriptions and program summaries and for their open and stimulating discussions during the site visits. Special thanks to Dr. Steve Olenchok and John Valosen who provide all assistance and materials needed to complete this review.

2. HAZARD, DISEASE, AND INJURY SURVEILLANCE

2.1 Summary

The National Institute for Occupational Safety and Health has identified Surveillance Research Methods as one of the 21 priority research areas in the National Occupational Research Agenda (NORA), and NIOSH has developed a Strategic Surveillance Plan with considerable external input. The goals of public health surveillance are multiple including : 1) to define populations at elevated risk of disease, injury or occupational exposures, 2) to estimate the magnitude, distributions, and trends in cases and hazards, and higher risk populations for purposes of resource allocation for prevention or to evaluate the impact of prevention programs, 3) to generate hypothesis which lead to a better understanding of injury, disease, or hazards, and 4) to evaluate the impact of prevention programs.

Like other NIOSH surveillance efforts, the NIOSH surveillance program for agriculture consists of intramural and extramural efforts. Primary responsibility for agriculture surveillance activities fall within the DSHEFS and DSR with considerable collaboration with external partners in the Centers, for Agricultural Disease, Injury, Research, Education & Prevention as well as cooperative agreements such as the Community Partners for Healthy Farming :Surveillance. DART researchers also are developing environmental sampling and bioassay methods for surveillance of pesticide exposures.

Many of the traditional and ongoing NIOSH surveillance programs such as the Sentinel Event Notification System for Occupational Risks (SENSOR), the National Traumatic Occupational Fatality (NTOF) Surveillance System, and Fatality Assessment and Control Evaluation (FACE) provide some data with respect to agriculture risks. However, these data systems provide little or no information concerning surveillance of hazards, non-fatal injuries, and morbidity among workers in agriculture.

NIOSH has several projects that address limitations of current agriculture surveillance efforts. The Farm Family Health and Hazard Survey (FFHHS) is a cooperative agreement program funded in FY90 with the objective of documenting health status, work-related risk factors, and hazards among a sample of farm families. Six states were funded through this effort which allowed considerable latitude with regard to information collected in each state. The data collection component of this effort has been completed and reports prepared for each state program. While the FFHHS is largely an extramural effort, DRDS is currently analyzing the respiratory health status and exposure data collected by the FFHHS and DSHEFS is developing statistical summaries of FFHHS data and is developing a database to allow others access to these data. Such a data system would supplement the NIOSH Agricultural Safety Database (NASD) currently accessible on the NIOSH internet web site and on CD-ROM. The NASD serves as an important agriculture information resource with OSHA and EPA standards, more than 2000 publications, 500 scientific abstracts, 1000 agricultural safety-related videos, and resources for locating people and organizations.

The Community Partners for Healthy Farming (CPHF) is an outgrowth of the NIOSH

Occupational Health Nurses in Agriculture Program and includes a case-based surveillance component. Cases are identified through hospital emergency logs, migrant clinics, Department of Transportation records, and volunteer organizations with follow-back investigations of selected cases in a manner similar to the SENSOR program. Six surveillance projects were funded through the CPHF in FY99 with programs and emphasis varying somewhat by state. Several important agricultural injury problems have been documented by these efforts including scalping injuries caused by rotating power transmission devices found on one hay bailer model and explosion hazards from hydrogen gas generated inside sealed plow frames. Both of these findings generated prevention and information dissemination efforts.

The National Traumatic Injury Surveillance of Farmers (NTISF) was initiated by NIOSH in 1993 to provide national and state level estimates non-fatal injuries occurring in agriculture. The NTISF was done in collaboration with the USDA and consisted of mail surveys in 1993, 1994, and 1995 sent to a national sample of farm owners. NTISF is not currently active although DSR continues to analyze these data.

NIOSH has collaborated with USDA in a telephone survey of 50,000 farm operators in 1998. NIOSH is also working with the USDOL to add occupational safety and health questions to the National Agricultural Workers Survey (NAWS) which focuses largely on labor pool issues. The NAWS also is a component of the NIOSH program for Occupational Health Surveillance of Hired Farmworkers and has provided the first national population-based data on the occupational health status of hired farm workers.

The NIOSH Childhood Agricultural Injury Prevention Initiative includes a surveillance component. In collaboration with the CPSC, telephone follow-back interviews of youth injured on farms are conducted with cases identified through the National Electronic Injury Surveillance System (NEISS), which is based on hospital emergency department visits.

The NIOSH SENSOR program has been expanded to include surveillance of acute occupational pesticide-related illness in 5 states. The program is done in collaboration with the USEPA and the National Center for Environmental Health.

2.2 Strengths and Achievements

A major strength of the NIOSH agricultural safety and health surveillance program is the diversity of surveillance expertise available within the Institute. In addition, the array of projects demonstrates an impressive level of collaboration with other federal and state agencies as well as other NIOSH collaborating Centers. The NIOSH Centers also provide an important resource for future development of the NIOSH surveillance program for agriculture.

Important achievements in surveillance of agricultural hazards, injuries, and illnesses were described in the program overview. Population based surveillance of health outcomes has been achieved to some degree through the FFHHS and NTISF programs as well as use of NEISS in the Childhood Agricultural Injury Prevention Initiative. Limited case-based surveillance

activities include SENSOR-Pesticides and the Community Partners for Healthy Farming. Occupational deaths occurring in agriculture are captured by the NTOF and FACE.

2.3 Weaknesses and Gaps

Surveillance of agricultural health and safety is difficult due to the complex labor structure found in this industry which ranges from small family farms to large corporate farms and seasonal and migrant labor in some sectors. Unfortunately, many of the traditional surveillance systems may fail to fully capture hazards and health events occurring in this sector.

There seem to be weaknesses in hazard, injury, and disease surveillance in the mix of NIOSH agriculture surveillance. While the FFHHS survey provides some information in each of these areas, the data elements collected in each funded program varied; therefore, these data are difficult to analyze and may not provide reliable estimates beyond the actual populations surveyed. The NTISF program conducted in 1993-95 provided national data concerning non-fatal injuries in agriculture; however, this program is not currently collecting new surveillance data. While the NIOSH Centers are collecting some information concerning hazards among agriculture workers, this effort is spotty and is unlikely to provide meaningful national estimates. An internal NIOSH hazard surveillance effort for agriculture does not currently exist.

The most important gaps in the NIOSH surveillance effort for agriculture are: 1) little systematic surveillance of agriculture hazards, 2) no ongoing system for surveillance of non-fatal injuries, and 3) no current program for morbidity surveillance.

2.4 Recommendations

- NIOSH should include agriculture as one of the industry sectors in the planned NIOSH program on Hazard Surveillance in the Workplace.
- A systematic program for surveillance of non-fatal agricultural injuries is needed. The NTISF survey conducted in 1993-95 provides useful information as well as valuable experience which should be used to design an ongoing effort in collaboration with the USDA.
- NIOSH should work closely with the USDOL to expand the NAWS effort to collect more information concerning injuries and work related morbidity of agriculture workers.
- NIOSH should increase its collaboration with the NIOSH Centers, especially on hazard and case based surveillance efforts. NIOSH should provide leadership concerning development of case definitions and standardized data collection tools.

3. ETIOLOGIC RESEARCH AND EXPOSURE ASSESSMENT

3.1 Summary

NIOSH staff identified 5 projects in FY99 under this theme, comprising a total of 13.8 FTE positions and approx. \$1.3 million (non-personnel costs). This appears to be the largest component of the overall agriculture intramural program. These projects are briefly summarized below. Many of the projects combined intramural and extramural activities.

Respiratory exposures hazards in composting (DRDS)

As with many of the NIOSH agriculture projects, most of the respiratory disease research in agriculture carried out by the Division was in the form of extramural co-operative agreements. This particular project was identified as one in which 'intramural' funds had been re-directed to an 'extra-mural' cooperative agreement and no written information was provided for the review team.

Case-control study of primary intracranial gliomas among rural residents (DSHEFS)

This is a large case-control study, with an extensive exposure assessment component directed in part towards exposure to pesticides. Only a description of the development of the solvent exposure component of the data base was included and the project was mentioned only in passing by one of the investigators present at the DSHEFS meeting. This may have been due to the project not being classified as >80% agriculture. The committee cannot comment on the study except to note that this project seems to be the only hypothesis driven epidemiologic research project being carried out through intramural agriculture funds. Occupational exposures occurring in agriculture represent one of the many possible occupational exposures considered in this project.

Occupational injury prevention in Alaska (DSR)

This is a surveillance and research project focussing on fishing, logging, and air transport, carried out under the leadership of the NIOSH Alaska field station. The etiologic research component is an investigation of potential occupational asthma in crab processing workers, carried out as an HHE, with some collaboration with external researchers.

In vitro assessment of reproductive toxicity (HELD)

Endocrine disruption: consequences for occupational exposures (HELD)

These are two of many projects identified by staff at HELD as having an application to agriculture, but not focusing solely on agriculture. Other projects also listed in this category (by HELD staff) included 'pulmonary responses to occupational dusts, identification of occupational allergens, and mechanisms of arsenic related skin disorders'. Why these two projects were singled out in the written materials was not clear to the review team. However, it was apparent to the team that HELD researchers were conducting a considerable amount of investigator initiated research directed towards understanding etiologic mechanisms of disease, much of which was relevant to agriculture

as well as to other industries.

In addition to these 5 exposure assessment and etiologic research projects identified by NIOSH, the following projects also seem to fall within this category.

Biological and environmental monitoring methods for pesticides (DART)

This includes the development of new immunochemical methods and a single unified pesticide sampling device. The objective of this basic laboratory research is to provide tools that can be used in etiologic research and in regulatory settings.

Exposure assessment methods (DSHEFS)

In meeting with the DSHEFS division, staff identified this as one of the key components of its agriculture research program, i.e. the development of new techniques for measuring air and skin exposures for pesticides and agricultural chemicals.

Emerging issues in exposure assessment in agriculture

This project existed only in FY98. Early in the project, it was felt that the investigation was 'not fruitful' and the project was terminated, without any substantive work being carried out (although considerable funds were 'charged' to this project).

Relationships among workload, work processes, stress, biomechanical demands, and injury among children in agriculture (DART)

This is etiologic research that has also given rise to considerable intervention research. The work has been carried out in collaboration with external researchers at the University of Kentucky.

3.2 Strengths and Achievements

The committee noted the high degree of extramural collaboration on the part of intramural researchers for hypothesis driven research projects. This was viewed as a strength by the review committee as it felt that traditional external peer review remained the most efficient and effective way to ensure outstanding quality for such projects. The committee agreed that NIOSH's strengths were best directed towards the kinds of projects that traditional academic scientists are less able or less willing to carry out such as surveillance, targeted interventions, communications, and evaluation. Collaboration between NIOSH scientists and external researchers (eg. as in the composting study and the workload / injuries study) were viewed as examples of the kind of research relationships to be encouraged. Similarly, the transfer of 'intramural' funds to support extramural, co-operative agreement type research projects was viewed positively by the review team. This was felt to be an appropriate approach when faced with limited internal expertise in certain key topic areas.

NIOSH should be encouraged to support intramural etiologic or exposure assessment research projects only where there is a specific research question identified that matches directly with specific internal expertise and resources. The glioma case-control study appears to be an example of this approach.

3.3 Weaknesses and Gaps

Communication between divisions, between disciplines, and between NIOSH internal scientists and external scientists who collaborate with NIOSH via extramural funding remains a problem. For example, it was not obvious if the pesticide exposure assessment work at DSHEFS has been carried out in collaboration with work addressing similar objectives being done by DART researchers. Recommendations for improved communication are made elsewhere in this report.

The review committee was unable to determine the source of the mismatch between the very large dollar and FTE allocation to the 'etiologic research and exposure assessment' theme on the one hand, and the apparent paucity of projects on the other. This may reflect a limitation of the administrative record keeping system (i.e. of deciding if a project should be classified as an agriculture project) rather than a substantive failing.

In the same vein, it was very difficult to determine what NIOSH considers 'intramural' and 'extramural' research, both under this theme and others. Several of the projects described in the written materials and presented at the meetings were co-operative agreements, or other kinds of collaborations, in which a significant portion of the work was being done outside of NIOSH, with much of the intellectual input from external scientists. As noted above, this may well be an efficient use of NIOSH internal resources, but it should not be construed as part of the intramural program itself. Other examples described in the written document (e.g. Occupational Health Nurses in Agricultural Communities, OHNAC; and the Farm Family Health and Hazard Survey) are part of the 'extramural' projects.

3.4 Recommendations

- Etiologic research funded with NIOSH intramural funds should be carried out only where it fulfills a specific objective or answers a specific research question identified through an agency wide strategic planning process for agriculture research. Etiologic research conducted in collaboration with extramural partners makes the best use of available resources and expertise.**
- NIOSH is encouraged to make better use of targeted cooperative agreements to enhance collaboration on etiologic research projects between internal NIOSH scientists and external scientists, and in particular with scientists affiliated with the**

NIOSH funded Agriculture Centers. The committee encourages a reallocation away from exclusively 'intramural' projects to greater emphasis on hybrid (intramural / extramural) projects, in which there is true collaboration among the parties. Many such projects are currently underway and should be continued.

- **NIOSH scientists and project officers should be provided funds and time to participate actively in conferences, workshops, and continuing education courses of specific relevance to research in agricultural health and safety.**

4. CHILD AGRICULTURE RESEARCH AND PREVENTION

4.1 Summary

A summary of NIOSH intramural projects concerned with children in agriculture is provided below based on written materials reviewed and discussions at the site visits. To better understand the extent and nature of the Institute's intramural activities, these projects have been arbitrarily divided into several different categories:

Specific Child Safety Projects

DART – Workplace hazards to children and adolescents in agricultural work settings --- Hazards to children and adolescents are being investigated in order to examine the relationship of stress/economics to selection and training of children for farm tasks. In this project, physician surveillance of injury leads to subsequent analysis of injury-related tasks and an ergonomic evaluation. Eventually these projects propose to develop interventions, implement, and evaluate appropriate interventions.

DSR - Child agriculture injury surveillance – This project utilizes a series of different data sources to develop child injury database. Pilot testing is underway to evaluate each of the different data sources.

EID - Agriculture safety and health training intervention of young workers – This project is adapting the previously developed "Kayle's Difficult Decisions" to interactive electronic media (CD-ROM) and testing in KY high school vocational agriculture classes.

EID - Occupational injuries among children in rural areas – This project aims to prioritize issues raised by the National Action Plan of the Committee for Childhood Injury Prevention, to develop an action plan to address these, and to develop documents to be used in addressing these issues.

HELD - NIOSH Website for Kids and Teens - Interactive electronic and internet format information for communication of safety and health principals is being investigated in this project. This is not specifically an agricultural project but clearly has implications for this sector.

EID – Scientific basis for the NAGCAT Guidelines – Existing scientific literature is being

evaluated to assure that there is evidence for the validity of the recommendations in the NAGCAT documents.

Projects Which Involve Children

DART – Behavioral health risks in farm families – Neurobehavioral alterations in Ohio orchard pesticide applicators and their families, including children are being investigated.

DSHEFS – Support of the Agricultural Health Study in Iowa and North Carolina - This project is being conducted collaboratively with the National Cancer Institute and aims at assessing the significance of pesticide exposure to farmer applicators and their families, including children. NIOSH has been asked to assist with the exposure assessment component of this epidemiological study.

Support of External Child Projects and Projects Which Involve Children

DSHEFS – Community Partners for Healthy Farming. This is a collaborative effort with external partners with DSHEFS providing and evaluation of prevention programs including the North Dakota educational programs for youths.

DRDS – Agricultural Centers – Each of the Centers has projects designed to investigate or prevent child illness/injury. DRDS provides the NIOSH intramural support and coordination of these cooperative agreements.

DSR - Child agriculture injury prevention – DSR conducts a series of activities including coordination of a federal task force, establishment of National Child Injury Center, and establishment of an external grant and cooperative agreement program aimed at child injury.

The activities outlined above are all appropriate efforts aimed at better understanding potential hazards, their effects upon children and practical methods of intervention. At the present time it appears that traumatic injury is one of the major threats to children in the farm environment. Other potential threats would include pesticides, noise, organic dusts, emotional stress and ergonomic hazards. Currently there are limited data to assess the relative importance of each of these threats. As can be seen from the above list, NIOSH intramural research activities are diverse but not numerous – particularly those that have a primary childhood focus. A few approach the problem of child agricultural injury and illness in a somewhat holistic fashion, considering the economic, cultural and other factors which determine behaviors. The majority of the intramural projects are either quite focused upon one specific issue or are primarily serving administrative or evaluative functions for other projects.

Although child activities of the Agriculture Centers and other extramural collaborators have had only a cursory overview, it appears that the intramural program nicely complements the extramural activities and that the Institute has wisely left much of the child work to extramural investigators with special expertise in this field. Productive collaboration within the Institute is

evident in some of these projects. Given the somewhat limited intramural program, it is expected that a number of gaps can be identified. Many of these are covered by extramural activities. A few areas that are not currently covered are noted below and may deserve some attention.

4.2 Strengths and Achievements

Much of the Institute's child initiative – intramural and extramural - is focused on childhood injury and is based in DSR where there is considerable injury expertise. This seems to be an appropriate decision. The division appears to be progressing well in this effort, building a diverse extramural research effort, providing support for the National Child Center in Marshfield and beginning coordination of federal efforts. Other DSR intramural efforts are aimed at surveillance of child injury. The challenges associated with trying to keep count of these events are clearly recognized by the branch personnel. Their approach of monitoring a number of potential surveillance mechanisms in early pilot efforts seems reasonable. It is hoped that they will discover some combination of databases that will provide reasonable injury data on children in agriculture because this is important information for all who are working in this field.

Several of the projects dealing with children involve analyses of the presence of pesticides and their potential effects. The groups involved in these studies clearly have impressive chemical expertise and experience. Additionally there appears to be good collaboration within the several groups involved in pesticide monitoring and analysis. Collaboration is evident in other areas as well. It is most impressive in the development of the interactive teaching CD-ROM, "The Kayle's Difficult Decisions" which was done in collaboration with the University of Kentucky. This project began in DART where it was devised, written, evaluated and completed in manuscript form. Subsequently it has been picked up by EID where it has been transformed into an illustrated booklet and an interactive CD-ROM. These instruments are now being tested with a new audience - high school agricultural students.

One intramural project, in particular, stands out as being specifically designed for better understanding childhood issues in agriculture. "Workplace Hazards to Children and Adolescents in Agricultural Work Settings" is attempting to examine the network of issues associated with child agricultural work, from the economic and social issues influencing parental decisions to the ergonomic and social effects of this work upon the child. The eventual goal is the development of intervention and education materials for dissemination to parents, employers and young workers aimed at enhancing safe work practices.

The Institute is to be commended upon its appropriate reliance upon external collaborators with many of the childhood agricultural issues.

4.3 Weaknesses and Gaps

The Institute's intramural program for children working in agriculture is relatively thin. The majority of projects are primarily adult projects which have been expanded to include children. "Kayle's Difficult Decisions", an interactive examination of family decisions and economic impacts of injury to a child, seems particularly well suited for adolescents. However, even this project was originally intended for use by parents.

There are few projects that involve Institute staff with which reflect deliberate planning by persons within specific expertise in child physiology, development, learning, etc. This is not terribly surprising, given NIOSH's overall focus on enhancing safety for adult workers.

This relative scarcity of intramural child-ag projects may actually be more indicative of an institutional strength if it reflects a conscious decision by NIOSH to expend its child resources extramurally where child expertise is more readily available. A brief overview of the extramural program where there is an extensive commitment to many aspects of the child agriculture problem suggests that this may well be the case.

It seems appropriate to attempt an evaluation of this in light of the extramural child initiative. A systematic examination of this extramural initiative and particularly of the activities of the various Agriculture Centers, is beyond the scope of this review. However, a brief overview of the non-center projects funded in recent years by NIOSH shows that attention is being paid to children of migrant and traditional family farmers, to many aspects of child injury, toxicology, education and evaluation

There are several areas which do not appear to be receiving much attention within the child initiative (though some of these may be under study through Agriculture Center projects). The effects of organic dust upon young workers deserves attention. It is clear that children may develop ODTs, hypersensitivity pneumonitis, asthma and allergic symptoms in response to relatively common barn and silo exposures. Such issues are being well studied by DRDS in adult workers and should be explored in young workers. There is compelling evidence from the Farm Family Health and Hazard Survey that hearing loss is a common and significant problem with some farmers showing substantial losses by their fourth decade. Earlier data from the Marshfield Clinic has documented less dramatic but measurable losses in high school students. The Institute has no intramural activities addressing this problem. Outside of the centers, it is not clear that this is being addressed in the extramural program either. There has been some effort at stimulating intramural and extramural work on ergonomic hazards for child workers in agriculture. Although challenges here are myriad, more such work should be undertaken.

4.4 Recommendations

- **A systematic study of effective education and training techniques aimed at changing behavior of young workers should be undertaken by the Institute. It seems likely that NIOSH will be addressing other challenges relative to child labor in the future. Expertise in the training of young workers in the basic principles of safe work**

would be a good investment for the Institute. Efforts directed at applying these teaching techniques in agriculture as well as other fields are likely to be paid back many times during the work careers of these young people.

- **Noise-induced hearing loss is a significant risk for young people in the agricultural setting. The Institute should either address this issue directly or be assured that it is being appropriately pursued elsewhere.**
- **Efforts directed at understanding and preventing pulmonary injury related to chronic and acute exposure of children to agricultural dusts should be considered by NIOSH if this is not being currently pursued with the mix of intramural and extramural projects.**

5. PESTICIDE RESEARCH PROGRAMS

5.1 Summary

Pesticides are generally considered to be a generic class of chemicals used to kill insects, weeds, and fungi and includes pesticides, herbicides, and fungicides. There are numerous research projects that are examining the effects of pesticides on agricultural workers. For example, the following pesticide research programs are a part of NIOSH agricultural research programs.

Use of Hepatocyte Model for Identifying Biomarkers

This research program is centered on studying the biotransformation of chemicals. This work is being done using human hepatocytes, which is important because the human biotransformation enzymes are not identical to that in rodents. This technique has not yet been used to study the biotransformation of pesticides.

Behavioral Health Risks in Farm Families

Organic phosphate insecticides are extensively used and are known to produce toxicity by inhibiting cholinesterase with the resultant increase in acetylcholine. This can produce acute toxicity, and has been studied extensively over the years. In contrast, this study is examining whether there are long-term neurobehavioral effects of organophosphate insecticide usage in humans.

A Method for Simultaneous analysis of Multiple Pesticides

Pesticides are usually monitored analytically by chromatographic techniques. However, in this research, attempts are being made to identify and quantitate human exposure to pesticides, such as atrazine, heptachlor, metolachlor and alar, by antibody technology.

Biomonitoring Methods for Agriculture Exposures

This research project is to take the immunoassays developed in the above project and to use them to biomonitor herbicide exposure by quantifying their excretion into urine of agricultural workers.

Engineering Controls to Reduce Exposure to Musculoskeletal Injuries and Pesticides

It is not clear what efforts are being made to reduce pesticide exposure by engineering controls.

Agricultural Health Study - Pesticide Exposure among Farmer Applications and their Families

This program is in the planning-feasibility-assessment stage.

Neurological Effects of Organophosphate Pesticides in Structural Applicators

This research program centers on the biological effects, more specifically neurological effects, of the widely used organophosphate insecticide, chlorpyrifos.

Agricultural Emerging Problems

This research program has examined a number of various topics, such as the urinary excretion of the herbicide alachlor, as well as the effectiveness of gloves in protecting workers from herbicides.

Herbicide Exposure Assessment among Custom Applicators

In this research area, studies have been performed to quantify exposure of custom applicators to herbicides such as alachlor, atrazine, 2,4-D, and metolachlor and the immunoassay described above are used to quantify them. In addition, they are studying the exposure to the insecticide azinphos-methyl (Guthion) and the fungicide ethylenebis(dithiocarbamate).

Direct Reading Device for Dose Assessment

This project is designed to develop a direct reading device for field use by herbicide applicators and farm workers to measure uptake of the herbicide alachlor.

Pesticide Exposures of Greenhouse Workers

This is a pesticide exposure assessment of workers in rose growing greenhouses. This study is near completion.

Immunochemical Biological Monitoring of Agricultural Workers

This research centers on biological monitoring of pesticides, such as alachlor.

Field Evaluation of a New Method for Measuring Mancozeb and Maneb Exposure

Under this research program organophosphorus pesticide exposure was measured in children of agricultural workers.

Investigation of Pesticides as Endocrine Disruptors

In this program, the effects of a fungicide vinclozolin as an endocrine disruptor is being examined.

5.2 Strengths and Achievements

Pesticides that are used to kill insects, weeds, etc. also have biological effects in humans, and can cause untoward effects including death. Pesticides are definitely perceived as a health hazard, especially for agricultural workers. Thus, there is probably a societal expectation that NIOSH should be doing research on pesticides.

Probably the most scientifically unique aspect of the program is the development of immunological tools for evaluating human exposures to pesticides. These methods have the potential of providing innovative markers of exposure useful for etiological research, exposure surveillance, and evaluation of prevention programs.

5.3 Weaknesses and Gaps

The main weakness of the program on pesticides is there appears to be little or no coordination of the various programs. In fact there are apparently 16 research programs as described above. Many of them appear to be the same program, just with different titles. It is not clear what the overall goal of the pesticide program is, or how it is coordinated with extramural researchers. In a research program, such as this one on pesticides, the sum of the individual research projects should be greater than the sum of the individual projects. This is more likely to occur with better planning and coordination.

The use of pesticides is presently undergoing a revolution in the United States. As a result of molecular-biology techniques, scientists are engineering genetically modified organisms which are more insect resistant. It does not appear that there is a coordinated effort of the pesticide researchers to evaluate how this will affect pesticide use in the USA, and thus how it should impact the NIOSH pesticide research strategy.

5.4 Recommendations

- A major workshop should be held of the NIOSH researchers (internal and external), government, industry, and labor organizations that are interested in pesticide research to determine the future direction for the NIOSH pesticide research program. The new paradigm that NIOSH has used to prioritize research projects (ex dermatotoxic) before they are started and funded should be implemented in this research area.

6. INTERVENTION RESEARCH

6.1 Summary

The primary focus of the NIOSH intramural intervention program is the development and application of engineering controls for agriculture injury and illness risks. Intramural intervention research projects are located in DART, DSHEFS, and DSR. The engineering control projects initiated by scientists and engineers within NIOSH are exemplary given that they address NORA priorities and use basic public health theory to assess priorities and assign available staff and other resources to projects. NIOSH intervention projects are typically conducted in collaboration with external partners.

DART researchers are investigating cabin filtration and pressurization as a control measure for prevention of pesticide exposures during spraying. The project is being done with the State of California and has resulted in a standard performance test procedure based on modified respirator fit testing protocol. This procedure has been adopted by the Society of Agricultural Engineers. Surface mine vehicles are similar in design to agriculture vehicles and DART researchers are working with the NIOSH Pittsburgh Research Laboratory to extend this new technology to mining and construction.

Rollover protection systems (ROPS) for agricultural vehicles are the focus of several DSR projects. These projects have resulted in a new rollover protection system which deploys automatically when potential upset conditions are encountered. A new overturn sensor is being designed and tested in this project.

The Community Partners for Healthy Farming program contains an intervention component which is overseen by DSHEFS. This project is funded through cooperative agreements starting in 1996 and currently funds six projects as a new cycle. The bulk of the work on these projects is done in the Centers and cover a broad range of issues including health-behavior research in injury prevention, musculoskeletal disorder, ergonomics, pesticides, and economic consequences for farm injuries and illness. While occasional involvement of NIOSH intramural scientists is demonstrated, most of these projects are conducted entirely within the Centers.

6.2 Strengths and Achievements

The NIOSH agricultural intervention projects are scientifically sound. Additionally, many of the intervention projects have emanated from surveillance data indicating a compelling need. As a result, the projects selected possess clear merit for agricultural workers and other potentially affected households. For example, simple surveillance studies have identified musculoskeletal injuries as a significant risk amongst agricultural workers. NIOSH has responded to these findings by designing studies which seek to reduce musculoskeletal injury and enhance long-term health of agricultural populations. Surveillance activities in several states have identified respiratory issues associated with malfunctioning tractor, combine, and forage harvester, cab enclosures or enclosures that have lost their structural integrity. Injuries and deaths resulting from rollovers of agricultural equipment is a significant problem and NIOSH

engineering control research is important in this area. This research also has implications for mining and construction. The potential impact of the NIOSH intervention activities upon America's's working agricultural population is significant.

The NIOSH intramural intervention research effort is modest but productive. NIOSH has actively sought to coordinate its activities across divisions as well as with some of the Agricultural Research Centers where appropriate work is already underway. This is important for several reasons, including access to a diverse body of research expertise as well as for better access to populations at risk.

Cooperative activities with the Pittsburgh and Spokane Research Laboratories is to be commended. This effort has the potential for broad development and transfer of intervention technology and methods affecting agriculture, mining, and construction.

6.3 Weaknesses and Gaps

As noted above, the NIOSH intramural intervention effort is small but productive. The bulk of the NIOSH intervention research efforts are conducted by the external Centers through cooperative agreements. While good examples collaboration between NIOSH researchers and extramural partners are evident, a closer working relationship would benefit this effort. Also, NIOSH researchers do not appear to have a prevention or intervention endpoint in mind. One example is the Farm Stressor Index being developed by DART. While this appears to be a useful tool for research, potential uses as an intervention or evaluation tool apparently have not been addressed.

Exposures to high noise levels remains as an important hazard for agricultural workers; however surveillance and prevention efforts in this area have received little attention.

6.4 Recommendations

- While some excellent examples of intramural-extramural collaborative intervention efforts were identified during the review, it is clear that much greater impact can be realized through additional collaborative efforts. In some cases, NIOSH scientists may be unaware of these opportunities and recommendations for improved communication are contained elsewhere in this report.
- Collaboration with the Pittsburgh Research Center should be encouraged and expanded where appropriate.
- Partnerships with equipment manufacturers and suppliers offer an excellent opportunity for development and dissemination of intervention technologies and efforts. The NIOSH partnership for prevention of asphalt fume exposures during use of highway paving equipment is an excellent template to follow.
- Additional intervention research efforts should be devoted to noise induced hearing loss

and protection for agriculture workers.

7. COMMUNICATION AND INFORMATION DISSEMINATION

7.1 Summary

NIOSH lists a relatively few number of agricultural safety and health projects under the category of communication and information dissemination. There are other projects with a communications component that were reviewed for the quality of their research rather than for how well that research was communicated to various audiences, especially non-scientific audiences.

The three main agricultural projects listed by EID were the National Agricultural Safety Database, available on CD ROM and the internet; the Health Training Intervention for Young Workers, a training exercise that demonstrates how safety and health decisions are related to economic and workload pressures; and the project Evaluating the Scientific Basis of the North American Guidelines for Children's Agricultural Tasks. In addition there are other information dissemination efforts, including the development and dissemination of agricultural documents including Alerts and fact sheets, NIOSH exhibits at appropriate meetings, the NIOSH home page and response to external inquiries on the 1-800 number.

These are highly appropriate NIOSH activities, consistent with the Institute's leadership role in agricultural safety and health research. As with many other NIOSH "intramural" projects, the major projects are a mix of intramural and extramural effort.

7.2 Strengths and Achievements

The National Agricultural Safety Database seems to be a successful effort at providing a central repository that safety and health professionals can use to search for safety and health information and materials. Its on-line format is used frequently and accounts for 25% of NIOSH Web traffic. It is also available on CD-ROM.

The exercise for young workers about decision-making on the farm also seems to be a successful training scenario available both on CD-ROM and hardcopy. Both of these projects were largely developed at universities (the University of Florida and University of Kentucky, respectively) with NIOSH funds.

It is not possible to evaluate the project looking at the scientific basis for the children's agricultural task because the project is only now getting underway. It does seem a little curious, however, first to develop guidelines, then work to get them adopted by others and lastly review their scientific validity. The usability of the guidelines has also not been assessed and was mentioned as an area for future research.

7.3 Weaknesses and Gaps

The greatest weakness is the apparent lack of an overall NIOSH communications strategy for developing and disseminating information on agricultural safety and health. There seems to be a need for better coordination among the many different groups in NIOSH responsible for assisting researchers in getting their information out to the farming community--defined by DSR as "scientists, policy makers, the public, populations at risk and those who influence that risk." Some researchers mentioned that they were not sure whom to turn to for assistance in developing information for a variety of audiences.

EID seems to have overall responsibility for communications and information dissemination and is the only division that listed agricultural safety and health projects within this category. There are other units with responsibility for health communications, however, over which EID has no direct control, including the Office of Health Communications in the Office of NIOSH Director, the Health Communications Research Branch and the Communication and Information Activity within the DRDS Office of the Director in Morgantown

It is difficult to determine from the NIOSH Web page what is happening within the Institute on agriculture. There is information on completed documents and links to the NIOSH agricultural centers and other agricultural-related sites, but no good way to find out who within NIOSH is focusing on agricultural research and what the nature of their research is.

The 1-800 number seems to be a way to triage calls to appropriate NIOSH staff, but there does not seem to be a mechanism to feed back information on trends in calls into an overall NIOSH communications strategy. For example, if there were a large number of calls on a particular topic it might be the subject of a fact sheet or FAQ site on the Web page.

The primary gap in the NIOSH agricultural communication and information dissemination effort is the lack of an Institute-wide strategic plan to communicate information on agricultural safety and health.

7.4 Recommendations

- Develop a NIOSH communications plan specifically for agricultural safety and health information. As part of that communications plan consider the following:
- A mechanism to set Institute-wide priorities for development of agricultural communications documents, videos and CD-ROMs. Better coordination of existing resources with responsibility for health communications.
- Better coordination of existing resources with responsibility for health communications.
- Development of a Web page covering intra-mural agricultural safety and health activities that is linked to extra-mural research programs.
 - a. Inclusion of a FAQ section to the NIOSH home page that includes agricultural safety and health information when appropriate.
 - b. Incorporating information from the 1-800 line into the communications strategy.

8. OVERALL RECOMMENDATIONS - CROSS-CUTTING ISSUES

In addition to the specific program area recommendations contained in the other sections of this report, the committee makes the following recommendations with respect to the overall NIOSH intramural agriculture initiative.

8.1 Strategic Planning

As a supplement to the traditional mechanisms used by NIOSH for program and project planning, NIOSH created the NIOSH Agricultural Steering Committee (NASC) to assist the Institute in future planning efforts related to the National Program in Agricultural Safety and Health. The NASC was formed in 1996 and was charged to review the intramural and extramural research programs; to determine strengths, weaknesses and gaps; and to make recommendations for future research activities in agricultural safety and health. The NASC consists of members from all NIOSH divisions and laboratories and from the Office of Extramural Coordination and Special Projects. Among the many notable accomplishments of the NASC is an extensive review of all NIOSH agriculture and related activities and bringing these many and diverse projects under one umbrella. This effort has better defined the breadth and depth of the overall NIOSH agriculture research program and provides valuable information for program planning. In addition to NASC, an ad hoc external agriculture team (EAT) consisting of the project officers of the major cooperative agreement programs provides additional input to strategic planning.

It is clear that considerable effort is expended on planning at the division level. It was also noted that the NIOSH Agriculture Steering committee functions much like a grant review committee. Projects are proposed by individual scientists and then evaluated and prioritized by the NASC. Subsequently these priorities are returned to the appropriate division. On occasion this has engendered considerable review and revision of existing plans. Although this is a useful function, it does not replace strategic planning regarding the overall objectives of the agriculture initiative. For example, although the NIOSH document listed eight general priority areas for research for FY01, only one division appeared to be familiar with these priorities, despite pointed questioning on this point from the review committee. It is unclear whether the timing of the NASC planning is inopportune for division planning, whether the planning efforts of the NASC are insufficiently communicated to the branch and division level or if NASC input is simply not built into the division planning process.

The review team noted that the written material did not link the projects to NORA priority areas, nor did this emerge as a prominent focus in much of the discussion. There was no obvious future plan or strategy followed by all divisions (or even by any one division) to guide research choices.

8.2 Communication

Because agricultural activities are distributed throughout the Institute and to a substantial

number of external collaborators, communication is both an essential attribute and a daunting challenge. Notable efforts have been made to enhance communication. These include establishment of the office of the Agricultural Coordinator, routine meetings of the National Agricultural Steering Committee (NASC), assembly of an ad hoc external agriculture team (EAT) consisting of the project officers of the major cooperative agreement programs. Some of the divisions have made particular efforts at marketing of their extramural activities within NIOSH. Most notable are the activities of the Agriculture Centers project officers in DRDS where Centers web sites, biennial meetings, pamphlets, descriptive booklets and other materials have been organized and advertised to other divisions.

The impact of these various communication efforts has been mixed. It seems clear that input from the NASC is valued and its priorities are acknowledged by division management in division planning and decision making. Some members of each of the divisions are well informed regarding certain aspects of the agricultural initiative. Among this group are the NASC members, but there are certainly other knowledgeable staff members. However in most divisions the majority of the staff appeared to be relatively uninformed about agricultural projects, certainly about ones outside their immediate collaborative activities. Most staff cited the NIOSH Agricultural Conference as their main source of information regarding both intramural and extramural agricultural projects. It was not clear however, that many of the scientists participated in this conference on a regular basis. Many of the staff were unaware of the Agriculture Centers web site as a source of information on this program. Similarly awareness of the Community Partners results was not usually in evidence. While lack of awareness may not invalidate the work of many of the intramural scientists, it certainly represents lost opportunities for meaningful collaboration and could lead to needless duplication of efforts.

8.3 Recommendations

- NIOSH should formulate a more clear-cut strategic planning process for the agriculture initiative to develop overall Institute priorities for agriculture safety and health research. There seem to be many continuing projects but no good mechanism for choosing new projects and for determining which projects are best conducted intramurally and which are best conducted extramurally. There also seems to be little communication between recipients of NIOSH RO1 research grants and NIOSH researchers, so that many NIOSH staff are not really aware of research being conducted at universities.
- **To assist NIOSH in its strategic planning efforts, NIOSH should sponsor an international workshop on agriculture health and safety research and prevention needs over the next 10 years. This is particularly important given the rapid changes taking place in the demographics of the agriculture workforce as well as agriculture methods and technology. This workshop should have broad participation from government, industry, labor, and academia.**

- **The efforts of the NASC and EAT should be adequately supported. This includes basic financial support for the members from each of the divisions (which currently does not appear to be an issue) as well as formal recognition of NASC efforts as valuable contributions to NIOSH. Staff time devoted to NASC should be considered in addition to scientific achievement and administrative effort in personnel evaluations. Staff members participating in NASC and EAT activities should be encouraged to actively disseminate agricultural information within their respective branches and divisions.**
- **Consideration should be given to supporting a communications function within the office of the Agricultural Coordinator to assist with intramural and extramural marketing of all NIOSH agricultural activities. This may require allocation of an additional FTE and supporting funds to this office.**

Part of this effort should include establishing an agriculture site within the NIOSH web site. This could be linked with the Agriculture Centers site and with each of the centers. The Agriculture Centers Access database will provide easy reference to any centers activities. Establishment of related databases which would include other extramural and all intramural agriculture (>80%) projects should permit easy searches for any NIOSH activities via the agriculture website.

- **NIOSH staff working on agricultural projects should communicate their progress at the NIOSH Agricultural Conference. Since many cited this conference as their major source of information on NIOSH agricultural projects, attendance and participation should be facilitated and encouraged. Divisions (such as DSR) who seek to communicate with their external agriculture collaborators via annual meetings should strongly consider piggybacking such meetings onto the NIOSH Agriculture Conference in the years that one is planned.**

The NIOSH National Program in Agricultural Safety and Health

Prepared for a Review of the Intramural Research Program by the NIOSH Board of Scientific Counselors Subcommittee on Agriculture

A Brief History

In 1988, approximately 170 scientists, policy makers, and private citizens met in Iowa City and in Des Moines, Iowa. The conference was named “Agriculture Occupational and Environmental Health: Policy Strategies for the Future,” and its primary goal was to expand the life and spirit of the conference beyond just the meeting and develop a capability of instigating policy development in the future. Grass roots contributions were invited and included from the very beginning. Scientific information was reviewed, summarized, simplified and given to the general public and to policymakers. The initial product from that conference was the 1989 publication of the document, “Agriculture at Risk: A Report to the Nation,” that described the process and the issues and listed policy recommendations in agricultural safety and health, and environmental health.

In large part due to that grassroots effort, in 1990, the Congress of the United States established a national initiative in agricultural safety and health that directed NIOSH to develop a program which, “...when sustained over a period of time will have a significant and measurable impact on [these] health effects among rural Americans.” That program included surveillance, research, and intervention and also funded the Surgeon General’s Conference on Agricultural Safety and Health that was held the following year in Des Moines Iowa in 1991. The Conference established a vision for improving the health and safety of agricultural workers and their families throughout America by raising consciousness, building coalitions, disseminating information and encouraging action.

In 1992, the Childhood Agricultural Injury Prevention Symposium was held in Marshfield, Wisconsin. That Symposium brought together individuals from a wide group of diverse disciplines and sought to develop consensus on relevant research, education, policy, and other interventions aimed at reducing agriculturally-related injuries in children. From that beginning group, a smaller core group formed the National Committee for Childhood Agricultural Injury Prevention with broad stakeholder representation, including researchers, farmers, agricultural groups, safety and health professionals, and government officials.

In 1996, the members of that National Committee published the document, “Children and Agriculture: Opportunities for Safety and Health. A National Action Plan,” which contained 13 objectives and 43 recommended action steps calling for leadership, surveillance, research, education and public policy. The National Action Plan called for NIOSH to serve as the lead Federal agency in preventing childhood agricultural injury.

From this second grassroots-lead effort of private- and public-sector cooperation to raise awareness and concern, in 1997 the Congress extended the NIOSH mandate to include efforts directed specifically at childhood agricultural safety and health issues.

As a tangible effect of the development of the NIOSH National Program in Agricultural Safety and Health, there exists a significant intramural research program and a network of surveillance, research, and intervention/education programs extramurally which span the Nation.

Currently there are 9 NIOSH Centers for Agricultural Disease and Injury Research, Education and Prevention across the United States: Seattle, WA; Davis, CA; Fort Collins, CO; Tyler, TX; Iowa City, IA; Marshfield, WI; Lexington, KY; Cooperstown, NY; and Tampa, FL.

By cooperative agreement, we fund one National Children's Center for Rural and Agricultural Health and Safety in Marshfield Wisconsin.

Through the Community Partners for Healthy Farming cooperative agreements, 7 intervention and 6 surveillance projects are active.

Finally, numerous grants, including National Occupational Research Agenda (NORA) grants, round out the NIOSH national effort in agricultural health and safety.

Continuous Improvement and Oversight

NIOSH is committed to continuous improvement and good stewardship of the National Program that was entrusted to NIOSH by Congress. Several mechanisms of oversight, evaluation, and recommendations have evolved throughout the life of the program.

1. Review of Extramural Cooperative Agreement Program

In 1994, eight external reviewers were engaged by NIOSH and asked to review the extramural components of the National Program. The review committee consisted of national and international experts in a variety of areas related to agricultural safety and health. Representatives from universities, migrant programs, agricultural centers, Federal rural health policy, agricultural equipment manufacturers, and farmworker justice comprised this international panel which was charged to review the overall extramural program and to make recommendations for future directions. The review focused on the overall program and not on specific projects. It was conducted in December 1994 and a report was presented to the Institute in January 1995. The report recommendations were treated seriously by NIOSH and continue to guide change in the Program. For example programs such as the Cancer Demonstration Projects and the Agricultural Health Promotion Systems were ended, in part, due to the recommendations of the panel. The Occupational Health Nurses in Agricultural Communities program evolved into a community-based surveillance and intervention program, Community Partners for Healthy Farming. That program requires real participation of community-based groups with a broad

group of researchers. Our extramural programs were strengthened further with studies of under-served populations, including women and children in agriculture, people of color, and migratory farm laborers. Specifically, NIOSH expanded the Agricultural Centers Program to emphasize health and safety issues that are unique to African-American farming populations (Southeast Center for Agricultural Health and Injury Prevention, Lexington, KY) and Native Americans (Southwest Center for Agricultural Health, Injury, and Education). At the same time, existing Centers expanded their focus to include research and outreach related to women and children, Hispanic and Latino farmworkers. NIOSH continues to be responsive to the external review panel's recommendations, as evidenced by the most recent (September 1998) establishment of the Deep-South Agricultural Health and Safety Center in Tampa FL which has a mandate to address minority and migrant farmworker/family health and safety issues in agriculture in Florida and the Mississippi Delta region.

As noted in the 1995 *Report of An External Committee to Review the Extramural Cooperative Agreement Programs*, the broad-based approach that NIOSH first structured to identify, evaluate, and manage health and safety issues in agriculture generated "...some programs that succeed(ed) more readily than others." NIOSH continues to accept and dedicate our efforts to the reviewers' challenge "... to consolidate and build on the successes and work towards ensuring program stability in order to achieve a long-term reduction in disease and injury in agriculture."

2. NIOSH Agricultural Steering Committee

In May 1996, NIOSH created the NIOSH Agricultural Steering Committee (NASC) to assist the Institute in future planning efforts related to the National Program in Agricultural Safety and Health. NASC was charged to review the intramural and extramural research programs; to determine strengths, weaknesses and gaps; and to make recommendations for future research activities in agricultural safety and health. The Committee goals included assistance in coordinating the agricultural research program across the Institute and to identify collaborative opportunities, both intra- and extramurally. NASC consists of members from all NIOSH Divisions and Laboratories and from the Office of Extramural Coordination and Special Projects. NASC participated in a series of retreats designed to provide gaps analysis and recommendations for future direction. An internal white paper was presented to the Director and the NIOSH Lead Team in March 1997. The process continues to evolve. Project planning guidance from NASC for Fiscal Year 2001 recognizes the following areas of priority/gaps:

A. Impact Issues for FY01 Project Plans: Eight general areas of research impact are priority issues for agricultural safety and health research. Other areas will be considered also.

1. Communications/Dissemination
2. Intervention Effectiveness
3. Control Technology/ Musculoskeletal
4. Machine-Related Injuries
5. Special Populations
6. Motivational Research/Work Organization

7. Morbidity Surveillance
8. Etiologic Research and Exposure Assessment

B. Pilot Issues for FY01 Project Plans: These general areas of research are recommended for pilot explorations:

1. Economics of agriculture-related disease, injuries, and fatalities
2. Connection of research findings to health care providers and farmers/workers
3. Effective communication of agricultural safety and health messages to the agricultural community:
 - a) agricultural production conferences
 - b) agricultural safety specialists
 - c) trade journal publications
 - d) rural media
4. Impact indicators of the NIOSH agricultural program on health effects among rural Americans.

C. Cross-cutting Research on Issues Common with Mining: The Office for Mine Safety and Health Research encourages support of collaborative research with the Pittsburgh Research Laboratory and the Spokane Research Laboratory researchers on cross-cutting issues. Cross-cutting issues likely exist in all eight of the general areas of research impact above. Research proposed will address the common issues in both an agricultural setting and a mining setting, thus requiring interaction of co-project officers.

NASC meets periodically and discusses issues related to agricultural safety and health. Additionally, the Committee evaluates newly-proposed projects and provides guidance and recommendations to the Project Directors and to the Divisions/Laboratories and the Institute Director. Similar to grants' review, each project is assigned to a primary and secondary NASC reviewer, not of the same organizational group as the principal investigator, whose responsibilities include understanding and evaluating the project. Consultation with the principal investigator is recommended if needed to fully understand the project. The primary reviewer presents the project, including the strengths and weaknesses, and recommends an overall score based on the general guidance. Next the secondary reviewer adds additional comments and considerations, including strengths and weaknesses, and recommends an overall score. A short general discussion with the full NASC will follow. Project officers for the new projects then will be invited for a question and answer session (in person, via e-mail, or by telephone) on the proposed project to the

full NASC. Following the sessions the entire NASC will participate in open discussion of the projects with the goal of reaching consensus on final NASC ratings and ranks.

Each project is rated on a five-point scale of Low, medium low, medium, medium high and high using the following general evaluation guidance:

Overall Project Ratings: High, Medium High, Medium, Medium Low and Low.

>> Seriousness of the hazard based on death, injury, disease, disability, and economic impact.

>> Number of workers exposed or magnitude of the risk.

>> Importance of the project based on documented need or customer request.

>> Probability that the research will make a difference reflected in proposed outcome measures.

>> Inter-divisional collaboration and/or development of external partnerships.

>> Strategy for dissemination or translation of results for use internally and externally.

>> Commitment of resources, including time, is sufficient to achieve projected outcome.

At the conclusion of the ratings, projects are ranked in order of recommendation by NASC for funding with funds dedicated to agricultural research. A final consensus report is presented to the Director, NCSH and to leadership in all the Divisions/Laboratories. That report provides NASC analysis of the proposed projects with ranked recommendations for funding. NASC also recommends removal of those proposed projects that the Committee feels are not agriculture-related.

Each Division/Laboratory may appeal the ratings/rankings of their respective projects, and that appeal is presented again to NASC for discussion of its merit.

NASC may then recommend changes in the ratings or reject the appeal. NASC provides continuous oversight on continuing projects by discussing progress over time with the

Project Directors. NASC reports to the Director, NIOSH.

3. NIOSH Leadership Team Examination of Agriculture Projects

The NIOSH Leadership Team, which includes the Institute Director and Deputy Director, Associate Directors, Chief of Staff, Directors of all NIOSH Divisions/Laboratories, Program Analysts, and others, met in Washington DC in December 1997 to examine all projects that listed “agriculture” as a focus area. At this meeting, every project that requested agriculture-related funds was discussed. Each Division Director presented that Division’s projects, followed by discussion by the full Leadership Team. A key question considered for each project was whether the project was correctly coded as an agriculture project. For those complex Institute projects involving some agriculture activities, the percentage of the total budget attributable to agriculture was determined. Administrative costs, personnel costs, contract/cooperative agreement costs, and discretionary (research) monies were discussed. Encouragement was given to proceed toward development of big targeted projects and compliments were given to the Agriculture Team for reviews of quality and importance of new projects. During this “truth squad” approach, the Leadership Team verified which projects were truly agriculture-related, and affirmed that the Institute resources assigned to Agriculture were appropriately distributed

4. NIOSH Childhood Agricultural Injury Prevention Program

Because the Childhood Agricultural Injury Prevention Program was grassroots-driven initiative, NIOSH believes it is important to maintain stakeholder input. In February of 1997, as NIOSH was developing a plan to implement this new initiative, a meeting was convened of stakeholders to gain input on the draft implementation plan. As a result of this valuable input, revisions were made and the final plan was developed and implemented in that fiscal year.

NIOSH organized a mid-course review of the Childhood Agricultural Injury Prevention Initiative in September 1999 in order to receive stakeholder comments on the progress and proposed future activities of the Initiative. The document of the progress and proposed activities was made available on the NIOSH web page at <http://www.cdc.gov/niosh/childagz.html> or a hard copy was available from the NIOSH docket office. A Federal Register Notice announcing the public meeting was printed on July 7, 1999 and interested parties were invited to attend a public meeting in Washington DC. Stakeholders were given an opportunity to present oral testimony about the program and recommendations for future directions. There was also opportunity to provide written comments to the NIOSH docket office if attendance was not possible for stakeholders. The mid-course review and public meeting were very productive. Eleven individuals provided comments at the public meeting, and nearly 30 individuals who were unable to attend the meeting provided written comments. Comments were received from researchers, a representative from a federal agency (Maternal Child Health Bureau), a representative from a state government agency (Colorado Dept. of Education) and representatives from the media (e.g. Successful Farming), private industry (e.g. Zenith Insurance), and non-governmental organizations (e.g. Farm Safety 4 Just Kids and the Farmworker Justice Fund). The comments demonstrated a diversity of perspectives, and were all

very constructive. Strengths and limitations of the Initiative were noted, and recommendations made for modifications and revisions to proposed activities. NIOSH is distilling all the comments and will give them due consideration as plans develop for FY01 funding.

5. Construction-Agriculture-Mining Partnerships (CAMP) Workshop

In 1999, special monies were made available as an impetus for bringing researchers together in multi-disciplinary efforts to focus on common high-priority needs of workers in construction, agriculture, and mining. Over the previous two years, comments from stakeholders in each of these sectors as well as from Federal advisory committee members reinforced the potential for forming multi-sector, multi-disciplinary research teams in NIOSH that can transfer well-recognized advanced technologies and information from one sector to bear upon common problems or issues in another sector. The strong rationale that supported bringing the former Bureau of Mines laboratories into NIOSH focused on the synergy that could be realized through such partnerships. After review and deliberations by the NIOSH Lead Team and the Agriculture and Construction Coordinators, NIOSH awarded several FY00 projects to intramural investigators that crossed sectors. For example, a project to use new technology to increase roll over protective structures (ROPS) on tractors is expected to produce results that could be useful for tractor use in construction, agriculture, and mining.

In December 1999, NIOSH organized a workshop for internal NIOSH researchers who expressed scientific interest in developing/sharing ideas that could lead to major research activities that incorporate all three work sectors. The Construction-Agriculture-Mining Partnership(CAMP) Workshop was held in Pittsburgh. Approximately 100 attendees represented all segments of the Institute. Removing barriers to building effective partnerships across Divisions/Laboratories to address cross-cutting issues in the three sectors was an important goal of this workshop. The purpose of this workshop was to facilitate the personal interactions which are necessary to build the desired internal research partnerships.

Five breakout sessions were arranged to bring researchers with common interests together to discuss likely areas they could study jointly.

- A. Exposure Assessment, Instrumentation and Exposure control related to Chemicals, Dust, Fumes, Mist, Noise, Explosions, and Fire. (2 Groups)
- B. Physical Hazards Including Machines, Equipment, Electrical, Structures, (plus) Ergonomics and Human Factors.
- C. The Health and Safety Spectrum to Special Populations (Aging and Young Workers), Social and Economic Consequences, Work Organization Issues, and Diverse Workforce
- D. Methods and Issues Related to Occupational Safety and health Education, Training, Information Dissemination, and Risk and Health Communications

The attendees were charged to work within their selected breakout session to:

1. Identify significant problems/issues that cut across construction, agriculture, and mining;
2. Explain the important challenges/impediments to addressing each identified problem/issue effectively;
3. Determine the professional disciplines and level of expertise that would be necessary to address each identified problem/issue effectively;
4. Assess whether internal staff, external researchers, or both would be needed to pursue each identified problem/issue;
5. State what actions, developments, or activities would be necessary to facilitate working jointly with Institute partners to address the problems/issues; and
6. Produce a report reflecting the outcomes of your deliberations.

The pages of brainstorming, discussion, and consensus-defined issues are being analyzed. It is hoped that the passionate and open discussion and issue-driven activities will help break down barriers to inter-Divisional/Laboratory, multi-disciplinary collaborations. The ultimate goal of CAMP is to develop strong and important projects that will address needs in all three sectors: Construction, Agriculture, and Mining.

At the end of CAMP, attendees were asked to reflect on the workshop and present an evaluation of the effort. The attendees felt that the experience was very successful and rated CAMP overall as 4.7 on a 6-point scale. The report from that workshop is expected in 2000.

6. National Occupational Research Agenda

Many of the partnerships which were established within the agricultural community evolved to become participants in the National Occupational Research Agenda (NORA). NIOSH developed NORA with over 500 partners in the public and private sectors. NORA provides a framework to guide occupational safety and health research for the Nation and encompasses 21 priority research areas in three categories: Disease and Injury, Work Environment and Workforce, and Research Tools and Approaches. Most priority research areas are directly relevant to agricultural safety and health. Each priority research area has an interest group that includes intramural and extramural scientists working together to recommend priorities and future direction. For example, Health Services Research addresses issues of access to health care, quality of care, and outcomes for agricultural injuries and illnesses. Through NORA funding, NIOSH has the opportunity to fund quality research grants in many areas of agricultural safety and health, such as "Injury and Illness Surveillance in Migrant Farmworkers," and, at the same time, provide oversight and direction for these important issues.

One of the most encouraging testaments to the success of NORA is the number of other organizations that use NORA as a model for creating research agendas or other types of partnership and planning. This recognition of the importance of partnering is found also in the agricultural community as evidenced by the NIOSH-funded Pacific Northwest Agricultural Safety and Health Center in Seattle WA. This Agricultural Center organized a farm summit

modeled after NORA to develop areas of consensus about key agricultural safety and health problems in the Pacific Northwest Region that can be addressed by research and intervention programs. That Center recently published its “Occupational Research Agenda for Northwest Farming” which is the result of a process that involved key stakeholders (producers, labor, health care professionals, academicians, public health agency officials and other) throughout that Region. This document should serve as a useful guide for anyone interested in farming health and safety in the Pacific Northwest, and should improve the use of existing resources through focused efforts and direction. The Pacific Northwest Center continues in this NORA direction with a just-completed Forestry Summit which used the same process to address health and safety issues in that sector of agriculture.

7. Board of Scientific Counselors Subcommittee Review of the NIOSH Intramural Program in Agricultural Safety and Health.

In 1999, a subcommittee of the NIOSH Board of Scientific Counselors (BSC) was formed with three Board Members and three external, internationally-recognized, consultants to The Board. The BSC Subcommittee for Agriculture was charged to examine the internal NIOSH program in agricultural safety and health, reporting the program's strengths, weaknesses, gaps, appropriateness, and effectiveness. Additionally, the Subcommittee will examine the NIOSH internal agricultural program in light of the extramural programs and the Subcommittee's vision of new or future areas in agriculture that could produce yet unrecognized potential hazards to health and safety and opportunities for prevention. This effort will assist the Institute in strategic planning for the future and provide assistance to the Director for effective allocation of resources for Fiscal Year 2001 and beyond. The report to the Board of Scientific Counselors is expected in early 2000.

Recently a panel assembled by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, suggested that Federal agencies that support scientific research should adopt a new kind of peer-review system in which outside teams of experts would evaluate whether the research is producing useful results. It was felt that regular reviews of scientific progress “...can only benefit the national research enterprise by focusing resources on the most vital fields.” As evidenced by the historic efforts at continuous improvement and oversight, NIOSH welcomes and encourages both intramural and outside reviews of the NIOSH National Program in Agricultural Safety and Health. It is through such efforts of self-correction and external expert peer-review that the health and safety of the Nation’s agriculture workforce can be protected and enhanced.

Additional Agriculture-Related Projects

For the purpose of the review of the intramural program by the NIOSH Board of Scientific Counselors Subcommittee on Agriculture, projects that are designated 80-100% agriculture comprise the universe of projects. This pool of work represents the dedicated agriculture-related program within the Institute. There are additional projects within NIOSH that contribute in various lesser degrees to the overall Agricultural Program. In these important cross-cutting

projects, agriculture is but a part of the larger project, but an important part nonetheless. For example, in the project, “National Traumatic Occupational Fatality (NTOF) Surveillance System,” agricultural traumatic fatalities are enumerated as are other occupational traumatic fatalities. Likewise, research projects related to biological monitoring, control technologies, asthma, pesticides, Fatality Assessment and Control Evaluation (FACE), predictive animal models, and electrical hazards, to name a few, contain important agricultural elements. And Institute support systems such as publication of Alerts, documents, and exhibitions also are related to agricultural safety and health, but at a level under 80%.

Benefits to Agricultural Safety and Health

There are numerous benefits to agricultural safety and health that continue to bloom from the NIOSH National Program. Identification of new hazards; recognition of new preventions; effective methods of communication; changes in paradigms for NIOSH investigators, are just a few areas in which NIOSH has grown or moved others to growth. The NIOSH Agricultural Steering Committee (NASC) was asked to provide some examples of “lessons learned” or highlights that came to light because of the National Program. The responses to the request are as varied as the Program, itself. But it is in that diversity of lessons learned, and in the diversity of the many disciplines within the NIOSH Agricultural Program that the strength of the National Program can be found. The following represents a potpourri of lessons learned and highlights of the NIOSH Agricultural Program as seen through the eyes of NASC. The list is not meant to be inclusive, nor is it meant to portray only the things that NIOSH recognizes as important. The following comments from members of the NASC are meant to provide a flavor of the varied and exciting activities that have occurred because of the NIOSH National Program in Agricultural Safety and Health.

1. Changes in Perspectives

Some of the changes that have occurred at NIOSH with respect to the approach to agricultural safety and health are part of an Institute-wide shift in emphasis and follow-through. Especially during the 1980's, a research program was completed once its findings were published in a professional journal, a NIOSH criteria document, or a similar publication. It was left to others to communicate the results to workers. To be sure, NIOSH had a very active training division, but it was very small and could not cover every training need.

What has been learned is that if we fail to communicate our results to farmers so that they can protect themselves, then our research has been ineffective. This realization has led to a much greater emphasis on finding ways to communicate the results directly to farmers in ways that they can use for themselves. Some types of interventions are training demonstrations; other interventions concern the tools that farmers use every day. The key is active participation in the intervention by farmers and farm workers.

A decade ago NIOSH scientists tended to work within their own disciplines, with little thought for what colleagues in other NIOSH divisions might be doing. But we have learned that it does no good to convince a farmer to retrofit his or her tractor with a ROPS unless we can also

convince him/her to use the seatbelt every time. This fundamental drive toward inter-disciplinary research coincides with the need to communicate our findings effectively. NIOSH has not given up the traditional tools of our sciences, but we have gradually begun to add quasi-experimental methods, program evaluation methodology, and qualitative techniques to our research designs. And we have recognized the need for effective health education and health communication components in our projects.

This shift toward inter-disciplinary work has led to a shift in how farm problems are viewed. No longer do we study only the forces involved in a tractor overturn. We now include: 1) the economic costs of a ROPS retrofit as perceived by the farmer, 2) the workload pressures that may contribute to placing the vehicle in a situation where it is at risk of an overturn, 3) the social and economic costs of an overturn, and 4) family and community views about the need for ROPS on tractors. This is just one example. NIOSH researchers have come to recognize that farmers and farm workers are important to their families and to their communities. We communicate best when we approach agricultural safety and health through a farming community's values and priorities.

A second area in which NIOSH has struggled concerns the productivity of an enterprise. Coming from a strong public health model, any mention of workplace productivity was taken as a willingness to compromise worker health and safety. But in agriculture, as in many other industries, farmers will intentionally place themselves at risk to maintain productivity and complete a task quickly. Further, no matter how effective a given safe work practice may be, it will be ignored by farmers if it is perceived to slow the work. Thus it has been farmers and farm workers who have taught NIOSH researchers to pay attention to farm productivity. This is a recent change at NIOSH, and one that has been helped by the addition of the staff of the former Bureau of Mines.

Specifically with respect to agricultural safety and health, these changes in perspective at NIOSH have led to four, inter-related hypotheses for creating effective interventions for U.S. farmers, farm family members and farm workers:

- 1) The interventions require the active participation of the farmers and farm workers, for whom the interventions are intended;
- 2) Farm economics and productivity are recognized as powerful determinants in shaping the structure and organization of the enterprise;
- 3) Safe work practices and safety-related improvements in the work environment are shown to promote the productivity and economic viability of the farm; and
- 4) Participation from community members, including extension agents, 4-H, FFA, educators, equipment dealers, insurance agents, bankers, local media, and others can be the key to making such interventions successful - both in the early phases, and over the long term.

2. Biological Monitoring for Agricultural Exposures

The Division (DART) has had a program in biological monitoring, generally geared to NIOSH field studies, for over 20 years. With the advent of the Agricultural Initiative, developing biological monitoring methods for assessing agricultural exposures became a major focus of our in-house effort. Initially, we developed a method for the herbicide alachlor. Because this method took an inordinate amount of time to develop and was extremely difficult to use, we also investigated the potential of immunochemical methods (ELISAs) for biological monitoring. In 1992 we adapted a commercial ELISA kit, developed for measuring alachlor in ground water, for measuring alachlor in urine. The ELISA results, although positively biased, correlated extremely well with results from the traditional biological monitoring method. This initial success led to our evaluation of other commercial kits and the development of one new kit in-house for use in biological monitoring. Subsequently, we have used these ELISA methods to perform over 2,000 field sample analyses for analytes such as cyanazine, atrazine, metolachlor mercapturate, and chlorpyrifos. Currently, we are developing an ELISA for the organophosphate, azinphos-methyl. This method will be validated using urine specimens from orchard sprayers that were obtained from Dr. Jay Wilkins of the Ohio State University.

We also have investigated new approaches to biomonitoring, a direct reading device for use in the field and a new technology for measuring several pesticides in urine simultaneously. A prototype direct reading device based on immunoassay technology was developed and evaluated in the field by herbicide sprayers. Mr. Ron Meyer, County Extension Agent for Kit Carson county in Colorado, identified a small cohort of sprayers who used the device on mornings after spraying to determine whether their urinary atrazine levels were above or below 20 ppb. The prototype kit, although rather crude and more complicated than desired, successfully analyzed approximately 70% of the samples. The study demonstrated that an in-home kit, designed to be used by workers (or farm family members) to test their own urine for pesticide level, could be useful in alerting the users to their exposures.

While immunoassays offer a faster, easier, and less expensive alternative to traditional biological monitoring methods, both analytical methods generally are restricted to one analyte per analysis. Hence, an accurate estimate of total pesticide exposure requires separate analyses for each individual pesticide, a task which is costly and time consuming. Consequently, we are currently developing a new multi-analyte urinary biological monitoring methodology by combining immunoassay technology with flow cytometry. Initially, the project is focusing on the pesticides atrazine, metolachlor, heptachlor, and alar. Successful application of multi-analyte technology should allow for a more complete and less costly biological monitoring program for pesticide applicators. A more complete and accurate characterization of workplace exposures will allow for enhanced intervention measures to prevent exposures.

3. SENSOR-Pesticide Program

A national consensus - involving state partners, the U.S. Environmental Protection Agency, the Council of State and Territorial Epidemiologists (CSTE), and representatives from CDC/NCEH -

on a pesticide-related illness case definition and case reporting formats was reached. This case definition has been widely praised and is used by all eight state health departments with surveillance activities for pesticide-related illness. In 1999, CSTE adopted a recommendation that all states conduct surveillance of pesticide-related illness and that this case definition should be used. Use of this case definition will insure that pesticide poisoning data can be compared and aggregated across all states to assess trends, determine magnitude, and identify emerging problems.

Three articles were published in the CDC Morbidity and Mortality Weekly Report (MMWR) that highlighted pesticide problems identified through the SENSOR-Pesticides program.

The first was an incident in which a crew of 34 field workers became ill after entering a field sprayed two hours earlier with a pesticide solution containing carbofuran (this insecticide has a restricted entry interval of 48 hours). This article was praised by the U.S. Environmental Protection Agency (EPA) for reenforcing the importance of compliance with the EPA's Worker Protection Standard, and documenting the need for safer pesticide alternatives. State involved: California

The second article described 42 cases of pesticide-related illnesses attributed to occupational use of flea-control products. Most of the products that were associated with illness contained either phosmet, an organophosphate insecticide, or pyrethrin. This report reinforced the need for workers to be trained in the safe handling of flea-control products, and that the substitution of safer, less toxic pesticides should be adopted when feasible. As a result of this article, the US EPA and eight State Health Departments are notifying grooming shops, veterinary offices, and professional veterinary associations to increase awareness of this problem. States that provided data: California, Texas, and Washington.

The third article identified 123 cases (34 probable and 89 possible cases) of pesticide-related illness that were associated with the 1998 Medfly Eradication Program in Florida. The identified cases likely resulted from sensitivity to the irritant/allergic effects of malathion/bait. Federal and state agricultural authorities were encouraged to prevent Medfly importation into the United States, quickly identify Medfly infestation, and identify and use safer eradication agents. As a result of our findings, the US Department of Agriculture has bolstered activities to address these recommendations. State involved: Florida.

4. NIOSH Toll-Free Number: 1-800-35-NIOSH

In January, a Technical Information Specialist at the 800-number had a call from Wayne Baggett, Public Affairs Office of the U.S. Department of Agriculture, requesting information on suicide in the farming industry. Unfortunately, we don't have any details of why he requested the information. In the mid 90's (Midwest flood) there was a number of inquiries to the 800-number about suicides of farmers, and we talked with some depressed family members. The

Wisconsin State Department of Agriculture Trade and Consumer Protection reported a high level of stress and a significant increase in talk of suicide or calls considered suicidal to their Farmer's Hotline. They reported that in January 1994, of 1,789 callers, 172 were described as being under "severe stress" and 14 were described as suicidal. Attempts were made to reach them today to see if the numbers were up again, but have not received a return call. If the numbers were up, we would have tried to contact Mr. Baggett to get more details on what the Department of Agriculture was doing. This may be a continuing problem or there may be new stressors.

Field Sanitation Rules have been in place over ten years. Some workers are still working under deplorable conditions as shown by this call. The temperature was in the high 90's and these workers had no relief. An employee in New Mexico called about her working conditions. She was loading pumpkins into semi-trucks at a loading shed. It was very hot and no water or bathrooms were available for the workers at the site; these were located further up the road. The supervisor objected to the workers leaving their work to use the facilities or to get a drink. The caller also expressed concerns for the workers who were picking pumpkins in the fields. We provided information on field sanitation requirements from the Agricultural Safety Data Base and after discussing working in hot environments, the caller was referred to the local OSHA office for further assistance regarding field sanitation requirements.

5. Hay Baler Scalpings

A sentinel health event identifies a preventable injury, disease, disability, or death whose occurrence serves as a warning signal that the quality of preventive services is lacking and may need to be improved (Stroup, Zack and Wharton, 1994). The State-based Occupational Health Nurses in Agricultural Communities (OHNAC) program at NIOSH has identified several types of machine-related injuries as sentinels for broader action (Freund, 1992). A surveillance component of the NIOSH Community Partners for Healthy Farming (CPHF) program has replaced OHNAC. An example of the sentinel events concept is the NIOSH partnership with the OHNAC program in New York where scalping incidents were investigated. Investigations of these events utilized NIOSH FACE investigators (and the FACE protocol) and a NY state agricultural extension safety specialist. Results of these investigations were published concurrently in a NIOSH *Update* (NIOSH, Jul 1992) and the *MMWR* (Roerig, Melius, and Casey, 1992). These publications reported on four scalpings by hair entanglement in rotating power transmission devices on one hay baler model. In collaboration with the manufacturer, NIOSH identified a retrofit shield in collaboration with the manufacturer that would solve the problem. At the time that the *MMWR* article was published, NIOSH sent its *Update* to every county extension agent in the country. The *Update* provided a message—that the shield would control the hazard and how to order it—for the county agent to give whenever a concerned citizen called in response to the print or radio reports that resulted from the *MMWR* story. As shown in the figure below, farmers increased their investment in the protective shield following the release of the report. The next two years, NIOSH issued a preemptive *Update* (NIOSH, May 1993) and *Alert* (NIOSH, Jan 1994) to warn farmers of the hazard prior to the hay harvesting season. The actions taken to protect workers from hair entanglement demonstrated the success of a system of surveillance with targeted dissemination and recommended preventive actions.

6. Chisel Plow Explosions

In 1996, through NIOSH's Community Partners for Healthy Farming (CPHF) surveillance program, two separate reports were identified of farm workers who were injured while attempting to drill into sealed, ballasted plow frames in order to mount a hitch or a "slow-moving vehicle" sign. These workers received serious burns and other injuries when the drill bits penetrated the plow frames and ignited flammable gases. AN OHNAC nurse, NIOSH FACE investigators, Agricultural Safety Promotion Systems(ASPS) principle investigator (who was conducting a hazard reduction intervention program on farms), and a Pittsburg Research Laboratory (PRL) research chemist were all involved in determining the cause of the explosions. It was determined by laboratory analysis that hydrogen gas was being generated at up to 12 times atmospheric pressure. While the mechanism for the generation of hydrogen has not been definitively proven, all available evidence points to an electrochemical reaction involving metals of substantially different activity and electrical potential in the presense of water and oxygen.

While initially, these two reports dealt with the same manufacturer of plows, the use of scrap fill for ballasting purposes may not be limited to plows or a specific manufacturer.

A NIOSH Technology News (No. 473) bulletin entitled *The Explosion Hazard From Hydrogen Gas Generation Inside Sealed Frames* was released in June of 1977 detailing the laboratory

findings of the analysis of the plow frames, along with recommendations for prevention of injury. This was followed in August 1998 by a NIOSH Hazard ID entitled *Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment*, identifying recommendations for prevention of injury by agricultural workers and identifying roles for equipment manufacturers, dealers, agricultural extension agents, and universities. These were subsequently mailed to identified dealers and other potentially interested parties.

In 1998, an article in *Successful Farming* magazine noted how FFA Chapters were implementing a safety program to get slow-moving vehicle signs on agricultural equipment. A long time NIOSH FACE investigator (who had been involved with the chisel plow project) noticed this and contacted the magazine which subsequently printed information on the potential problem of penetrating ballasted equipment.

The preceding incident is an example of extramural NIOSH agricultural program personnel finding the expertise needed to solve a problem through the public health model—identifying a problem through surveillance, finding solutions to the problem and communicating the problem to those most likely to be at risk.

7. Fatal and Non-Fatal Injury Surveillance in Agriculture

NIOSH has not had a good source of information on non-fatal injuries occurring in agriculture. The Traumatic Injury Surveillance of Farmers (TISF) has been able to provide a national estimate of non-fatal injuries for 1993, 1994 and 1995, down to the state level. Detailed information on tractors and ROPS use was gathered in 1993.

Both fatal and non-fatal injury data on youth who work in agriculture have been lacking, too. The NIOSH Childhood Agricultural Injury Prevention Initiative has sought to gain insight into this problem through the use of multiple surveillance systems. NIOSH decided to pursue several different methods of obtaining population-specific childhood agricultural injury data, to assess how each system works, and to examine the possibility of utilizing a combination of surveillance methods in order to obtain representative data sources for these injuries.

Three data collection methods have been initiated by NIOSH. The first is a telephone follow-back interview of youth injured on farms based on cases identified in the Consumer Products Safety Commission's (CPSC), National Electronic Injury Surveillance System (NEISS), which are based on hospital emergency department visits. The second uses a personal interview of seasonal

farmers identified through the US Department of Labor's (USDOL) National Agricultural Workers Survey (NAWS). The third is a telephone survey of 50,000 farm operators conducted for NIOSH by the US Department of Agriculture, National Agricultural Statistics Service (USDA NASS).

A news release on this latter surveillance effort indicates approximately 32,800 agricultural-related injuries occurred to children or adolescents under the age of 20 who lived on, worked on, or visited a farm operation in 1998. The injuries occurred at a rate of 1.7 injuries per every 100 farms. The findings are based on a random telephone survey of 50,000 farm operations conducted by the National Agricultural Statistics Service (NASS) for the ~~National Institute for Occupational Safety and Health (NIOSH), an agency of the Centers for Disease Control and Prevention.~~ About 56 percent of all childhood injuries that occurred on the farm operation were classified as non-work-related, while 44 percent were classified as work-related injuries. The majority of these injuries happened to male youth. Males were about four times more likely to suffer an injury than females. Approximately 34 percent of all youth injuries happened to children under age 10, about 39 percent to children age 10-15, and 27 percent to adolescents age 16-19. Most injuries during 1998 happened to youth who were part of the farm household. Results from the survey show that 23,640 injuries happened to youth who were part of the farm household, for an injury rate of about 1.9 injuries for every 100 youth. Of these injuries, approximately 37 percent happened to children under age 10, about 42 percent to children age 10-15, and 21 percent to adolescents age 16-19. Approximately 43 percent of the injuries to household youth were classified as work-related injuries which happened at a rate of 1.4 injuries per 100 youth. About 57 percent of the injuries to household youth were classified as non-work-related injuries and happened at a rate of 1.1 injuries per 100 youth. A total of 7,040 injuries occurred to youth visiting the farm. About 69 percent of these injuries were classified as non-work-related injuries while 31 percent were classified as work-related injuries. Results showed about 2,130 injuries occurred to youth hired to work on the farm, for a rate of 0.3 injuries per 100 youth.

8. NIOSH Centers for Agricultural Research, Education, and Disease and Injury Prevention

The NIOSH Agricultural Centers represent a major part of the our National Program in Agricultural Safety and Health. Since 1990, nine Agricultural Centers have been established in different geographic locations nationally to address the unique regional differences in agriculture. NIOSH has encouraged the Centers to become regional resources to provide expertise for research, education, and prevention / outreach. Current efforts underway through the NIOSH Agricultural Centers target all 21 of the NORA priority research areas.

Collectively, the Centers bring together a unique, multidisciplinary team of experts to address the significant health and safety problems in agriculture. The staff of the individual Centers consult and collaborate with scientists in all NIOSH Divisions and with other NIOSH Agricultural

Centers. They have formed partnerships, linkages and coalitions with many organizations and constituents in their regions. The work completed through the Agricultural Centers has contributed significantly to our knowledge on agricultural safety and health problems; this work also serves to drive prevention efforts Nationally. The Centers also play a critical role in moving regional partners to action in the prevention of agricultural disease and injury.

Research underway through the Agricultural Centers has helped to identify the needs of special agricultural populations and, through these efforts, there is an increase in research and outreach to these populations including women, children, and minorities. Agricultural Center researchers have identified repetitive motion trauma as a major hazard in labor intensive agriculture and, in response, have developed tools, work practices, and education materials to reduce these hazards while maintaining productivity. The Centers are working to identify the mechanisms of the disease process resulting from exposure to a range of occupational exposure hazards in agriculture; NIOSH investigators have been collaborative in providing technical assistance and support where needed. The Agricultural Centers, along with NIOSH scientists, have taken a leadership role in reducing agricultural fatalities and injuries from tractors. This has been accomplished through the retrofitting of older tractors with roll over protective structures (ROPS) and new tractor stability research. The Centers have developed and are evaluating novel educational materials and messages targeted at the agricultural workforce. NIOSH actively participates in the dissemination of the work from the Centers thru publication of NIOSH documents such as hazards controls, alerts, through conference support, by the Internet, and others.

With the substantial changes taking place and predicated for agricultural production, the NIOSH Agricultural Centers are a needed national resource with the expertise to address these changes and the emerging health and safety problems facing this unique workforce.

9. Agricultural Dust Exposures

Field dust can be high in crystalline silica and can lead to pulmonary fibrosis. Research was initiated by Val Vallyathan in collaboration with the UC Agricultural Health and Safety Center at Davis, California. The study involves analysis of field dust samples collected at various agricultural settings in California and pathological analysis of autopsied lung tissue from agricultural workers in Central California.

When dealing with work shifts longer than 8 hr, pulmonary response to organic dust is related to the dust concentration x exposure duration product. A study was initiated in response to a question by the National Cotton Council of America concerning what would be a safe cotton dust level for employees on extended work shifts. An inhalation study with guinea pigs was conducted. The inflammatory response to total respirable cotton dust, i.e., dose x time, did not deviate significantly from a linear relationship. Therefore, exposure levels should be lowered when exposure is expected to exceed 8 hr. Although this study was on cotton dust, it should be applicable to exposures to organic dusts containing endotoxin, such as those common in agriculture.

Division/Laboratory Overviews

The Divisions provided brief overviews of their respective programs in Agricultural Safety and Health. Although not directly part of this review, but as evidence to the potential for future development and growth of the NIOSH Agricultural Program, the NIOSH Pittsburgh Research Laboratory provided information on cross-cutting collaborations in which their scientists participated with other Divisions. These are examples of research that can address common issues in both agriculture and mining environments (see CAMP, above). To complete the picture and further emphasize the potential for transferring mining technologies to agricultural situations, the NIOSH Spokane Research Laboratory began a cross-sector project during this current fiscal year.

For convenience, the Division statements are listed in the same order as they are in the site review schedule.

1. Division of Applied Research and Technology (DART)

The Division of Applied Research and Technology (DART) is NIOSH's newest division, formed by the merger of the former Division of Behavioral and Biomedical Sciences and the Division of Physical Sciences and Engineering. DART has an intervention focus, conducting work site and laboratory research to develop techniques for the control and measurement of occupational safety and health hazards. DART addresses a broad spectrum of safety and health issues, including the measurement of workplace hazards through biological and environmental monitoring, the detection of the precursors or presence of disease; work organization; and the development, identification, and evaluation of effective controls and work practices. The agriculture research program in DART (and its immediate predecessors) has been geared towards pesticides, children working in agriculture, and farm workload. These research areas and significant accomplishments are highlighted below:

Pesticides:

DART pesticide research is focused on neurotoxic and male reproductive function effects, development of biological and environmental monitoring methods, and techniques for minimizing exposure. This research involves collaborative efforts with many others both within and outside NIOSH, and supports health hazard evaluations and epidemiological studies.

Neurotoxicity Assessments: Findings from the NIOSH Farm Family Health and Hazard Survey (1991-1997) suggested risk of pesticide-related neurobehavioral disorders among family farmers. Subsequently, NIOSH and the Ohio State University initiated a study of orchardists and their minor children. Research is also being conducted to improve the test methods (cognitive, motor and sensory functions) for populations of workers exposed to neurotoxic chemicals. The test battery was evaluated in a field study of termiticide applicators exposed to chlorpyrifos. Some mild acute effects were detected in current applicators as well as some evidence of longer term effects in former workers who had been poisoned by chlorpyrifos. The validity of the test

battery is being studied in individuals poisoned and suspected of a pesticide-related illnesses, through a cooperative agreement with Oregon Health Sciences University.

Male Reproductive Function: NIOSH and the University of Minnesota conducted a reproductive health study of men applying pesticides in northwest Minnesota. Men who had a history of applying fungicides had fewer normal shaped sperm and a slower sperm velocity.

Biological and Environmental Monitoring Methods: DART chemists have developed biological monitoring methods for six pesticides. These methods were developed for use in NIOSH field studies assessing pesticide applicator exposures. Classical analytical chemical methods were developed and used to analyze urine specimens for cyanazine, atrazine, and 2,4-D. New immunochemical methods also were developed and used to analyze these same samples for metolachlor, alachlor, cyanazine, and atrazine. These new immunochemical methods (enzyme-linked immunosorbent assays or ELISA's) have analytical sensitivities equal to traditional methods as well as significant advantages in cost, and analysis time. In addition to biological monitoring, a method using this immunoassay technology has been developed for air sampling of alachlor. An ELISA also was developed and used to analyze urine specimens for workers who sprayed chlorpyrifos. Immunochemical methods also offer the potential for direct analysis in the field. A prototype direct reading kit for field use by herbicide applicators to measure their own exposure to atrazine was developed and tested in the field by applicators in Colorado. This study demonstrated the utility of a kit designed for use by workers to test their own exposures.

Unified Pesticide Sampler: This study demonstrated that a single sampler (OSHA Versatile Sample) could be used to sample for 14 organonitrogen pesticides and 19 organophosphorus pesticides. Each of the pesticide classes utilized a different analytical technique, the organonitrogen compounds were determined by HPLC/UV and the organophosphorus compounds by GC/FPD. As a result, two new methods were added to the NIOSH Manual of Analytical Methods.

Cabin Filtration for Agricultural Pesticides: DART engineers have investigated cab pressurization and ventilation to prevent pesticide exposures during spraying applications. This study, conducted in conjunction with the State of California's EPA, has resulted in a standard test procedure that has been adopted by the Society of Agricultural Engineers. From an engineering perspective, the cabin filtration for surface mine vehicles and agricultural vehicles are similar - a new project will be conducted in concert with the Pittsburgh Research Laboratory to extend the benefits of this research to mining and construction.

Children, Farm Workload, Stress, and Risks for Injury:

DART scientists and colleagues at the University of Kentucky (UK) are examining the complex relationships between workload, work processes, musculoskeletal demands, productivity, stress, and risks for acute (traumatic) and cumulative (non-traumatic) injury for children working in agriculture. A jointly developed physician-based health surveillance system has been evaluated in a rural area of the Midwest. The system involves the use of an incident-triggered survey that is completed by the physician when a potential work-related musculoskeletal disorder is

presented at a community medical provider or health clinic. To date, it has been determined that chiropractors provide the best information about potential work-related MSD cases.

Another aspect of DART research involving children in agriculture began with the UK collaboration. This research began by looking at machinery and livestock but very quickly developed the additional, important focus on farm workload. Workload pressures have emerged as a major stressor and risk for injuries on farms. And workload planning has emerged as a critical feature of successful interventions with farmers. This picture of the changing pressures of U.S. farming has directed the research into three focal areas:

- A. Farm Stressor Inventory (FSI): The FSI is being developed to assess farm workload demands and pressures, supervisory responsibilities for adults with children, and stress and strain outcomes experienced by farmers.
- B. Guidelines for child agricultural labor: Advance the standards pioneered in the North American Guidelines for Children's Agricultural Tasks (NAGCAT), the first realistic standards for youth work on farms.
- C. "The Kayle's Difficult Decisions" farm simulation exercise: This intervention allows farm family members to make decisions for a typical, but fictional farm family.

2. Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)

As described below, a number of NORA priority areas are addressed in the DSHEFS Ag research program.

Control Technology & Personal Protective Equipment: A variety of types of protective clothing were used by workers in our research studies. The measurements in our studies are useful for evaluating the effectiveness of the various types of gloves, protective sleeves, aprons, coveralls, shoes, and respirators used by workers. Based on the sampling results of our observational surveys, intervention studies are proposed to evaluate the effectiveness of improved work practices and use of protective equipment.

Exposure Assessment Methods: New techniques for measuring workers' air and skin exposures and urine metabolite levels were developed in our studies for specific pesticides and ag-chemicals. These techniques may be applied to monitor workers exposures to other chemicals in other situations.

Special Populations at Risk: Agriculture operations are commonly small businesses employing a diverse population including family members of the owner, adolescents, women, minorities, and migrant and seasonal laborers. Frequently the employees are non-English speaking. The reports of individual sampling results are written in the language of the study subjects. The study results will also be useful for developing health and safety training materials directed to these types of workers.

Over 50% of workers in agriculture are non-white workers, females, or <18 or > 55 years of age. Unlike other occupations and industries in the US, children begin working at young ages and workers often continue working into their 70's and 80's. Data from Community Partners for Healthy Farming (CPHF) projects in California and Oregon almost entirely involved migrant/seasonal and/or Hispanic workers.

With respect to special populations, almost half of the cases of acute occupational pesticide-related illness identified by the SENSOR pesticides program occur in the agricultural sector. Information, on the proportion of these cases that belong to minority races is not known. However, given the high proportion of farm workers that are African-American and Hispanic, it is likely that the same proportions are represented among those with acute occupational pesticide-related illness.

Surveillance Research Methods: The FFHHS was adapted from protocols and survey instruments integral to three national surveys (National Health Interview Survey, National Health and Nutritional Examination Survey, and the National Occupational exposure survey). In turn, these tools are being adapted for use in surveys of other special populations (e.g., see National Agricultural Worker Survey (NAWS), where NIOSH partnered with the U.S. Department of Labor). We continually re-invent or adapt surveillance methods as we are charged to survey new industries or hard-to-reach populations. The early efforts of the California FFHHS in the development and field-testing of survey instruments was adapted for our surveys of migrant agricultural workers. This early instrument was developed for bilingual use, though we came to learn some of the special problems in studying migrant agricultural labor in California, where many workers are not Spanish-speaking, but speak Central American Indian dialects. The Ohio and Iowa FFHHS permitted us to explore new approaches to gathering potential exposure and safety hazard data. These lessons will be adapted for intramural use as we begin the planning for the new National Occupational Exposure Survey. The SENSOR-pesticides program continues to explore new sources of disease reports. For example, the California SENSOR-pesticides program recently received a NIOSH grant to support efforts to enhance the usefulness of laboratory reporting of serum cholinesterase concentrations for identifying acute occupational pesticide related illness.

Interaction, Collaboration and Co-ordination:

Other NIOSH Divisions/Programs: Research chemists in the Division of Applied Research and Technology (DART) and Data Chem Inc. (NIOSH contract analytical laboratory) developed the analytical procedures for various pesticide exposures examined in DSHEF studies. These methods may be modified to sample and analyze for other chemicals. Toxicologists and biochemists within DART developed techniques to measure the urine metabolite levels of the target pesticides. Manuscripts describing these analytical techniques are published and are included in the NIOSH Manual of Sampling and Analytical Methods.

The FFHHS was a truly inter-divisional project. Through the various phases of development and implementation, project-level collaborators from DSR, DRDS, and DART were involved in developing instruments for personal interviews and medical examinations (e.g., PFTs, audiometry). Colleagues from DRDS worked closely to train FFHHS field staff in the use of portable spirometers, and provided feedback on the data submitted for evaluation. The protocol used is the same NCHS incorporated in the NHANES. Colleagues from DART trained, provided field oversight, and assisted in the interpretation of audiometric data collected from the medical exams. NIOSH staff from several Divisions (DSHEFS, DRDS, OD, EID, DBBS, DSR) have served as technical advisors to extramural projects throughout their funding cycle. This collaboration has helped not only in the goals of the project, but has enhanced the expertise of both the intramural and extramural researchers.

DSHEFS collaborated with DART to develop an easy-to-understand document on ergonomics hazards among farm workers. DSHEFS also collaborated with DSR to enhance a Department of Labor annual survey of farmworkers. The enhancements include the addition of questions to obtain information on health effects, health care, medical history, and housing conditions.

State and Other Agencies: Several DSHEFS projects collaborate with state health departments via cooperative agreements. These include Community Partners for Healthy Farming-Surveillance (CPHF-S), Community Partners for Healthy Farming-Intervention (CPHF-IR), and SENSOR-Pesticides.

CPHF-IR (1999-2002) recently funded six projects four years. Four projects are outgrowths of prior projects: the reduction of ergonomic risk factors in handling cut grapes in CA and small scale growers of tame berries in WI, MN, MI, and IA; replicating promotion of roll-over protective structures and seatbelt use in VA, SC, and throughout KY; and evaluation of the sustainability of the Certified Safe Farm financial incentive project through private sector commitment (IA and NE). One new project focuses on reducing eye injuries and illnesses in Latino farmworkers (IL and MI). One is creating youth-focused, multimedia tractor and machinery safety training curriculum (IN). This funding cycle the project has increased focus on underserved populations.

OHNAC (1990-1996), funded 10 state health departments to place public occupational health nurses in rural communities and hospitals (CA, GA, IA, KY, ME, MN, NY, NC, ND, and OH). These nurses conducted active, case-based surveillance of agriculture-related illnesses and injuries that occurred among farmers and their family members. These surveillance data was used in a timely manner to assist in reducing the risk of occupational hazards, illness, and injuries in agricultural populations.

CPHF-IR: Beginning in August 1999, six projects were funded for four years. Four projects are outgrowths of prior projects: the reduction of ergonomic risk factors in handling cut grapes in CA and small scale growers of tame berries in WI, MN, MI, and IA; replicating promotion of roll-over protective structures and seatbelt use in VA, SC, and throughout KY; and evaluation of the sustainability of the Certified Safe Farm

financial incentive project through private sector commitment (IA and NE). One new project focuses on reducing eye injuries and illnesses in Latino farmworkers (IL and MI).

One is creating youth-focused, multimedia tractor and machinery safety training curriculum (IN).

SENSOR-Pesticides currently supports surveillance of acute occupational pesticide-related illness in 5 states: CA, FL, NY, OR, TX.

SENSOR-pesticides actively collaborates with US EPA. To date, EPA has supported the SENSOR-Pesticides program with \$674,000. These funds have been used to support field investigations by our state partners, the development of a database program for states to record and process their surveillance data, and to support a consultant to the SENSOR-Pesticides program. Finally, EPA provides direct surveillance support. EPA has access to a national poison control center database. Information from this database was used in two recent MMWR articles developed by SENSOR-pesticides. Finally, the SENSOR-pesticides technical advisor is a member of an interagency committee organized by EPA to increase awareness of pesticide-related illness among health care professionals.

SENSOR-pesticides also collaborates with NCEH. NCEH was one of the organizations that helped develop the standardized case definition for acute occupational pesticide-related illness and injury. In addition, NIOSH and NCEH collaborate on events that involve both occupational and non-occupational exposures (e.g. the recent MMWR describing illnesses associated with the Florida Medfly Eradication Program). Finally, the NCEH Division of Laboratory Support has analyzed serum samples provided by the Florida SENSOR-pesticides program.

SENSOR-pesticides also collaborates with CSTE and AOEC. These organizations helped develop the standardized case definition for acute occupational pesticide-related illness and injury. In 1999, CSTE adopted a recommendation that all states conduct surveillance of pesticide-related illness and that this case definition should be used. Use of this case definition will insure that pesticide poisoning data can be compared and aggregated across all states to assess trends, determine magnitude, and identify emerging problems.

FFHHS: The early efforts in exploring the feasibility of a farm family health and hazard survey prompted site visits to leading university-based agricultural extension programs across the U.S. (e.g., Indiana, Texas A&M, Cornell, Ohio State, Michigan State, UC-Davis). We also engaged in a dialogue with colleagues at the USDA, and NCHS.

DSHEFS also collaborates with the Department of Labor in the NAWS survey. The survey interviews about 1,500 agricultural workers in each of three annual interview cycles. The survey includes questions on medical history, use of medical services, participation in pesticide training, health effects associated with pesticide exposure, and housing conditions.

NIOSH External Programs: Almost every CPHF-S project has actively collaborated with another NIOSH-funded program in their state, e.g. CPHF-IR, FACE, agricultural centers. In

NY, investigations are often conducted in collaboration with engineering expertise funded by the Northeast Center. The Northeast Center is collaborating with the ME project to collect data on hearing loss among high school students. In MN FACE conducted the training of nurses in farm safety and health. In KY and ND, the same team works on both CPHF-S and CPHF-IR.

SENSOR-pesticides programs are encouraged to collaborate with any NIOSH Ag Centers in their state. For example, the coordinator of the Florida SENSOR-pesticides program sits on the advisory committee of the Deep South Agricultural Health and Safety Center. In addition, officials from the Deep South Agricultural Health and Safety Center participate in the Florida SENSOR-pesticides program advisory committee.

FFHHS: The NIOSH Agricultural safety and health research program created a number of opportunities for interchange between and among recipients of NIOSH's extramural funding. The FFHHS awarded agreements in California, Kentucky, Iowa, New York, Ohio and Colorado. Without exception, each FFHHS principal investigator had frequent, if not integral involvement from collaborators from one of the other NIOSH-sponsored agricultural safety and health research programs in their home states.

It is important to recognize that the FFHHS principal investigators/partners were drawn from universities and state health departments. As much as one can promote communication and collaboration between extramural groups, we did observe a less than cooperative relationship between two FFHHS programs and NIOSH-sponsored Centers. While we don't believe this necessarily detracted from either program's accomplishments, it reinforced the importance of promoting dialogue among extramural parties early in the development of such programs.

Process Used to Set Priorities for Ag Research Efforts: DSHEFS has used several sources to derive priorities for its Ag programs. In particular, we wish to note the following:

Congressional Funding: In 1989, the U.S. Congress directed the CDC to sponsor a health initiative to reduce injuries and illnesses in agricultural populations. Three specific initiatives affected the overall DSHEFS surveillance and research programs:

- Farm Family Health and Hazard Surveillance (FFHHS)
- Occupational Health Nurses in Agricultural Communities (OHNAC)
- Cancer Control Demonstration Projects

DSHEFS has maintained active surveillance and survey activities deriving from both the Farm Family Health and Hazard Surveillance and Occupational Health Nurses in Agricultural Communities.

Agriculture At Risk - a Report to the Nation: This report stems from conferences on agriculture health and safety held on September 18-21, 1988, in Iowa City and April 30 - May 3, 1991 in Des Moines, Iowa. The report was a major source of information and support for congressional action and funding of current NIOSH agricultural research programs.

The report identified particular DSHEFS surveillance and research initiatives:

Completion of a survey to provide measures of occupationally-related diseases and risk factors in targeted agricultural/rural populations.

Development of surveillance programs for occupational diseases and injuries, targeting farmers, farm workers, and farm families.

Assessment of special agricultural populations, including migrant and seasonal agricultural workers, to determine the health effects related to their occupational exposures, to assess risk factors, and to develop dose-response relationships. Specifically the report supported further research to evaluate exposures of formulators and applicators; dermatitis among field workers; mental disorders and suicides related to pesticide exposures; and, repetitive trauma syndromes and degenerative osteoarthritis among agriculture workers.

Development methods for sampling and analyzing agricultural exposures, particularly related to ag-chemicals.

The “Kennedy Report”: In December 1994, Dr. Susan Kennedy chaired a review committee and prepared a January 1995 document “National Occupational Safety and Health Program in Agriculture - Report of an External Committee to Review the Extramural Cooperative Agreement Programs”. Recommendations from this report significantly influenced the FFHHS and OHNAC programs.

NIOSH Agricultural Steering Committee: In April, 1996, Dr. Rosenstock instituted the NIOSH Agricultural Steering Committee, composed of staff from each NIOSH Division, to review the NIOSH agricultural (intramural and extramural) program, determine the strengths and weaknesses, and make recommendations for future research activities. This committee advises NIOSH on the technical aspects of new and continuing projects, as well as opportunities for inter-divisional collaboration.

Collaboration with the Office of Pesticide Programs: U.S. Environmental Protection Agency: The USEPA Office of Pesticide Programs is charged with developing policy to regulate the use of pesticides and to address concerns of ag-operators, ag-workers and the general community. Much of the research on pesticides conducted by the Industrywide Studies Branch has been done under the instigation and support of this office. Surveillance activities for acute pesticide-related illness and injury are also supported by USEPA. These efforts have been used to guide regulations and policy of the Office of Pesticide Programs.

Building Upon Past Research: During the course of our research studies we often identify gaps that need further research. Based on the results of these studies we work to improve our sampling and analysis tools to better characterize exposures and health outcomes. An example is

the study of commercial herbicide applicators which is an improved study design survey of more pesticides, based upon a previous study.

Division Resources Devoted to Ag Research: In FY-1999, 22% of the overall Division budget was devoted to Ag research. Ten researchers within the Division spend a major portion of their time focusing on Ag-related projects.

Dissemination of Information beyond the Scientific Community: The ability to provide summary data and direct feedback to the medical community, agriculture, pesticide manufacturers, commercial pest control firms, policy makers, and the public is a critical aspect of surveillance. Although existing surveillance systems communicate their findings to some degree, this is an area where significant improvements can be made that will strengthen surveillance. For example, the ability to aggregate data across states, combined with increased dissemination of information will result in a better understanding of the nature of acute pesticide-related illness and injury.

Currently, efforts are made at the state level to disseminate information. This includes the development of brochures and newsletters. In addition, many of the MMWR articles written by SENSOR-pesticides have received extensive media coverage. Also, investigation reports prepared by NIOSH and state partners are shared with the company and workers.

CPHF-S project has released hundreds of press releases and articles focused toward workers in popular and trade media; e.g.,

“Ask a Nurse” columns in local newspapers, extension newsletters, utility coop magazines, and national farm journals.

California published 34 “NURSE” reports summarizing sentinel events and prevention in English and Spanish. These were disseminated state-wide and used by insurance carriers and other in prevention activities. The “NURSE” reports, other publications, and many educational materials have been placed on the National Agricultural Safety Data Base which is now available through NIOSH’s homepage.

Educational materials directed at workers include:

- coloring book on potato harvesting,
- interactive farm safety game,
- contribution to logging safety education.

FFHHS: Currently, DSHEFS is taking the lead to develop a web-based data base to promote the use and further dissemination of data and information from the six surveys. The current project has a projected completion in early calendar year 2001. Initially, these data will be available to

NIOSH intramural staff. We plan to move these data to the NIOSH Homepage, where we hope to promote wider dissemination and use.

DSHEFS efforts to disseminate data and information through the NIOSH HOMEPAGE is responsive to the many recommendations received from the Kennedy report and the NIOSH Steering Committee. This is also consistent with the soon-to-be-released NIOSH Surveillance Strategic Plan, which calls for NIOSH to “improve public access to and utilization of NIOSH and other surveillance information by establishing a “Surveillance sub-site” on the NIOSH Web site.”

The results of our research projects are provided to each worker who participated in the studies. They also receive our interpretation of what their individual sample results mean and a summary report of the overall study results. A final report of the study results, interpretation, and recommendations are sent to the EPA and the industries affected by the studies. From these reports manuscripts are prepared for publication in scientific journals. These manuscripts will also provide the basis for articles submitted to industry trade journals.

3. Education and Information Division (EID)

The Education and Information Division (EID) supports the Agriculture Initiative within the Institute through three major projects as well as a number of other projects relevant to promoting occupational safety and health within the agricultural sector. The three major projects include the National Agricultural Safety Database (NASD), Agricultural Safety and Health Training Intervention of Young Workers, and Evaluating the Scientific Basis of the North American Guidelines for Children’s Agricultural Tasks.

National Agricultural Safety Database (NASD): The National Agriculture Safety Database (NASD) is the largest collection of information about health, safety, and injury prevention in agriculture. NASD is a central repository that agricultural safety and health professionals can search for information and materials they need and share information and materials they have developed. The information contained in the database was contributed by safety professionals and organizations from across the nation. It contains over 3,000 agricultural-related health and safety publications from 32 states, 4 Federal agencies and 5 national organizations. The collection includes OSHA and EPA standards, agricultural extension agent publications, a database of abstracts and ordering information for over 2,000 agricultural safety-related videos, a NIOSH bibliography database with abstracts for over 500 scientific publications, and a resource directory for over 1,500 people and organizations involved in agricultural safety and health. Presently, NASD generates approximately 400,000 hits per month on the NIOSH Web site and has consistently accounted for 25% of all NIOSH Web traffic. The popularity of NASD is due largely to its depth of materials in the most important topic and resource areas. NASD is also

available on CD-ROM and can be purchased from the National Technical Information Service.
Contact: Richard W. Niemeier - (513) 533-8388

Agricultural Safety and Health Training Intervention for Young Workers: In collaboration with the University of Kentucky, NIOSH has developed a training scenario to promote awareness of the adverse personal and economic consequences of an agricultural injury. The exercise focuses on a hypothetical farm family (the Kayles) and a series of events leading to the eventual injury of their son due to a tractor roll-over. The purpose of the training program is to demonstrate how occupational safety and health decisions are connected to economic and workload pressures that farmers must address. CD-ROM and paper & pencil versions of the exercise were delivered in a set of rural Kentucky high schools in the fall of 1999 to assess the effectiveness of the two approaches in influencing student awareness of farm safety. Data analysis is currently underway and a final report will be available in 2000. The product will be available for distribution in FY 01. Contact: Michael Colligan - (513) 533-8222

Evaluating the Scientific Basis - North American Guidelines for Children's Agricultural Tasks: EID has assumed the lead in FY 00 in an effort to evaluate the scientific basis of the North American Guidelines for Children's Agricultural Tasks. The evaluation will take the form of a literature review to identify research which supports or contradicts the guidelines, and those guidelines that may require additional research to document their efficacy.
Contact: Christy Forrester - (513) 533-8526

EID also conducts a wide range of projects which, although not totally focused on agriculture, support the agriculture initiative in NIOSH. Examples of these projects include the following:

Document Development: During FY 99, EID, in collaboration with the Division of Safety Research, developed and published a Hazard ID on injuries associated with operating wood chippers. NIOSH [1999]. Hazard ID 8: Injury associated with working near or operating wood chippers. Cincinnati, OH: U.S. Department of Health and Human Services, PHS, CDC, NIOSH, DHHS (NIOSH) Publication No. 99-145. Contact: Marie Haring Sweeney - (513) 533-8339

NIOSH Pocket Guide to Chemical Hazards: The *NIOSH Pocket Guide to Chemical Hazards* includes over 80 chemicals that have direct application to agricultural operations, including pesticides, insecticides, and herbicides. The *Pocket Guide* provides occupational safety and health professionals, employers, and workers with the vital information (e.g., exposure limits, respiratory protection and other personal protective equipment, first aid, etc.) necessary for the protection of workers' safety and health. In the last two years, NIOSH has expanded the dissemination of the *Pocket Guide* via the Internet and in CD-ROM format with the intention of reaching many diverse occupational sectors including agriculture. Contact: Henry Chan - (513) 533-8341

International Chemical Safety Cards: NIOSH, in collaboration with the World Health Organization, develops and disseminates International Chemical Safety Cards. These cards provide information on the physical and chemical properties, occupational exposure limits, toxicity, and environmental effects for a wide range of chemicals. The number of cards

developed for agricultural chemicals varies from year to year. During the last year, five of the eight cards developed by NIOSH were for agricultural chemicals – Alachlor, Benomyl, Bladex, Benzenethiol, and Fenamiphos. Contact: Richard Niemeier - (513) 533-8388

NIOSH Guide for Respiratory Protection: EID, in collaboration with the other NIOSH divisions, is presently updating the NIOSH Guide for Respiratory Protection. This document is one of the most requested NIOSH publications. Since 1987, a great deal of research at NIOSH, and regulations promulgated by OSHA, have modified the information presented in the original guide and it needs updating to remain useful in the field. Several of the proposed chapters for the revised guide address issues specific to agriculture and the need for proper respirator use. Contact: Jeffery Bryant - (513) 533-8251

Risk Assessments and Other Research:

EID is conducting a quantitative risk assessment on silica exposure and lung cancer. The goal of this project is to estimate lung cancer risks that will be applicable to all silica-exposed workers, including agricultural workers. Work in farm fields often involves exposure to airborne mineral dust with crystalline silica concentrations of 10 to 20 percent or higher. Agricultural workers also may be exposed to silica-containing ash from burned plants, such as rice husks, or from exposure to calcined diatomaceous earth, either by using these products or while disturbing soil containing these products. Presently, the data analysis has been completed and a journal article is being prepared for submission. Contact: Faye Rice - (513) 533-8335

EID is conducting a quantitative risk assessment on diesel exhaust and lung cancer. The goal of this project is to develop quantitative estimates of the lung cancer risk associated with occupational exposures to diesel exhaust. This work was initiated at the request of the Mine Safety and Health Administration (MSHA). However, the results from this work should be relevant to a large number of industries, including agriculture. The number of agricultural workers exposed to diesel exhaust is unknown but is likely to be large, given the common use of diesel engines in tractors and other farm equipment. Contact: Leslie Stayner - (513) 533-8365

EID, in collaboration with the Division of Applied Research and Technology, is producing an interactive teaching program for the NIOSH Lifting Equation (LE). The rate and cost of lower back injuries is the highest among all occupational injuries in the USA—including agricultural work. In an effort to mitigate these costs, NIOSH developed the LE. However, unless the LE is calculated properly, it is of little use. This effort will make available an interactive training program on the proper use and calculation of the LE and will evaluate the benefits of this interactive training program compared to traditional classroom instruction. The final interactive training program will be distribution via CD-ROM and, eventually, on the Internet. Contact: Gregory Loos - (513) 533-8565

Information Dissemination: EID plays an integral role in the transfer of safety and health information to the agriculture sector. This includes the dissemination of information through the NIOSH 800-number, the NIOSH Web site, the Publications Clearinghouse, the RTECS database, and the exhibit program. Examples of these activities are outlined below:

The NIOSH 800-Number provides responses to inquiries from the general public that are received via the NIOSH 800-number, e-mail, and the Internet. In FY 99, NIOSH technical information specialists answered 237 calls classified as “agriculture/pesticide,” although many more agriculture-related calls may be receive but are classified elsewhere (e.g., “lifting,” “respirators”). Contact: Elaine Mann - (513) 533-8349

The Registry of Toxic Effects of Chemical Substances (RTECS[®]), NIOSH’s premier toxicological database, provides exposure data for more than 135,000 chemicals along with detailed health effects information. RTECS presently contains information on 5,645 agricultural chemicals. Contact: Doris Sweet - (513) 533-8359

The NIOSH Publications Clearinghouse distributed approximately 85,000 agricultural-related publications during FY 98 and FY 99. Contact: Thomas Ziegler - (513) 533-8372

The NIOSH exhibit program educates and informs the safety and health community and targeted worker populations about recent advances in occupational safety and health. Results of NIOSH research in agricultural safety and health are highlighted through the NIOSH exhibit program at appropriate conferences. Examples of conferences where agriculture focused exhibits were displayed include the *National Farmworker Conference* and *Rural Health in a Changing World*. Contact: Charlene Maloney - (513) 533-8380

4. Division of Safety Research (DSR)

The DSR agriculture research program has its origins in the mid-1980s with a series of Fatality Assessment and Control Evaluation (FACE) investigations of agricultural-related fatalities and an evolving fatality surveillance effort. The FACE investigations involved a number of farm worker fatalities, and resulted in the publication of two NIOSH Alerts [*Preventing Grain Auger Electrocutions*, Pub. No. 86-119 and *Preventing Entrapment and Suffocation Caused by Unstable Surfaces of Stored Grain and Other Materials*, Pub. No. 88-102]. During this same time period, DSR was implementing national fatality surveillance through the National Traumatic Occupational Fatalities (NTOF) surveillance system. At the time, the NTOF was the first, and most comprehensive, national surveillance system for capturing traumatic work-related fatalities. Through the NTOF system, NIOSH was able to characterize high risk industries, occupations and causes of death for use in identifying research needs and targeting prevention efforts. The NTOF data identified the agriculture/forestry/fishing industry division as one of the four highest risk industries for fatal workplace trauma. These NTOF data provided some of the documentation used by Congress to justify increased appropriations for NIOSH to expand occupational safety and health research within the agricultural industry. [Note: The definition of agriculture that DSR uses includes the industry sectors of agriculture, forestry and fishing.]

Program Focus and Priority Setting:

The DSR intramural agriculture program has four primary components: injury surveillance for defining and characterizing work-related fatalities and injuries, epidemiologic field

investigations to identify potential risk factors for traumatic injury, safety engineering to develop and/or improve protective technologies for prevention, and information dissemination. Since the DSR mission focuses primarily on traumatic injuries, our research is closely aligned with the NORA Traumatic Injuries Priority Area. However, the DSR program also cross-cuts a number of other NORA priority areas, including: Control Technology and Personal Protective Equipment, Intervention Effectiveness Research, Special Populations at Risk, and Surveillance Research Methods.

In general, the DSR program uses a combination of injury surveillance data, information collected during FACE investigations, stakeholder input and guidance provided by the NIOSH Agricultural Steering Committee to establish research priorities. Using input from each of these areas, new project concepts are proposed annually by DSR research staff. These concepts are reviewed internally using three criteria: need for the project based on data and/or stakeholder interest; soundness of the methods for completing the project; and expected impact of the results in reducing or furthering research toward preventing occupational traumatic injuries. Once this initial review is completed, the Director and Deputy Director, with the Division's Leadership Team, determine which concepts merit further development into Institute-level project plans based on the concept review process and projected resources available for the upcoming fiscal year. For FY2000, DSR has seven projects addressing specific agricultural safety issues (i.e., Agriculture Special Interest Area 80% or greater), and 14 which are agricultural-related (e.g, surveillance, FACE, etc.). Approximately 30% of the DSR budget is allocated to our agricultural research program (which includes the DSR portion of the child agricultural injury initiative).

Examples from the DSR Agriculture Program:

As a result of these initial surveillance and investigative efforts, and the additional fiscal appropriations by Congress to NIOSH, DSR began to expand both its intramural and extramural agricultural research programs. For example, using the NTOF data, DSR identified machine-related incidents as the leading cause of death in the agricultural industry, and specifically, tractor rollovers as the most common event. Based on these initial surveillance efforts, the Division embarked on a long-term effort to develop improved approaches to increase the application of rollover protective structures (ROPS) on farm tractors. DSR engineers have designed and constructed a low profile ROPS that will automatically deploy in the event of a tractor rollover event. A prototype of this ROPS has been developed, and a patent application submitted. The Division is continuing research on further development of the auto-deploying ROPS. Additionally, an FY2000 new project will focus on developing simpler, more economical ROPS designs for retrofitting older tractors, along with using composite materials to reduce the weight of adjustable ROPS.

Other Division efforts early in the NIOSH agricultural initiative focused on the need to improve surveillance of non-fatal injuries within the agricultural sector. There was a general lack of detailed surveillance data for non-fatal agriculture-related injuries. As a result, DSR, in collaboration with the U.S. Department of Agriculture, National Agricultural Statistics Service

(NASS), initiated the Traumatic Injury Surveillance of Farmers (TISF) project. The TISF was the first national level surveillance effort in more than 15 years to provide detailed injury data for the entire agricultural production industry. Through this collaborative effort, the TISF project provided more detailed surveillance data necessary to target specific farm types, farm activities, and farm workers at high risk of non-fatal work injuries for further research and prevention efforts. Through the TISF project, DSR was able to collect specific information on the make, model and year of manufacture for tractors, and whether the tractor had a ROPS installed. The TISF data are also useful for use at the state-level to help target prevention efforts.

In 1991, NIOSH established the Alaska Field Station (AFS) to address the unique occupational injury hazards in Alaska [NTOF data identified Alaska as the highest risk state for fatal occupational traumatic injury, and through a supplemental appropriation from Congress, NIOSH opened the AFS]. Initial surveillance efforts were conducted by the AFS to provide more detailed information needed to prioritize the most compelling occupational issues for the state. As a result, commercial fisherman in Alaska were identified as having a remarkably high fatality rate, and the AFS implemented a comprehensive partnership with the public and private sectors to identify critical risk factors and recommend intervention strategies. From these collaborative efforts, fishing-related fatalities in Alaska have declined 56% between 1991 and 1999 [from a high of 36 in 1991 to 16 in 1999]. As well, efforts in Alaska have proven to have application outside the state. For example, NIOSH, in collaboration with the Harvard ERC, are co-sponsoring an International Fishing Industry Safety and Health Conferences in October 2000. The conference will serve to bring together colleagues from around the world to raise consciousness, build coalitions, disseminate information and encourage action to prevent injury in the commercial fishing industry.

In 1996, the National Committee for Childhood Agricultural Injury Prevention (NCCAIP) published the landmark document *Children and Agriculture: Opportunities for Safety and Health*. This document served as a National Action Plan for the prevention of childhood agricultural injuries. In the document, the NCCAIP recommended NIOSH serve as the lead federal agency to implement and coordinate this national initiative, and the FY97 NIOSH appropriation included \$5M from Congress for this purpose.

DSR was assigned the lead within the Institute to implement the childhood agricultural injury prevention initiative. Following the guidance provide in the NCCAIP document, and input obtained during a stakeholders' meeting in February 1997, NIOSH began implementation of a comprehensive program which included both intramural and extramural research targeted to reduce childhood agricultural injuries. Much of the DSR effort dedicated to this initiative focuses on improving the extremely limited injury data that are available for children who work, live or visit farms and for identifying research gaps to address in the extramural component of the Initiative. Additionally, DSR is responsible for overseeing the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) which was established in 1997 as a cooperative agreement, and is co-funded with the Maternal and Child Health Bureau of HRSA. The NCCRAHS serves as an important external focal point for the child agricultural injury initiative, and DSR staff work closely with the NCCRAHS on many diverse issues related to the

initiative. In September 1999, NIOSH sought additional stakeholder input on proposed future directions for the Initiative through a public mid-course review.

Collaboration with Partners:

Other areas of DSR collaboration with NIOSH-funded extramural programs include the Agricultural Health Promotion System (AHPS), and its successor, the Agricultural Safety Promotion System (ASPS), both of which were DSR projects. The ASPS was funded in six states, and focused on intervention evaluation. For example, the ASPS program in California conducted an ergonomic intervention project in cooperation with nurseries in the state. After identifying a number of potential risk factors for musculoskeletal disorders, a prototype nursery container “handle” was developed and implemented which eliminated much of the trunk inclination and pinch grip required of workers. The evaluation was able to demonstrate a statistically significant reduction in musculoskeletal disorders among nursery workers. DSR surveillance staff also provided significant input into the injury components of the Farm Family Health and Hazard Survey. Division FACE and engineering staff worked closely with the Occupational Health Nurses in Agricultural Communities (OHNAC) and Community Partners for Healthy Farming (CPHF) programs in New York state on two specific efforts. The first involved scalping-related injuries from hair entanglement in unguarded drivelines on hay balers. This hazard was initially identified by an OHNAC nurse in New York in August 1991. Further investigation identified four other similar incidents in New York during an 18-year period. NIOSH field staff conducted an on-site investigation into the 1991 incident, and identified entanglement hazards for a specific manufacturer and type of hay baler due to an inadequately guarded rotating driveline. After an MMWR article and NIOSH Update were published in July 1992, there was a significant increase in the number of retrofit kits distributed. These retrofit kits, when installed on the hay baler, would significantly reduce the injury risk from the rotating driveline. Based on the DSR investigations, an Alert was also issued [*Preventing Scalping and Other Severe Injuries from Farm Machinery*, Pub. No. 94-105].

The second example involved a potential ignition hazard with a specific manufacturer and type of agricultural plow frame. In separate incidents, two farmers were injured while attempting to drill holes into sealed plow frames in order to mount a hitch or a “slow moving vehicle” sign. The farmers received serious burns and other injuries when the drill bits penetrated the frames, releasing and igniting flammable gases. In conjunction with staff from the Pittsburgh Research Laboratory, DSR was able to identify the apparent cause of the ignition hazard (flammable gases generated as a result of an electrochemical reaction within the sealed frames), and worked with the manufacturer to warn users of the hazard. The manufacturer also made design changes to reduce the hazard on newly manufactured equipment. The results of this collaboration were published in a NIOSH Technology News bulletin *The Explosion Hazard From Hydrogen Gas Generation Inside Sealed Frames* and a NIOSH Hazard ID *Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment*. The Hazard ID identified recommendations for preventing injuries to agricultural workers and roles for equipment manufacturers, dealers, agricultural extension agents, and universities. In 1998, an article in *Successful Farming* magazine noted how FFA Chapters were implementing a safety program to get slow-moving

vehicle signs on agricultural equipment. One of the NIOSH FACE staff involved with the investigation of these incidents contacted the magazine which subsequently printed information on the potential problems with penetrating ballasted equipment.

In the conduct of the DSR agricultural research program, DSR staff have routinely collaborated with or sought input from numerous external partners to improve the scope and focus of the DSR program, as well as the DSR products targeted for the farming community. During the last 10 years, external public and private sector partners have been involved with many aspects of our surveillance, research and dissemination efforts. Included in this list of external partners are the USDA, the USDA Cooperative Extension Service (CES), OSHA, Consumer Product Safety Commission, American Society of Agricultural Engineers, National Institute for Farm Safety, and the Agricultural Division of the National Safety Council. Additionally, DSR has collaborated with numerous academic centers, such as the Ohio State University, Penn State University, Colorado State University and the University of Minnesota. Specific examples of collaboration with the CES follow.

In May 1990 the Alert *Preventing Deaths of Farm Workers in Manure Pits* [Pub. No. 90-103] was published. DSR recognized the value of involving the CES in disseminating this Alert directly to farmers since CES staff are established, credible resources for the agricultural community. To our knowledge, this was the first such effort by NIOSH to utilize the CES network as a mechanism to facilitate dissemination of NIOSH publications. Since then, the Division and Institute routinely utilizes the existing CES network to assist with dissemination efforts targeted for the agricultural sector.

Another example is the 1995 *Safe Grain and Silage Handling* document [Pub. No. 95-109]. Once this document was drafted by DSR, we obtained input from the agricultural community through the use of focus groups. Based on feedback from the focus groups, the document was reformatted to a more user-friendly design with more basic illustrations. This document was also disseminated with the assistance of the CES network.

Summary:

Throughout DSR's involvement in agricultural safety research, the Division has attempted to fill critical data gaps in injury surveillance, identify risk factors which require further research or where specific prevention efforts are needed, conduct safety engineering research to address compelling issues identified through surveillance and FACE data, and disseminate practical, prevention-oriented materials for the agricultural community. In the last decade, DSR staff have published a broad array of documents in this area, ranging from analysis and interpretation of injury surveillance data in the peer review literature directed toward researchers and policy makers, to NIOSH Alerts, Hazard ID bulletins and worker safety guides targeted to farmers for use in day-to-day safety prevention efforts. As the DSR agriculture program continues to evolve, our goal is to maintain those programs where we have been successful (such as FACE), while continuing to seek new approaches to address changing priorities and emerging technologies as our knowledge base and expertise in the agricultural safety arena continually expands.

5. Division of Respiratory Disease Studies (DRDS)

Scientists in the Division of Respiratory Disease Studies (DRDS) of NIOSH have been active in research on agricultural respiratory disease for many years. During the 1970s and 1980s, the Division provided national leaders in the study of byssinosis in the cotton industry. This work has had significant impact in improving understanding disease etiology and in the promulgation of occupational exposure standards. Successful partnerships between labor, industry, academia, and government were also an important underpinning of our research efforts in the cotton industry. DRDS scientists have played a continuing national and international leadership role in the study of endotoxin exposure and the related health outcomes in many agricultural settings. Many successful collaborative research partnerships have formed as a result of these efforts. During the 1980s, our Division's research efforts diversified to include respiratory disease from agricultural organic dusts and dust constituents. We worked collaboratively with extramural scientists in the study of hypersensitivity pneumonitis and Organic Dust Toxic Syndrome in agriculture related to feed storage and handling, and animal confinement. Concurrent with these field-based research efforts, DRDS scientists were working in laboratory settings to develop animal exposure models for dust-induced respiratory disease in agriculture.

In 1990, DRDS played a leadership role responding to the CDC/NIOSH Congressional mandate to develop NIOSH's National Program in Agricultural Safety and Health. DRDS provided Institute leadership in formulating the NIOSH extramural agricultural program. Through this Agricultural Initiative, DRDS started the NIOSH Agricultural Centers Program by funding two Centers in 1990. These first NIOSH Agricultural Centers, located in Iowa and California, were charged with conducting research, education, and prevention intervention programs targeting priority health and safety problems in agriculture. In response to the new mandates, the Division's agricultural research program took a new extramural focus. At the same time, new intramural projects were developed to better understand and prevent lung disease in agricultural workers. These have relied on collaborative interactions between field and laboratory research scientists. This research program involved investigation of disease or exposure incidents to better understand disease etiology and the prevention strategies most appropriate to different agricultural settings. The intramural research involves an integrated, multi-disciplinary approach to the study of agricultural lung disease through clinical evaluation, environmental exposure assessment, microbiological characterizations, epidemiological surveillance, study of disease mechanisms, and animal exposure studies. Division scientists have been active in studying agricultural respiratory disease in a number of settings including cotton processing, mushroom farming, animal confinement, grain harvesting and storage, composting, and others.

The DRDS agricultural research program grew through the 1990s with the most substantial growth in extramural research programs. In 1996, following a review of the NIOSH extramural agricultural program, the Agricultural Centers Program was competitively re-announced: Eight Centers were funded and a ninth was added in 1998. Division scientists also became actively involved in other extramural agricultural programs including participation in the intervention aspects of the NIOSH Community Partners for Healthy Farming Cooperative Agreement. A new

cooperative agreement on respiratory exposure hazards in the composting industry was awarded by DRDS in 1997. At the same time that these expansions in the Division's extramural programs were occurring, DRDS intramural agricultural research experienced a significant reduction. In 1996, approximately 75% of the DRDS staff involved in laboratory research were moved to a newly created NIOSH Division, the Health Effects Laboratory Division (HELD). The transfer included many of the Division's active agricultural project officers. In the fall of 1998, additional DRDS staff, involved in microbiology and bioaerosol research, were relocated to the new Division. These personnel shifts had significant impact on the scope of intramural agricultural research efforts underway in DRDS.

Current Program:

The Division's current program (1999 to present) includes 11 projects addressing agricultural health and safety issues, in whole or in part. Nine are intramural and two are extramural, as noted below:

<u>Project</u>	<u>Type</u>
Centers for Agricultural Disease and Injury Research, Education	Extramural
Respiratory Exposure Hazards in Composting	Extramural
Feasibility Study to Investigate Acute Inhalation Injuries in Agriculture (Just completed)	Intramural
Occupational Asthma Identification Methods	Intramural
Agricultural Dusts: Field Based Eval of Exposures and Acute Respiratory Illness	Intramural
Closed Environmental Tractor Cab Filter Efficiency Study	Intramural
Farm Family Health and Hazard Surveillance Study: Descriptive Analysis	Intramural
Work-Related Lung Disease Surveillance Report	Intramural
Development of Respiratory Disease Surveillance Systems	Intramural
Air Purifying Respirator Testing	Intramural
Quality Assurance Documentation Control	Intramural

Of the nine intramural projects, five target one or more National Occupational Research Agenda (NORA) priority areas, and four are full NORA projects with greater than 80% of the project targeting a single NORA priority. The NORA priority areas addressed through the Division research projects include:

<u>NORA Priority Area</u>	<u># Projects</u>
Asthma and Chronic Obstructive Pulmonary Disease	4 Projects
Control Technology and PPE	1 Project
Special Populations	1 Project

Allergic & Irritant Dermatitis	1 Project
Emerging Technologies	1 Project
Mixed Exposures	1 Project

Collaboration:

DRDS has a history of diverse and productive collaborations through our agricultural research program. In our current research program, the Division collaborates with a range of intramural and extramural partners:

NIOSH Agricultural Cooperators:

Deep-South Agricultural Center
 Great Plains Center for Agricultural Health
 High Plains Intermountain Agricultural Center
 Midwest Center for Agricultural Research & Education & Disease & Injury Prevention
 Northeast Center for Agricultural Medicine and Health
 Pacific Northwest Agricultural Safety & Health Center
 Southeast Center for Agricultural Health and Injury Prevention
 Southwest Center for Agricultural Health, Injury Prevention, and Education
 University of California Agricultural Health and Safety Center
 Community Partners for Healthy Farming Intervention Research Cooperators
 Farm Family Health and Hazard Surveillance Cooperators
 University of Washington
 Eastern New York Occupational & Environmental Health Center

Other Government Agencies:

U.S. Department of Agriculture
 U.S. Bureau of Labor Statistics
 Occupational Safety and Health Administration (OSHA)
 Wisconsin State Health Department
 Michigan State Health Department
 North Dakota State Health Department

Academia:

University of Pittsburgh
 University of Washington
 University of Maryland
 University of Wisconsin
 Harvard School of Public Health
 Marshfield Medical Research Foundation

Agribusiness:

John Deere

Other NIOSH Divisions:

Division of Biomedical and Behavioral Sciences (DBBS)

Division of Physical Sciences and Engineering (DPSE)
 Division of Safety Research (DSR)
 Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)
 Education and Information Division (EID)
 Health Effects Laboratory Division (HELD)

Our collaborative interactions with these partners include active participation in field studies and research. We provide collaborative support through environmental sample analysis and the loan of environmental sampling equipment and pulmonary function equipment. We collaborate in data analysis, reporting writing, and publishing, including the development of new NIOSH Documents. We also work with our cooperators in organizing agricultural conferences, meetings, and training courses. In addition, Division staff serve as project officers for extramural agricultural cooperators, including direct participation in program activities with nine Agricultural Centers, seven Community Partner for Healthy Farming Intervention Cooperators, and with two Composting Research Cooperators.

Planning:

A number of tools are used to guide DRDS project planning for agriculture. NORA has been a primary source of guidance used to direct our Division's project planning. Additionally, the intramural NIOSH Agricultural Steering Committee (NASC) established priority areas and criteria for new agricultural projects, and the NASC also provided a scientific review of all new agricultural projects to ensure that they were consistent with Institute priorities and scientifically sound.

Following the move of DRDS laboratory investigators to HELD, our Division held multi-disciplinary brainstorming sessions to identify gaps which could be addressed with our present program focus. In addition to these internal program planning steps, the Division contacted several NIOSH Agricultural Centers with expertise in agricultural respiratory disease for guidance in program planning.

To stimulate new research ideas and aid Division project officers in identifying appropriate research topics for new agricultural research projects, we posted project planning guides on our Division's Intranet; these included a document on agricultural respiratory disease (including research needs) published by the *American Thoracic Society* in November of 1998, *Respiratory Health Hazards in Agriculture*. Also posted was information on the respiratory projects currently underway through the NIOSH Agricultural Centers. In fiscal year 2000, we were successful in adding a new agricultural research project, *Closed Environmental Tractor Cab Filter Efficiency Study*. This project is a full NORA project and 100% agriculture.

Resource Commitment:

DRDS has spent 10% (or greater) of our annual, intramural budget on agriculture health and safety for the past three years. The percent of our Division's budget allocated to agriculture is presented below by fiscal year:

Fiscal Year 1997 - 10%

Fiscal Year 1998	-	14%
Fiscal Year 1999	-	12%

In 1997, the budget for NIOSH's large agricultural cooperative agreement programs was moved to NIOSH/Atlanta in our Office of Extramural Coordination and Special Projects (OECSP). The percentages above do not reflect the annual core budgets for the NIOSH Agricultural Centers Program. The Division's budget does include some extramural agricultural spending for the cooperative agreement research on composting. Historically, the Division has made efforts to provide intramural funding to support special extramural agricultural funding needs that arise through our collaborative partnerships in agricultural research.

From these resource commitments, a number of NIOSH (or NIOSH-assisted) publications have been produced:

- NIOSH Alert. Preventing Organic Dust Toxic Syndrome. April 1994.
- NIOSH Current Intelligence Bulletin 56. Washed Cotton. A Review and Recommendations Regarding Batch Kier Washed Cotton. August 1995.
- NIOSH Hazard Control. Control of Organic Dusts from Bedding Choppers in Dairy Barns. April 1997.
- NIOSH Agricultural Disease and Injury Research, Bibliography 1990-1996, NIOSH Centers for Agricultural Disease & Injury Research, Education, and Prevention. July 1997.
- Journal of Agricultural Safety and Health, Special Issue No. 1. May 1998. Papers from the NIOSH Agricultural Safety & Health Conference, Morgantown, WV, July 1997.
- American Thoracic Society, MB Schenker (Ed). Respiratory Health Hazards in Agriculture. Am J Respir Crit Care Med 158, pp S1-S76. November 1998.
- NIOSH Alert. Preventing Asthma in Animal Handlers. January 1998.
- NIOSH Alert: Preventing Phosphine Poisoning and Explosions During Fumigation. September 1999.
- NIOSH Agricultural Centers Home page, <http://www.cdc.gov/niosh/agcnthom.html>. July 1999.

The Division hopes to continue to pursue an active program of research and service to better understand and prevent respiratory disease for those working in agriculture.

6. Health Effects Laboratory Division (HELD)

The Health Effects Laboratory Division (HELD) does not yet have a well-defined program of research in agriculture. In fact, only 4.6% of our current budget is devoted to agricultural research. However, the nature of our research will lead to results that cut across most industrial sectors including agriculture.

For example, the HELD-initiated, multi-divisional, NORA dermal research program will strengthen the scientific basis for making recommendations about skin exposure to chemicals including pesticides. Research into real-time exposure assessment instruments such as a silica monitor can

lead to a valuable assessment tool for agriculture, as well as addressing the NORA requirement for easy-to-use, direct-reading instruments.

Research into the causes and mechanisms of workplace diseases and identification of biomarkers and assays will also be directly applicable to agriculture and to several NORA disease priority research areas (mainly allergic and irritant dermatitis and asthma). This mechanistic research includes inflammation, oxidant injury, carcinogenicity and dermal toxicity caused by occupational contaminants (e.g., allergens, arsenic, silica, etc.). A good example of our biomarker research is the GFAP assay developed by a HELD scientist. This assay may be an early way to detect neurological damage from metals, organo-metals, substituted pyridines and organic solvents, etc. In fact, this assay is being used to examine interrelations among makers of pesticide exposure, quantifiable brain tissue injury and clinical and pathological evidence of Parkinsonism dementias in an established epidemiological study.

HELD also does research on how to design health communication strategies. One project is designing and testing an Internet site for adolescents. Whenever possible interactive technology is being used to allow adolescents to complete problem solving activities and experience realistic outcomes of their decisions. Data indicates that most injuries to adolescents involve burns, sprains, strains, and farm-related injuries. Thus farming will be a major component for this web site.

Only five of HELD's projects since FY97 were at least 80% agricultural. Two of the projects looked at the pulmonary response to farm dusts. The first was done in collaboration with the Agricultural Center of the University of California at Davis and had the following results:

1. Aerosolized field dust samples collected at various agricultural sites in California contain 7-21% crystalline silica.
2. Toxicity of field dust on alveolar macrophages was related to the crystalline silica content of the dust.
3. Histopathological evaluation of autopsied lungs of 44 agricultural workers indicates retention of dust particles containing silica. Areas of dust retention were associated with tissue remodeling and the development of fibrotic lesions.

The second study of farm dusts looked at the cellular and molecular events which initiated the pathogenic response. This study was done in collaboration with the Agricultural Center at Colorado State University and had the following results:

1. Exposure of alveolar macrophages to agricultural dusts induces the product inflammatory cytokines (IL-1, IL-6, and TNF α), heme oxygenase, metallothionein and nitric oxide.
2. Exposure of alveolar macrophages to agricultural dusts activates nuclear transcription factor kappa B (Nf κ B) which enhances the production of a number of pro-inflammatory cytokines.
3. Exposure to agricultural dusts can generate reactive oxidants which can cause DNA damage and lead to apoptosis.

Another study looked at whether altered thyroid hormone status would affect the pulmonary reaction to the endotoxins believed to be responsible for organic dust toxic syndrome (ODTS). The results indicate that the pulmonary response to inhaled endotoxin was more severe in hyperthyroid and less severe in hypothyroid rates compared to controls. These data indicate that the metabolic rate of the host may affect basal redox status and thus responsiveness to airborne microbial products often associated with organic dust exposures.

A study on pesticides (endosulfan and methoxychlor) which may exhibit estrogen-like activity and may adversely affect the male reproductive system is being performed. Effects of pesticides on isolated Leydig cells (testicular cells which product testosterone) and Sertoli cells (testicular cells which regulate spermatogenesis) are being determined and compared to the effects of other industrial chemicals (octyphenols and bisphenol A). This study has the following results to date:

1. The effect of octyphenol on Leydig cells depend on the age of the host. In neonatal cells, low doses increased testosterone production while higher doses caused a decrease in testosterone. Leydig cells from immature rats decreased testosterone production when treated with octyphenol. Adult cells exhibited only a modest reduction.
2. Effects of endosulfan were less dramatic than octyphenol.
3. The effects of octyphenol were not mediated through the estrogen receptor.
4. Methoxchlor decreased 2 genes (the cAMP response element binding protein and the iducible cAMP early repressor) in immature Sertoli cells. The consequences of these changes are being investigated.

Finally, a study which will look at the reproductive status (pregnancy or lactation), of women exposed to bacterially contaminated dusts that can cause Organic Dust Toxic Syndrome (ODTS) is in its initial stage.

Again, while only a few of HELD's projects are considered to be agricultural, much of our research will be valuable for looking at the causes and prevention of agricultural related diseases.

7. Pittsburgh Research Laboratory (PRL)

The Office for Mine Safety and Health Research encourages support of collaborative research with the Pittsburgh Research Laboratory and the Spokane Research Laboratory researchers on cross-cutting issues. Several areas of research address common issues in both agricultural and mining settings. Examples of research in mining that also applies to agriculture include:

- seating and suspensions design to reduce jolting and jarring injuries to equipment operators,
- ergonomics consideration for workers interacting with equipment, and performing jobs in difficult environments,
- hearing loss prevention,
- electrical shock prevention, and
- explosion prevention.

There are three specific research projects related to health and safety in agriculture that the Pittsburgh Research Laboratory (PRL) has recently been involved with.

Recommendations to Improve Safety in Potato Harvesting and Packing in Southern Colorado:

Pittsburgh Research Laboratory researchers traveled to the San Luis Valley in Colorado in September, 1998, at the request of Jane McCammon of the NIOSH Denver Field Office to provide assistance on a study related to injuries in the potato production and packing industry. This work was conducted under an agricultural Health Hazard Evaluation (HHE-980172) requested by Colorado State University, which involves defining the extent and nature of injuries in the industry and advising farmers and packers about effective controls to reduce the risk of injury. The PRL researchers, Jane McCammon, and Lori Berberet of Colorado State University spent 3 days visiting a number of harvesting and packing operations. During the visits, the team collected data (video, photos, notes) and provided verbal suggestions concerning equipment modifications to reduce the risk of hand and back injuries. After studying the information brought back from the field, PRL researchers prepared a web based summary report with specific recommendations for the industry. This report has been reviewed, and has now been approved by CSU. It will be posted on the NIOSH web site soon. In February, 1999, a safety talk was presented at the Annual meeting of the Colorado Growers Association. Jane McCammon plans to set up a conference call to discuss collaboration on future activities similar to work for the potato HHE.

Development of an Automatically-Deployed ROPS Overturn Sensor:

This project is a collaborative effort between the Division of Safety Research-Morgantown, WV and the Pittsburgh Research Laboratory to develop and evaluate a roll-over protection system for tractors. It was initiated in June 1998. The roll-over system would automatically deploy when a sensor indicated that the tractor is going in to a roll situation. PRL developed a remote-controlled farm tractor to be utilized as the test machine on which roll-over protection systems (ROPS) and sensors would be installed. The tractor needed to be remote-controlled because it would be actually rolled a number of times to test the ROPS. In addition, since the PRL site contains many acres of rolling land, it also provided the ideal site for the tractor roll tests to take place. Two roll test pits were constructed according to applicable industry standards, one for backward rolls, and the other for side rolls. Over 17 roll tests have been conducted to date. In addition, PRL and DSR also jointly collaborated on the development of a RO1 Grant Proposal for additional funding under the Ag/Mining/Construction initiative. The proposal, which was selected for funding, involves further development of the automatically-deployed ROPS.

Farm Explosion Investigation Report:

On Friday, October 25, 1996, the Division of Safety Research (DSR) received a request from a New York State agricultural health nurse to assist in the investigation of a farm explosion that occurred in Lima, New York. Personnel from the Pittsburgh Research Laboratory (PRL) were requested by DSR to participate in this investigation by taking and analyzing samples from the explosion area. A visit was therefore made to Joseph Shanks' farm in Lima (near Rochester) on Nov. 12, 1996 by Isaac A. Zlochower, a research chemist from PRL, and Virgil Casini, an occupational safety and health specialist from DSR, to gather information about the incident and to take appropriate samples. An HHE was prepared at the conclusion of this effort.

Summary

The NIOSH National Program in Agricultural Safety and Health is broadly diverse. We use the strengths of our intramural scientists and collaborate with scientists across the Nation to leverage our expertise, while collectively we work to improve the health and well-being of agricultural workers and their families. All Divisions/Laboratories are involved, to varying degrees, in work related to agricultural safety and health. Division/Laboratory walls are softening, and a real and successful emphasis on multi-disciplinary, multi-sector activities is evolving. Finally, resources are distributed according to quality of work design, based on several layers of review, justification, and open deliberations.

NIOSH is committed to continue good stewardship of the trust and resources that Congress appropriated for the National Program in Agricultural Safety and Health. We have used and continue to use both external and internal methods to review the Program and to add continuous improvement. This is especially critical with the changes that are occurring nation-wide in production agriculture. NIOSH enjoys a stature of prominence as a global leader in agricultural safety and health research. Through continued vigilance and an eye to the future, NIOSH hopes to maintain that reputation.

***Comments to the Report by the NIOSH Board of
Scientific Counselors Subcommittee for
Agricultural Review
September, 2001***

HAZARD, DISEASE, AND INJURY SURVEILLANCE

- NIOSH should include agriculture as one of the industry sectors in the planned NIOSH program on Hazard Surveillance in the Workplace.
- A systematic program for surveillance of non-fatal agricultural injuries is needed. The NTISF survey conducted in 1993-95 provides useful information as well as valuable experience which should be used to design an ongoing effort in collaboration with the USDA.
- NIOSH should work closely with the USDOL to expand the NAWS effort to collect more information concerning injuries and work related morbidity of agriculture workers.
- NIOSH should increase its collaboration with the NIOSH Centers, especially on hazard and case based surveillance efforts. NIOSH should provide leadership concerning development of case definitions and standardized data collection tools.

Comments: NIOSH agrees with the conclusions of the Subcommittee that USDA and USDOL/NAWS efforts are activities around which NIOSH is organizing its disease and injury surveillance efforts. Starting in 1999 NIOSH gave specific funding to USDOL to add injury questions in their NAWS assessment. This support was provided for 2 years. In 2001 funding was provided to USDOL to analyze the collected data. NAWS provided a good source for useful data collection related to occupation, but was not as useful for collecting data related to children in agriculture.

Also in 1999, NIOSH provided USDA with funding for the farm operator survey to include injury questions related to youth. In 2001, additional money was provided to USDA for youth injury data related to their minority farm operator survey. In 2001-2002, it is planned to provide USDA with money for a combined youth survey and farm operator injury survey to begin in 2002.

We are aware that in 2003 and 2008, USDA will be consumed with the Ag Census and unable to cooperate with NIOSH on these surveys. It is anticipated that a strategy of alternating NAWS and USDA surveys will provide a periodic surveillance approach that will be successful within the current capabilities.

Hazard surveillance is a difficult and resource intensive activity. It is unlikely that NIOSH will have the resources in the near future to carry out a serious hazard surveillance activity. Basically NIOSH is going sector by sector and trying to find federal partners to co-fund these activities with us. It is not clear at present who the federal partners would be. But the health care sector is likely to tie us up for a few years before we could add another major activity. NIOSH anticipates pursuing the following: 1) Keeping this alive as a topic for consideration in an internal strategic planning process; the project here would be to develop and pilot survey methods that could be used in hazard surveillance; 2) After the re-announcement of the Ag Centers is completed, identifying their activities and interacting with them where appropriate; and 3) As we develop stronger State occupational surveillance activities, encouraging the addition of Agriculture as one of the sectors that they consider.

ETIOLOGIC RESEARCH AND EXPOSURE ASSESSMENT

- Etiologic research funded with NIOSH intramural funds should be carried out only where it fulfills a specific objective or answers a specific research question identified through an agency wide strategic planning process for agriculture research. Etiologic research conducted in collaboration with extramural partners makes the best use of available resources and expertise.
- NIOSH is encouraged to make better use of targeted cooperative agreements to enhance collaboration on etiologic research projects between internal NIOSH scientists and external scientists, and in particular with scientists affiliated with the NIOSH funded Agriculture Centers. The committee encourages a reallocation away from exclusively 'intramural' projects to greater emphasis on hybrid (intramural / extramural) projects, in which there is true collaboration among the parties. Many such projects are currently underway and should be continued.
- NIOSH scientists and project officers should be provided funds and time to participate actively in conferences, workshops, and continuing education courses of specific relevance to research in agricultural health and safety.

Comments: The Subcommittee provides an excellent recommendation to pursue specific agricultural safety and health research questions in response to Institute-wide strategic planning. Recently a workshop was held in Baltimore, Agricultural Safety and Health Conference: Using Past and Present to Map Future Actions. In addition, the NIOSH Agricultural Centers Program will be re-awarded this fiscal year. It is our intent to commit to a strategic planning process when the report from the workshop is finalized and the Agricultural Centers are onboard. It is hoped that this can occur

within FY 2002.

NIOSH houses a cadre of talented and dedicated researchers with national and world-wide expertise in etiologic research. Over time, through NORA and Big-NORA announcements, NIOSH scientists are encouraged to collaborate both intramurally with scientists from other Divisions/Laboratories and extramurally with external partners. In the agricultural arena, a recent workshop was dedicated to enhancing intramural cross-disciplinary programs in agriculture, construction and mining. To emphasize the need to develop collaborations and expand the universe of expertise available to NIOSH, the most recent RFA for the Agricultural Centers emphasizes the importance of developing linkages, communications and collaborations with other NIOSH-sponsored agricultural health and safety programs. Partnerships and collaborative relationships were encouraged between the Agricultural Centers and NIOSH intramural programs as well. Additionally, NIOSH started a program that brings Agricultural Center Directors to NIOSH for a seminar which is televised via Envision throughout the Institute.

Announcements of upcoming Agricultural Conferences are made to members of the NIOSH Agricultural Steering Committee (NASC), where special emphasis is given to the NIOSH Agricultural Centers' Conference. NASC will be asked to pursue this role with more vigor, and Branch and Division/Laboratory Leadership will be encouraged to support attendance by their researchers whose principal area of research expertise is related to agriculture.

CHILD AGRICULTURE RESEARCH AND PREVENTION

- A systematic study of effective education and training techniques aimed at changing behavior of young workers should be undertaken by the Institute. It seems likely that NIOSH will be addressing other challenges relative to child labor in the future. Expertise in the training of young workers in the basic principles of safe work would be a good investment for the Institute. Efforts directed at applying these teaching techniques in agriculture as well as other fields are likely to be paid back many times during the work careers of these young people.
- Noise-induced hearing loss is a significant risk for young people in the agricultural setting. The Institute should either address this issue directly or be assured that it is being appropriately pursued elsewhere.
- Efforts directed at understanding and preventing pulmonary injury related to chronic and acute exposure of children to agricultural dusts should be considered by NIOSH if this is not being currently pursued with the mix of intramural and

extramural projects.

Comments: NIOSH is planning to request a Subcommittee of the Board of Scientific Counselors to review and make recommendations to the Childhood Agricultural Initiative as it nears the end of the first 5-year cycle. The activities that NIOSH pursues in the area of Childhood Agricultural Injury and Disease are linked directly with that Program. Although predominantly extramural, an intramural component is evident. NIOSH believes that important recommendations for future activities were included in this current report, namely, effective education and training techniques aimed at changing behavior of young workers, noise-induced hearing loss specific to children in agricultural settings, and understanding and preventing acute and chronic pulmonary injury in children. We anticipate that these specific recommendations will be included as potential areas of future expansion/development and examined specifically by the Subcommittee in light of an overall evaluation of the extramural and intramural Childhood Agricultural Program. This effort, in conjunction with the re-award of the Agricultural Centers will provide the background for determining strategic placement of Childhood Agricultural resources both internally and through cooperative agreements with the external scientific community.

PESTICIDE RESEARCH PROGRAMS

- A major workshop should be held of the NIOSH researchers (internal and external), government, industry, and labor organizations that are interested in pesticide research to determine the future direction for the NIOSH pesticide research program. The new paradigm that NIOSH has used to prioritize research projects (ex dermatotoxic) before they are started and funded should be implemented in this research area.

Comments: We recognize the importance of ensuring a cohesive and integrated program in pesticide research. Recently a workshop was held in Baltimore, Agricultural Safety and Health Conference: Using Past and Present to Map Future Actions. In addition, the Agricultural Centers Program will be re-awarded this fiscal year. It is our intent to examine the report from the Conference and the areas of pesticide-related research at the Agricultural Centers as guides to developing a broad-based and directed Pesticide Safety and Health Workshop. NIOSH will then convene such a Workshop that will be widely encompassing in which both intramural and extramural experts, federal agencies, end-users and environmentalists meet and openly discuss the problems, solutions, and future direction of agriculture.

INTERVENTION RESEARCH

- While some excellent examples of intramural-extramural collaborative intervention

efforts were identified during the review, it is clear that much greater impact can be realized through additional collaborative efforts. In some cases, NIOSH scientists may be unaware of these opportunities and recommendations for improved communication are contained elsewhere in this report.

- Collaboration with the Pittsburgh Research Center should be encouraged and expanded where appropriate.
- Partnerships with equipment manufacturers and suppliers offer an excellent opportunity for development and dissemination of intervention technologies and efforts. The NIOSH partnership for prevention of asphalt fume exposures during use of highway paving equipment is an excellent template to follow.
- Additional intervention research efforts should be devoted to noise induced hearing loss and protection for agriculture workers.

Comments: Partnerships and collaborations develop naturally over time when individuals become aware of opportunities, other interested individuals, and programs that are complementary. Recent workshops/meetings were designed to promote this type of communication/collaboration. Specifically the Construction-Agricultural-Mining-Partnership workshop brought together intramural investigators in those 3 sector-specific areas for mutual understanding and networking. The recent NOIRS conference did the same for injury-related researchers, both intramural and extramural.

The NIOSH Agricultural Steering Committee met several times by teleconference and pulled together an agricultural submission to the call for Big-NORA programs. This was the first formalized attempt for cross-Institute, multi-disciplinary collaboration on such a large scale.

Although some partnering with manufacturers in the agricultural sector is occurring, future and expanded involvements will be encouraged. NIOSH will further encourage interaction between agricultural intervention researchers and the NIOSH Intervention Effectiveness Team as an opportunity for broader collaborations.

The entire area of intervention research in agriculture must be part of a broader strategic plan in which intervention research plays a critical role. For example, many causes of noise-induced hearing loss are known. But what is less well-known is the workers' approach to risk assessment when balanced against the desire to get the job done quickly. Evaluating and disseminating existing interventions to workers in agriculture and their families is a major undertaking. Partnerships with equipment dealers/manufacturers can assist in this, although requiring time and financial commitment to establish the partnerships and dissemination. This is but one example of the need to look holistically at the agricultural situation and at the development of a NIOSH strategic plan in agriculture.

COMMUNICATION AND INFORMATION DISSEMINATION

- Develop a NIOSH communications plan specifically for agricultural safety and health information. As part of that communications plan consider the following:
- A mechanism to set Institute-wide priorities for development of agricultural communications documents, videos and CD-ROMs. Better coordination of existing resources with responsibility for health communications.
- Better coordination of existing resources with responsibility for health communications.
- Development of a Web page covering intra-mural agricultural safety and health activities that is linked to extra-mural research programs.
 - a. Inclusion of a FAQ section to the NIOSH home page that includes agricultural safety and health information when appropriate.
 - b. Incorporating information from the 1-800 line into the communications strategy.

Comments: These thoughtful and focused recommendations will lead to the development of a broad-based and extensive compendia of agriculturally-related communication products that represent the diversity of research, education, disease and injury prevention activities that make up the NIOSH National Program in Agricultural Safety and Health.

Direct Web links to home pages at all NIOSH-funded Centers, cooperators, grantees will be expanded to include synopses of projects, contact persons and other pertinent information. Intramural project descriptions, project officers, and appropriate information will facilitate collaborations with external and internal partners. A new web site for the NIOSH Child Agricultural Safety and Health Initiative is in development and soon to be brought on-line. NIOSH and NIOSH-funded agricultural documents will be made available to researchers.

Inclusion of a FAQ section on the NIOSH home page and incorporating 1-800 questions will greatly improve existing communication product dissemination. It is anticipated that information will be available to design a wide range of new communication products including research compendia, education modules/documents, print and electronic documents, and prevention strategies in response to public inquiry and concern.

OVERALL RECOMMENDATIONS - CROSS-CUTTING ISSUES

- NIOSH should formulate a more clear-cut strategic planning process for the agriculture initiative to develop overall Institute priorities for agriculture safety and health research. There seem to be many continuing projects but no good mechanism for choosing new projects and for determining which projects are best conducted intramurally and which are best conducted extramurally. There also seems to be little communication between recipients of NIOSH RO1 research grants and NIOSH researchers, so that many NIOSH staff are not really aware of research being conducted at universities.
- To assist NIOSH in its strategic planning efforts, NIOSH should sponsor an international workshop on agriculture health and safety research and prevention needs over the next 10 years. This is particularly important given the rapid changes taking place in the demographics of the agriculture workforce as well as agriculture methods and technology. This workshop should have broad participation from government, industry, labor, and academia.

Comments: Both of these recommendations are timely and important. It is important to look at agriculture broadly, with an eye to the future. An international workshop would provide the venue to bring together government officials, researchers, industry, academia, labor, and agricultural futurists to develop the picture of the changing face of agriculture. This could then lead NIOSH into strategic planning based on solid and representational bases. On a lesser scale, and without the full extent of broad participation implied in the recommendations, a recent workshop, for which NIOSH provided partial funding, was held in Baltimore: Agricultural Safety and Health Conference: Using Past and Present to Map Future Actions. The outcomes of the consensus-building process will be published into a document that will summarize recent past activities; describe progress made; identify gaps and needs remaining; anticipate changes, make recommendations on future action for the public record; and serve as a resource in national policy discussions. It is appropriate to first view the final document and use it as a guide to focus the direction of the NIOSH international conference and subsequent strategic planning. NIOSH will pursue identification of gaps in research, education, intervention, prevention, and information dissemination as the strategic planning process proceeds.

- The efforts of the NASC and EAT should be adequately supported. This includes basic financial support for the members from each of the divisions (which currently does not appear to be an issue) as well as formal recognition of NASC efforts as valuable contributions to NIOSH. Staff time devoted to NASC should

be considered in addition to scientific achievement and administrative effort in personnel evaluations. Staff members participating in NASC and EAT activities should be encouraged to actively disseminate agricultural information within their respective branches and divisions.

Comments: Members are encouraged to disseminate agricultural information within their respective organizations and are used as that conduit often. NIOSH considers the oversight, evaluation, and over-all planning and direction provided NASC and EAT members as critical components to the NIOSH mission. Members should ensure that the respective Branch and Division/Laboratory Leadership is informed of their activities related to agriculture. Leadership, likewise should consider these activities at evaluation times for the members.

- Consideration should be given to supporting a communications function within the office of the Agricultural Coordinator to assist with intramural and extramural marketing of all NIOSH agricultural activities. This may require allocation of an additional FTE and supporting funds to this office.

Part of this effort should include establishing an agriculture site within the NIOSH web site. This could be linked with the Agriculture Centers site and with each of the centers. The Agriculture Centers Access database will provide easy reference to any centers activities. Establishment of related databases which would include other extramural and all intramural agriculture (>80%) projects should permit easy searches for any NIOSH activities via the agriculture website.

Comments: This recommendation was addressed, in essence, in the comments to the section on communication and information dissemination. It addresses an important issue that will provide a service to agricultural safety and health not only intramurally, but nation-wide.

- NIOSH staff working on agricultural projects should communicate their progress at the NIOSH Agricultural Conference. Since many cited this conference as their major source of information on NIOSH agricultural projects, attendance and participation should be facilitated and encouraged. Divisions (such as DSR) who seek to communicate with their external agriculture collaborators via annual meetings should strongly consider piggybacking such meetings onto the NIOSH Agriculture Conference in the years that one is planned.

Comments: Vide supra. This is partially cultural; partially resource-driven. Yet, it accurately addresses the concerns of the staff. Meetings related to agriculture, especially the meetings related to the NIOSH Agriculture Conferences led by the Centers receive wide notice within the Institute.