



*NIOSH Agriculture, Forestry, and
Fishing
Safety and Health Program*

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Preface

The National Institute for Occupational Safety and Health (NIOSH) is seeking external review of its programs by the National Academies (NA) to assess its contribution to the public good and to improve its research and management. At the first meeting of the NA NIOSH Committee for the Review of NIOSH Research Programs on May 5, 2005, Dr. Lewis Wade, NIOSH senior science advisor, emphasized that these reviews should focus on evaluating their impact and relevance to health and safety in the workplace. Subsequently, the Framework Committee articulated the charge from NIOSH to the NA. It stated that NA evaluation committees should address the following:

- Progress in reducing workplace illness and injuries through occupational safety and health research through an analysis of relevant data about workplace illnesses and injuries for the program activity and an evaluation of the effect that NIOSH research has had in reducing illness and injuries.
- Progress in targeting new research to the areas of occupational safety and health most relevant to future improvements in workplace protection.
- Significant emerging research areas that appear to be especially important in terms of their relevance to the mission of NIOSH.

NIOSH believes that the framework developed by the Committee for the Review of NIOSH Research Programs will result in a fair and useful evaluation of its programs. NIOSH looks forward to supporting the NA so that workers everywhere will benefit from an improved Institute.

This report is the initial “evidence package” from NIOSH to the Agriculture, Forestry, and Fishing (AFF) Research Program evaluation committee assembled by the NA. We stress “initial” because we believe that the AFF Program review will be best-served by substantial communications between the program and the committee throughout the process. It is understood that the evaluation committee and the NA are charged with executing a thorough review of the program and that to do so it will need much information from the program. We have tried to anticipate those needs with this package. In addition, we look forward to an ongoing dialogue with the committee.

In the opening sections of this document, we provide an executive summary, an introduction to NIOSH, and an introduction to the AFF Program, including its research goals, its funding history, and a summary of its major accomplishments.

In this document, the AFF Program is organized into five general research goals. Some of those goals are divided into sub-goals. Within each goal section, there are up to seven parts:

- Challenge or Issue – the research need addressed by this part of the AFF Program
- Activities – the research activities undertaken
- Outputs – a description of the research outputs (e.g., reports and journal articles) and activities by the program to transfer the outputs to others

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- Intermediate Outcomes – the actions of other groups after they receive the outputs of the research program. We chose to classify the actions of others to request our outputs (such as requesting a copy of a research report or visiting our hearing loss Web site) as intermediate outcomes. Other examples of intermediate outcomes are standards, technologies, training methods, analytic methods, and control strategies adopted by others as a result of program outputs.
- End Outcomes – changes in workplace hazard exposures, reductions in injuries, illnesses, or fatalities. In some cases, we claim that the AFF Program has contributed to measured changes on these parameters.
- External Factors – a summary of circumstances and conditions outside the program that impacted program efforts. These factors might have impacted any stage of the program – or all stages.
- Future Directions – activities planned to extend the research program and potential outputs and intermediate outcomes that may result.

Within each research sub-goal there is a **Selected Outputs** section that lists particularly important AFF program results. In addition at the end of each chapter there is a complete list of **Outputs** for the corresponding goal.

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Abbreviations

A

AFF	Agriculture, Forestry, and Fishing
AFS	Alaska Field Station
AHPS	.....	Agricultural Health Promotion System
AHS	.....	Agriculture Health Study
AJIM	.....	American Journal of Industrial Medicine
AMSEA	.....	Alaska Marine Safety Education Association
APA	.....	American Pulpwood Association
ASABE	.....	American Society of Agricultural and Biological Engineers
ASAE	.....	American Society of Agricultural Engineers
ASH-NET	.....	Agricultural Safety and Health Network
ASPS	.....	Agricultural Safety Promotion System
ATR	.....	Alaska Trauma Registry
ATV	.....	All-Terrain Vehicles
AutoROPS	.....	Automatically deployed Roll-Over-Protection Structure

B

BLS	.....	Bureau of Labor Statistics
BSC	.....	Board of Scientific Counselors

C

CAIS	.....	Child Agricultural Injury Survey
CAMP	.....	Construction-Agriculture-Mining Partnerships
CARE Act	.....	Children's Act for Responsible Employment
CCDPF	.....	Cancer Control Demonstration Projects for Farmers
CDC	.....	Centers for Disease Control and Prevention
CFIVSA	.....	Commercial Fishing Industry Vessel Safety Act
CFOI	.....	Census of Fatal Occupational Injuries
CFR	.....	Code of Federal Regulations
ChE	.....	Cholinesterase
CI	.....	Confidence Interval
CIB	.....	Current Intelligence Bulletin
CLC	.....	Child Labor Coalition
CO	.....	Carbon Monoxide
CPSC	.....	Consumer Product Safety Commission
CROPS	.....	Cost-Effective Roll-Over Protective Structures
CSTE	.....	Council of State and Territorial Epidemiologists

D

DDT	.....	Dichlorodiphenyltrichloroethane
DHHS	.....	Department of Health and Human Services
DOL	.....	Department of Labor

Abbreviations

E

ED	Emergency Department
EMF	Electro-Magnetic Fields
EO	End Outcome
EPA	Environmental Protection Agency
ESA	Employment Standards Administration

F

FAA	Federal Aviation Administration
FACE	Fatality Assessment and Control Evaluation
FDA	Food and Drug Administration
FFA	Future Farmers of America
FFHHS	Farm Family Health and Hazard Surveillance
FISH	Fishing Industry Safety and Health
FLSA	Fair Labor Standards Act
FOPS	Falling Object Protective Structures
FRA	Forest Resources Association
FTE	Full-Time Equivalents

G

GC/MS	Gas Chromatography/Mass Spectrometry
GMO	Genetically Modified Organisms
GPS	Global Positioning Systems
GTS	Green Tobacco Sickness

H

HAI	Helicopter Association International
HHE	Health Hazard Evaluation
HO	Hazardous Orders
HPLC	High-Performance Liquid Chromatography
HRSA	Health Resources Service Administration

I

IAWG	Interagency Working Group
ICD	International Classification of Diseases
IFISH	International Fishing Industry Safety and Health
IFQ	Individual Fishing Quotas
ILO	International Labour Organization
ISO	International Organization for Standardization

L

L&I	Department of Labor and Industry
LH	Luteinizing Hormone
LSI	Logging Safety Initiative

Abbreviations

M

M-CAIS.....	Minority Childhood Agricultural Injury Survey
MCHB.....	Maternal and Child Health Bureau
MMWR.....	Morbidity and Mortality Weekly Report
MOB.....	Man Overboard
MOSH.....	Maryland Occupational Safety and Health
MSD.....	Musculoskeletal Disorders
MSHA.....	Mine Safety and Health Administration

N

NAGCAT.....	North American Guidelines for Childhood Agricultural Tasks
NASC.....	NIOSH Agricultural Steering Committee
NASD.....	National Agricultural Safety Database
NASS.....	National Agricultural Statistics Service
NAWS.....	National Agricultural Workers' Survey
NACOSH.....	National Advisory Committee on Occupational Safety and Health
NCASH.....	National Coalition for Agricultural Safety and Health
NCBDDD.....	National Center on Birth Defects and Developmental Disabilities
NCCAIP.....	National Committee for Childhood Agricultural Injury Prevention
NCCRAHS.....	National Children's Center for Rural and Agricultural Health and Safety
NCEH.....	National Center for Environmental Health
NCHS.....	National Center for Health Statistics
NCI.....	National Cancer Institute
NEISS.....	National Electronic Injury Surveillance System
NFPA.....	National Fire Protection Association
NHANES.....	National Health and Nutrition Examination Survey
NHIS.....	National Health Interview Survey
NIFS.....	National Institute for Farm Safety
NIH.....	National Institutes of Health
NIOSH.....	National Institute for Occupational Safety and Health
NOES.....	National Occupational Exposure Survey
NOIRS.....	National Occupational Injury Research Symposium
NORA.....	National Occupational Research Agenda
NPFVOA.....	North Pacific Fishing Vessel Owners Association
NSC.....	National Safety Council
NTOF.....	National Traumatic Occupational Fatalities
NVSS.....	National Vital Statistics System
NYCAMH.....	New York Center for Agricultural Medicine and Health

O

OEP.....	Office of Extramural Programs
OHNAC.....	Occupational Health Nurses in Agricultural Communities
OISPA.....	Occupational Injury Surveillance of Production Agriculture
OMB.....	Office of Management and Budget
OP.....	Organophosphate
OSHA.....	Occupational Safety and Health Administration

Abbreviations

OTTCOffice of Technology Transfer and Commercialization

P

PARTProgram Assessment Rating Tool

PFDPersonal Flotation Device

PMRProportionate Mortality Ratios

PPE.....Personal Protective Equipment

PRLPittsburgh Research Laboratory

PTO.....Power-Take-Off

R

RF.....Radio Frequencies

ROPS.....Roll Over Protection Structure

S

SENSORSentinel Event Notification System for Occupational Risk

SMRStandardized Mortality Ratio

SMVSlow-Moving Vehicle

SOII.....Survey of Occupational Injuries and Illnesses

T

TISFTraumatic Injury Surveillance of Farmers

TRAC.....Tractor Risk Abatement and Control

U

USCG.....United States Coast Guard

USDA.....United States Department of Agriculture

W

WoRLD.....Work-Related Lung Disease Surveillance System

WSDLI.....Washington State Department of Labor and Industry

Y

YWH&S.....Young Worker Health and Safety Network

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Over the past twenty years, agriculture has moved from the third to the most hazardous occupational sector. Agricultural workers and their families encounter a disproportionate number of injuries and diseases associated with physical, chemical, and biologic hazards. The National Safety Council (NSC) estimates that an average of 740 people lose their lives annually and another 130,000 workers are temporarily or permanently disabled as the result of farm- and ranch-related injuries.

Loggers and fishermen face similarly high rates of injuries and death related to their work. U.S. data reported in 1989 indicated that fishing had a fatality rate of 80 deaths per 100,000 workers, five times the sector average of 21 deaths per 100,000 workers. Logging is often considered to be one of the most dangerous industry segments in the U.S.

Agricultural safety and health has been an important focus in NIOSH for more than 30 years. Our efforts intensified in 1990, when the NIOSH AFF Program was initiated. Our efforts are challenged by two social realities. The first is the loose organization of professionals engaged in agricultural safety and health. That has been improved significantly with the advent of the AFF Program. Secondly, OSHA's regulatory activity in the agricultural industry is limited. The AFF Program has strengthened the science base for OSHA regulatory activity in areas such as logging.

Overall, the AFF Program is driven by the pursuit of reduction of occupational diseases, injuries, and death among agricultural workers, loggers, and fishermen. Over the past 15 year history of the program we have made significant inroads in meeting this objective. Our impacts have been in actual reduction of disease and death, and in reduction of exposure through legislation, regulation, increased use of protective clothing, and equipment, innovative technology and effective communication/education.

Our most important end outcome is actual reduction of disease, injury, and death. We have been successful in reaching that outcome in a number of areas. A few of the more significant examples of that include:

- Between 1998 and 2004 the AFF SENSOR-Pesticides Program effort observed a decrease in the rate of acute pesticide poisoning in the agricultural industry (from 13.1% to 8.9%). We believe the surveillance data and research findings from our program are among the drivers in that reduction, particularly as related to supporting new Environmental Protection Agency (EPA) regulations.
- Our Childhood Agricultural Injury Prevention Initiative began in 1997. During the initiative, the total number of youths injured on farms has decreased from 37,800 in 1998 to 27,600 in 2004. For the same time period, the number of farm work-related youth injuries decreased by 51% from 16,695 down to 8,130.
- After release of the North American Guidelines for Childhood Agricultural Tasks in 1999, the work-related injury rate for farm household youth decreased from 14.1 to 9.1 injuries per 1,000 working household youth for the time period of 1998 to 2004.

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- Since the initial release of the proposed OSHA Logging Standard in 1989, based largely on the NIOSH criteria document for a proposed logging standard, the national occupational injury and illness rate for the logging industry decreased from 19.5 cases per 100 full-time workers to 6.4 cases per 100 full-time workers in 2003.
- Since the intervention and implementation of the NIOSH-led Alaska Working Group's recommendations to prevent helicopter logging crashes in July, 1993, there has been only one additional helicopter logging crash in Alaska, which occurred in 1996.
- While the work-related fatality rate of commercial fishing fatalities in Alaska remains high, fatalities are decreasing. Since 1990, there has been a 74% decline in annual deaths to commercial fishermen there, due in some measure to our efforts.
- We continue to work closely with the Coast Guard in Alaska to implement new safety requirements. These safety requirements contributed to 96% of the commercial fishermen surviving vessel sinkings/capsizings in 2004, compared to only 73% surviving in 1991.
- AFF Program funding of a pilot eye injury prevention program in Florida between 2003 and the present resulted in reduced eye injuries (by 75%) among 500 workers. The project also found that the acceptance rate of using safety glasses increased from 65-75% post-intervention compared to 5% pre-intervention.

Other important impacts of the AFF Program have resulted from reduced exposure to hazards found on the job in farming, logging, and commercial fishing. Reduced exposure often correlates directly with reduced injuries, disease and death. We have made such impacts in strengthened legislation, new regulations, improved technology, increased use of protective clothing and equipment, and effective communication/education to prevent accidents. Examples of each of these outcomes follow.

Strengthened Legislation

- AFF investigators published an MMWR article in August 2004 describing a large outbreak of pesticide poisoning caused by a chloropicrin drift exposure from a farm in California. The article provided justification for legislation that was enacted just a month after the article appeared. It requires growers to reimburse any medical expenses incurred by the pesticide-drift victim.
- In both 2003 and 2005 the Youth Worker Protection Act was introduced in the U.S. Congress by Representative Tom Lantos. The bill would revise requirements relating to child labor and sets forth new requirements for the employment of minors. The requirements are largely based on the Hazardous Orders recommendations released by NIOSH in 2002.
- Wisconsin Act 455, passed in 1996, prohibits children younger than 16 years old from driving farm tractors on public roads until they complete a tractor and machinery certification course. This act was based on the results of the AHPS research in that state.

New Regulations

- Following the release of a MMWR article in November 1999 describing AFF Program findings on illnesses associated with efforts to control medfly infestations, our recommendations for accomplishing medfly control without the use of pesticides were adopted by the USDA, and the Florida Department of Agriculture. Since the adoption of these regulations, no infestations of medfly have been detected in the United States.
- Between July, 1989 and October, 1990 NIOSH provided three sets of comments to OSHA supporting a proposed logging rule. In 1994 OSHA adopted its final logging standard which incorporated the majority of our recommendations including first-aid training requirements, prohibited felling practices, personal protective equipment use, and equipment training requirements.
- In 1998, the Coast Guard convened a task force to develop a national plan for fishing vessel safety. The final report called “Living to Fish, Dying to Fish” adopted eight of the 11 recommendations made by NIOSH.
- In 1999, the Coast Guard initiated a Dockside Enforcement Program to identify and correct safety hazards known to exist in the Bering Sea crab fisheries based on NIOSH findings. The program was proven effective and subsequently became “institutionalized” as their way of doing business.
- Subsequent to the AFF Program neurological effects study and taking into consideration other data, EPA banned the use of chlorpyrifos for residential use. This action was taken primarily to protect children. In addition, chlorpyrifos is no longer used as a termiticide, thereby eliminating its exposure to termite control workers.
- Based on our work on cholinesterase, in 2000 the Washington State Supreme Court mandated that the Washington State Department of Labor and Industries develop a cholinesterase monitoring program for workers handling acutely toxic pesticides. The new rule was implemented in February 2004, requiring agricultural employers to provide blood testing to workers who handle organophosphorus and carbamate pesticides.
- With the help of industry, we successfully introduced a new American Society of Agricultural and Biological Engineers (ASABE) standard for the NIOSH Automatically deployed Roll-Over-Protection Structure (AutoROPS). This new standard is in draft form, and once issued, will give manufacturers criteria to build, test and sell AutoROPS to consumers. Their 1985 standard which recommended that all new farm tractors sold in the U.S. be fitted with a ROPS has resulted in compliance by more than 95% of all tractors manufactured after the adoption of this voluntary standard.

Improved Technology

- AFF Program surveillance data from Occupational Health Nurses in Agricultural Communities (OHNAC) and Farm Family Health and Hazard Surveillance (FFHHS) guided the development of an intervention project that has been shown to increase the use of Roll Over Protection Structure (ROPS) by farmers. In one intervention project, the use of retrofitted ROPS increased from 4 in 2 treatment counties to 81 in the 3.5

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years after the intervention was initiated. Because of the very high prevention rates of human injuries by ROPS/seat belt installation and use, we believe that ROPS plus seat belt installation are plausible proxies for actual reduction of hazard.

- Six Cost-Effective Roll-Over Protective Structures (CROPS) designs have been developed by the AFF Program and have been shared with a ROPS manufacturer (FEMCO). Having an estimate of the potential market for each AFF Program design was helpful in getting FEMCO to pursue CROPS on a commercial basis.
- NIOSH has developed a prototype emergency shutoff switch system to be used in the event a fisherman is entangled around a winch. The new e-stop system was successfully tested during the 2005 Southeast Alaska salmon fishing season. The response from industry has been overwhelming with inquiries from fishing vessel owners and operators asking for information on how to obtain the device for their vessels.
- Thirty percent of commercial fishing fatalities are due to a worker falling overboard. The AFF Program has developed a prototype improved personal flotation device that has thin, flexible, illuminated patches which become illuminated once the Personal Flotation Device (PFD) or jacket is submerged, allowing for quick location and recovery of victims.
- Control of carbon monoxide emissions resulted in the development of automatic engine shut-off sensors to stop equipment operations before CO concentrations reach hazardous levels.

Increased Use of Protective Clothing and Equipment

- The AFF Program investigated four incidents of “scalping” from hair entanglement around the rotating secondary driveline of hay baling equipment. A NIOSH Alert was published about this problem, with the result that retro-fitted machine guards, which were already in stock, sold out quickly and production of the guard has resumed.
- The Coast Guard in Alaska adopted a new “safety at sea” checklist in 1998 including a recommendation that fishermen wear a PFD at all times while on deck. This recommendation was made based on our research demonstrating the survivors of accidents were 7.5 times more likely to have worn a PFD in a vessel sinking.
- Many management and workers in wine grape production have adopted the smaller, lighter picking tubs that were developed by AFF Program researchers. Since our original study, these smaller tubs have become the most common type used in the Napa and Sonoma counties’ hand harvest.
- In 1993 our survey showed that less than 1% of workers were using the ergonomically advantageous long-handled harvesting rakes for blueberries. A follow-up survey by the New England Agriculture Center in 2006 estimated that most of the work force now used the long-handled rakes and many use rakes with two handles.

Effective Communication/Education

- Evaluations of day camp programs supported by the AFF Program to educate farm youth demonstrate that the camp programs are effective in raising safety awareness

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and behavior change in children. In 2006, such day camp program “Progressive Agriculture Safety Days” are projected to reach 59,000 children.

- The summaries and recommendations of our investigations into the leading causes of death in logging – being struck by falling objects and machinery events – have been distributed nationally by the American Pulpwood Association.
- In California, the AFF Program’s Social marketing Farm Safety Diffusion Tool project conducted a TV, radio and newspaper media campaign to deliver safety information to farm workers and employers. Three hundred copies of a multi-media tractor safety and field sanitation package, Loteria del Manejo Seguro, have been sold in California as another part of the campaign. These training materials have been recognized in California and Arizona as effective training tools for non-English speaking agricultural workers.

While much has been accomplished, much remains to be done. In 2005, NIOSH named AFF as one of the eight industry sector groups to be addressed by the second ten years of NORA (<http://www.cdc.gov/niosh/programs/agff/>). In the coming years, the AFF Program, in conjunction with its partners and stakeholders, will rededicate itself to explore new areas of research, facilitate moving research to practice in the workplaces of agricultural workers, loggers and fishermen, and evaluate the impact of our program on reducing injuries, disease and death among these workers.

