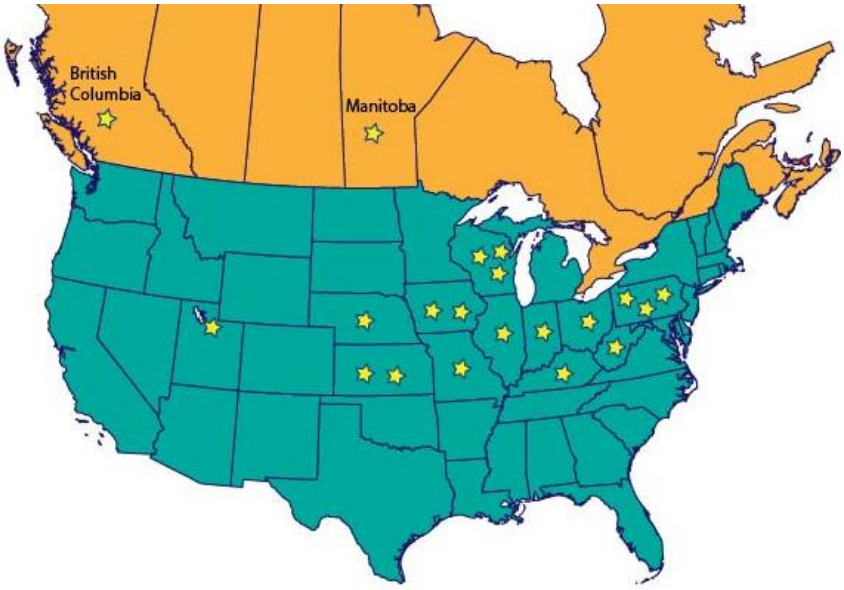
A Review of the National Research and Extension Agenda for Agricultural Safety and Health



States of NCERA-197 Committee Members

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Executive Summary

Agriculture continues to have the highest reported injury and fatality rates when compared with other U.S. industries (BLS, 2016). The National Research and Extension Agenda for Agricultural Safety and Health is a broad plan created by land grant universities to reduce the frequency and severity of agriculturally-related injuries through improve agricultural safety and health programing in the 21st century. This plan was developed by the North Central Region (NCR) 197 Committee on Agricultural Safety and Health Research and Extension between 2000 and 2003. The agenda provided a prioritized list of 12 research and extension areas with 115 individual topics relating to agricultural safety and health. It was determined that after more than 15 years, a review was justified to determine the level of scholarly activity generated by the plan that was associated with the 12 research and extension priorities, as well to identify major contributors of research articles and extension education products. The purpose of this effort is to provide documentation to assist in revising and updating the original agenda. It was determined that the production of relevant scholarly products and publications could be used as a metric towards achieving the original goals. Data searching was conducted between January and July, 2016. Scholarly products with publication dates of 2004 to 2015 were considered.

The results of this review are influenced by three documents and criteria: 1) the NCR-197 National Research and Extension Agenda; 2) the National Institute of Occupational Safety and Health (NIOSH) National Occupational Research Agenda (NORA), Agricultural, Forestry, and Fishing Sector Goals; and 3) research and outreach themes and goals of the NIOSH Ag Centers.

It was found that substantially more scholarly products were produced in the priority areas in more recent years, and more educational products were produced than peer-reviewed journal articles. Land grant universities alone produce almost one-half of the total scholarly products within the priority areas. Within the priority area of Special Population and Enterprises, scholarly products relating to Hispanic/Latinos and Children/Youth contributed the most in scholarly products produced. Almost 25% of educational products were produced in at least one foreign language.

A future report will review land grant university agricultural safety and health related resident education course development and offerings.

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Introduction

Agriculture continues to have the highest reported injury and fatality rates when compared with other U.S. industries. For example, recent numbers from the Bureau of Labor Statistics (BLS) indicate the rate of fatal agricultural injuries in 2014 was 25.6 per 100,000 full-time workers. This work-related death rate is nearly 8 times the all-industry work death rate of 3.4 (BLS, 2016). BLS reported a non-fatal injury incidence rate of 5.2 per 100 full-time workers in agriculture, forestry, and fishing in 2014 (BLS, 2016). These estimates are conservative, as they do not include the vast majority of farms (78%) that employ less than 10 workers (NIOSH AFF Centers, 2012).

The National Research and Extension Agenda for Agricultural Safety and Health is a comprehensive plan created by representatives of land grant universities serving on NCR 197 to improve agricultural safety and health in the United States in the 21st century. This agenda was developed between 2000 and 2003. The land grant system has been the primary facilitator of agricultural safety and health programming for over 70 years. The system possesses unique expertise particularly in areas such as engineering, control of environmental contaminants, animal handling, agricultural chemicals, prevention of secondary injuries, and evaluation of agriculturally-related educational programs. This coupled with land grant extension services providing the most comprehensive public agricultural education system in the country, places the land grant system in a prominent position to have a major impact on injury and illness risk reduction in agriculture.

The National Agenda for Action

The NCR-197 subcommittee established the 2003 research and extension priorities by: (a) building upon earlier efforts of organizations and agencies in identifying and establishing research agendas and priorities; (b) considering then contemporary concerns and issues; and (c) developing a new research and extension agenda that articulated the highest priorities, drawing on the historical strengths of the land grant system. Consideration was also given to the substantial amount of NIOSH sponsored research and engagement activities in the field of agricultural safety and health, and the need to compliment rather than duplicate these ongoing efforts. This national agenda provided a modest attempt at developing a prioritized list of 12 research and extension areas with 115 individual topics relating to agricultural safety and health in greatest need of attention and within the capacity of the land grant system to address. The priority areas with topics were:

1. **Sensors and guarding systems:** Enhanced rollover protection systems, equipment stability indicators, human presence detection, interlock and lockout systems, machine guarding characteristics, machine guarding standards, toxic environment monitors, use of global-positioning systems (GPS) for worker location.
2. **Operating agricultural equipment on public roads:** High-speed agricultural vehicles (marking, braking, controls), licensing of operators (age, skill level), lighting and marking of agricultural equipment, motor/agricultural vehicle operator training, operational procedures (nighttime travel), rural road design (bridges, signs, lighting), specialized vehicles (all-terrain vehicles, snow-mobiles, horse drawn buggies), transporting hazardous material (NH3, pesticides, fuel), use of sensors and enhanced vision systems, using GMOs to develop safer production methods, using GPS to monitor worker activities.
3. **Agricultural confined spaces:** Confined space rescue procedures, economic impact of confined space entry, regulations on agricultural producers, facility design for minimal entry, fall protection systems, fires and explosions, practices that minimize toxic gas production, safe entry procedures, toxic gas monitoring and warning systems, ventilation systems.
4. **Emerging technologies:** Automatic steering, auto pilot, and computer operated processing equipment, bio-sensors, exposure to high-pressure hydraulic systems, exposure to genetically

modified organisms (GMOs), high-speed equipment (vibration, jarring, reaction time), irradiation of food, land application of sludge, managing safety in on-farm, value-added processing operations, operatorless/remote control (autonomous) tractors and machinery, power transmission lines and communication towers (exposure to EMF, RF), using GMOs to develop safer production methods, using GPS to monitor worker activities.

5. **Human factors engineering and design:** Accommodating disabilities in the workplace, anthropometric data for agricultural tasks, controls and control layout, developmental-and age-related issues (child, elderly), gender issues, guarding design, effects of long-term exposure to vibration, noise, sun, dust, etc., human behavior (risk perception and acceptance), lifting and back protection, musculoskeletal disorders, prevention of secondary injuries, operator warnings/instructions (literacy, clarity, language), shift work, stress and behavior management, walking and working surfaces.
6. **Management of agricultural emergencies:** Decontamination processes, enhanced systems of rural communication, identification of vulnerability to bio-terrorism within agricultural production, impacts of disasters on livestock, preparation for severe weather, responding to agro-terrorism, responding to chemical spills, responding to farm-related entrapments and entanglements, rural fire prevention and response (structures, machinery, woodlands), sustaining rural emergency response capability.
7. **Livestock handling and housing systems:** Enhanced ventilation systems/air quality, fire detection and suppression, human/animal behavior, livestock handling equipment, personal protective devices, sanitation, working surfaces, zoonotic diseases/long-term exposure.
8. **Public policy issues:** Economics of safety (cheap food policy), funding of safety initiatives, impact of increased enforcement of occupational safety and health regulations, liability issues (statute of limitations), licensing for particular practices (machinery operation, chemical and manure application and storage), risk acceptance/role of family, role of family members as employees, rural/urban interface issues (pesticides, water quality, public roadways, noise, dust), worker compensation benefits.
9. **Capital and management intensive vs. family labor intensive operations:** Computer-based vs. traditional forms of instruction, design of small-scale equipment, effective channels of delivery for target audiences, impact of legislative exemptions on application of OSHA standards, long-term effects of safety management practices on profitability, risks associated with sustainable agriculture, seasonal and migrant labor issues, upgrading older equipment to current safety standards, worker health care and disability benefits.
10. **Fire detection and suppression:** Chemical storage fires and cleanup, crop storage fires, electrical standards (National Fire Protection Association, local codes), emergency communication systems, extinguishing agents appropriate for agricultural settings, fire detection and monitoring systems, fire suppression systems for buildings and machinery, machinery and equipment fires, safer fuel storage and handling procedures, training of rural firefighters.
11. **Agricultural safety education and training:** Developing more effective operator manuals and instructions, development and testing of risk assessment tools, development of agricultural equipment operator testing strategies, evaluating effectiveness of unique safety education and training curriculum (literacy, cultural acceptance, clarity), evaluation of teaching methodologies, evaluation of the use of graphics and pictorials to communicate worker instructions and warnings, evaluation of computer-based and Web-based (broadband Internet access) delivery formats, meeting mandatory training and certification requirements, meeting the needs of special populations.
12. **Special population and enterprises:** Development and testing of culturally sensitive safety and health resources for groups such as Latinos and the Old-Order Anabaptists (Amish, Mennonite,

Hutterites), effects of aging on agricultural workplace safety, gender influences on worker safety, hazards of logging, fishing, specialty crops, and exotics, injuries to children and youth, low literacy issues, secondary injuries to persons with disabilities, unique safety and health needs of those in transition from migrant to permanent agricultural employment.

The complete report of National Land Grant Research and Extension Agenda for Agricultural Safety and Health – 2003 is available for review at: **http://tinyurl.com/NCR2003.**

Since completion of the original agenda, NCR 197 has addressed two of the priority areas in-depth resulting in the publication of two white papers. The first addressed operation of agricultural equipment on public roads (2009), and the second, agricultural confined spaces (2016).

The Agenda for Agricultural Safety and Health: A National Action Plan is 13 years old and in need of updating. As a first step in this process, a review of research and extension activity relating to the 12 priority areas was undertaken by identifying scholarly products produced related to the priority areas since the Agenda was published. Scholarly products are defined as

- peer-reviewed journal articles,
- technical conference papers, and
- educational products (safety fact sheets, videos, educational programs, training manuals, etc.)

This review, presented below, provides background and data to develop a new national agenda document to guide future efforts within the land grant system.

Review Methods

The primary motivation for this review was to discover the level of scholarly activity associated with the 12 research and extension priorities established by the NCR 197 committee, as well as identifying major contributors of research articles and extension education products. Agricultural safety and health is a relatively small field of professional practice, and major contributors and outlets for scholarly products are well known. For example, the majority of agricultural safety and health journal articles are published in the Journal of Agricultural Safety and Health (JASH) and the Journal of Agromedicine (JA). Technical papers are most often presented at the International Society of Agricultural Safety and Health (ISASH, formerly National Institute of Farm Safety) and the American Society of Agricultural and Biological Engineers (ASABE, formerly American Society of Agricultural Engineers). The majority of educational products are developed through the cooperative extension at land grant universities (includes 1862, 1890, and 1994 institutions), and through the Agricultural Safety and Health Centers (Ag Centers) funded by the National Institute of Occupational Safety and Health (NIOSH).

The scholarly product search was conducted between January and July, 2016. Scholarly products with publication dates of 2004 to 2015 were considered. All scholarly products reviewed were initially categorized as peer-reviewed journal articles, technical conference papers, or as an educational product. Table 1 shows a complete list of scholarly product sources included in this review.

Table 1. Scholarly Products Reviewed

Scholarly Product Type	Sources Searched
Peer-reviewed journal articles	Journal of Agricultural Safety and Health
	Journal of Agromedicine
	Journal of Rural Health
	American Journal of Industrial Medicine
	Transactions of ASAE/ASABE
	Applied Engineering in Agriculture
	Journal of Safety Research
	Ergonomics
	Applied Ergonomics
	American Journal of Public Health
	Journal of Occupational & Environmental Hygiene
	Traffic Injury Prevention
	Accident Analysis and Prevention
	Journal of Extension
	Journal of Agricultural Education
Technical conference papers	ISASH
	ASABE
Educational products	NASDONLINE (Documents, Videos)
	Land Grant Universities
	eXtension
	NIOSH Ag Centers

Peer-reviewed journal articles: The two primary journals that address agricultural safety and health are the Journal of Agricultural Safety and Health (JASH) and the Journal of Agromedicine (JA). All issues of JASH and JA between 2004 and 2015 were reviewed, while key words were used to search for relevant articles of additional journals known to periodically publish agricultural safety and health articles. For all journal articles, the title and abstract were used to determine if the manuscript was relevant to one or more of the 12 priority areas. If relevance to a priority area was in question, the entire paper was reviewed.

Technical conference papers: All safety and health technical papers of ISASH and ASABE were reviewed. For all technical papers, the title and abstract were used to determine if the manuscript was relevant to one or more of the 12 priority areas. If relevance to a priority area was in question, the entire paper was reviewed.

Educational products: All land grant university websites were searched for agricultural safety education products, as well as were the National Agricultural Safety Database (NASD), eXtension.org, and NIOSH Ag Center websites. A large majority of educational products on NASD and eXtension originate from land grant universities and/or Ag Centers but may also reside on the author's home website. All educational products were first sorted by institution, date and title. Educational products authored by non-land grant universities and non-Ag Centers were excluded in the final database. Only educational products which were available via a Web link were included for this review. Educational products without a publication date or without a working web link were excluded. Some educational products were available in foreign languages, primarily Spanish, and were included.

Corresponding institute: The corresponding author or the leading author (if corresponding author information was not available) was used to identify if the product was authored at a Land Grant University,

a NIOSH Ag Center, or by another institution or organization. Some NIOSH Ag Centers are located at land grant universities: University of California, Colorado State University, University of Kentucky, University of Minnesota, and University of Nebraska. If the corresponding/lead author was employed by neither a land grant institution nor an Ag Center, they were assigned to the 'Other' category. Peer-reviewed journal articles and technical papers with an international corresponding/lead author were excluded. Some land grant universities or Ag Centers used or linked to educational products produced by other institutions. For example 'Animal Handling Safety Considerations (University of Missouri)' or 'Grain Dusts and Other Farm Hazards (Pennsylvania State University)' are listed under Oklahoma State University's Farm Safety and Health resources. Only the original source of the educational product was included. The list was reviewed for duplicates and, if found, removed from the database. A complete list of inclusion and exclusion criteria is summarized in Table 2.

Table 2. Study Inclusion and Exclusion Criteria

Inclusion	Exclusion
• Study years: 2004-2015 • Articles published in journals listed in Table 1 • Scholarly products that fit one of the 12 priority areas • Educational products by Land Grant Universities, NASD, eXtension, and Ag Centers • Educational products that can be obtained via Web sources • ISASH and ASABE technical papers	• Scholarly products before 2004 and after 2015 • Scholarly products with no publication date • Scholarly products by the non-US lead authors • Scholarly products that focus on non-priority areas • Educational products by non-land grant, NASD, eXtension, and Ag Center organizations • Educational products which had non-working web links

Topics: To identify the subject matter of scholarly products that fell within a priority area, the reviewed products were categorized by the original 115 topics. However, the topics listed in the following summary do not match exactly the topics listed in the national agenda document. Rather, scholarly product keywords and subject matter content were used to identify the scholarly products as accurately as possible.

Classification Categories of Scholarly Products: The peer-reviewed journal articles were further classified as action research, case study, commentary/editorial, experimental, literature review, modelling, simulation, and survey studies. The categories identified by Carvalho et al. (2013) and Carnevalli and Miguel (2008) were used to categorize the journal articles. The educational products were grouped by the commonly recognized categories Apps, CD/DVD/Videos, printed materials, training program, and webpage/presentation files (PowerPoint).

Review Findings

Using the previously identified review criteria and sources, 1121 scholarly products were identified. Yearly distribution of the scholarly products are given in Figure 1. There is an increasing trend in the number of all identified products after 2010, especially in the number of educational products that showed a substantial increase in 2011, 2013, 2014, and 2015. The number of peer reviewed journal articles stayed relatively constant over the 12 year period, while the number of documented educational products increased over ten-fold. The number of presented technical conference papers remained relatively constant.

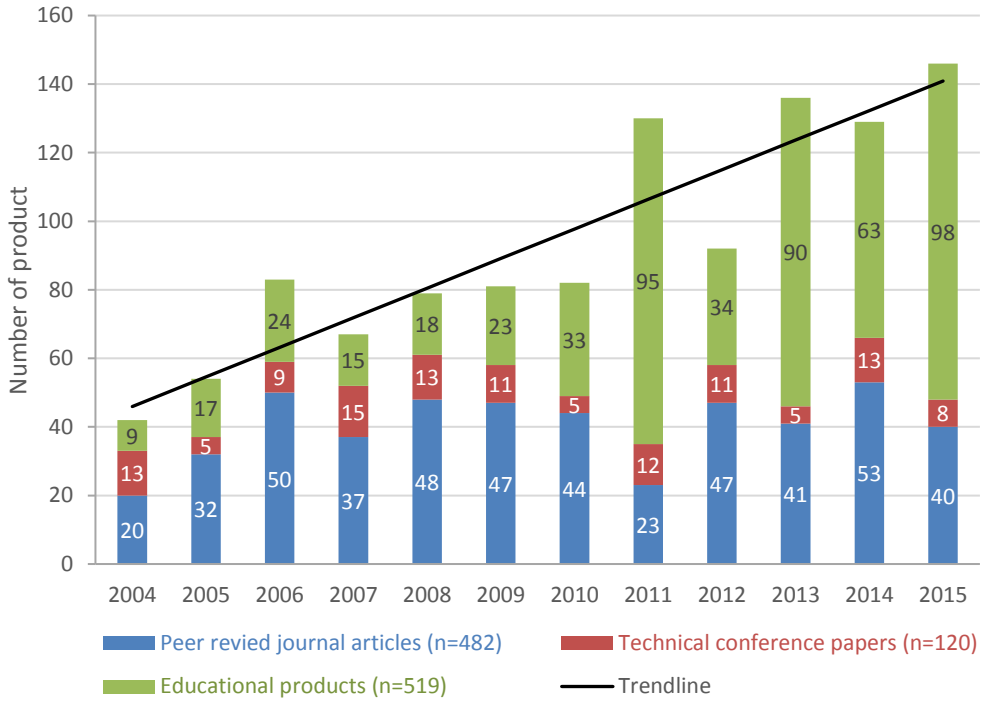


Figure 1. Yearly distribution of the document/products

The number of the scholarly products based on the loosely-defined 12-priority areas, corresponding sources, and type of scholarly products, are tabulated in Table 3.

Twice as many scholarly products addressed Special Populations and Enterprises (44.2%) as the next leading priority area, Human Factors Engineering and Design (23%). In the National Agenda (NCR 197), Special Populations and Enterprises was the last listed priority and Human Factors Engineering and Design was the 5th listed priority. Together, these two areas account for two-thirds of the scholarly products documented. The top two priorities, Sensors and Guarding Systems, and Operating Agricultural Equipment on Public Roads, accounted for only 6.4% of all scholarly products.

Table 3 also shows the types of scholarly products produced by source. Land grant only products accounted almost one-half (48%) of the scholarly products included in this review. This is partly because, for educational products, only land grant universities and Ag Centers websites were reviewed. A little over 60% of these scholarly products were educational with less than 25% peer-reviewed journal articles. While Ag Centers produced a little less than one-half of the scholarly products of land grant universities (22.3%), the distribution of scholarly products was not substantially different (32% journal articles; 66% educational products). When the corresponding/lead author was from a combined land grant and Ag Center institution, the percent produced of refereed articles was nearly 63% and educational products were just over 22%. Corresponding/lead authors categorized as 'Other' produced a significantly large portion of their products as journal articles as compared to educational products (91% vs. 9%).

Table 3. Number of Scholarly Product with Priority Areas and Corresponding Institute

Priority areas	Land Grant University	Ag Center	Ag Centers@ a Land Grant University*	Other	Total
Special population and enterprises	223	103	48	121	495 (44.2%)
Human factors engineering and design	117	61	30	45	253 (22.9%)
Livestock handling and housing systems	38	50	20	13	121 (10.8%)
Agricultural safety education and training	30	5	10	19	64 (5.7%)
Operating agricultural equipment on public roads	39	9	4	7	59 (5.3%)
Agricultural confined spaces	39	11	2	4	56 (5.1%)
Management of agricultural emergencies	27	6	2	1	36 (3.3%)
Sensors and guarding systems	10	0	1	1	12 (1.1%)
Public policy issues	1	4	3	4	12 (1.1%)
Emerging technologies	6	0	1	0	7 (0.6%)
Fire detection and suppression	4	1	0	0	5 (0.5%)
Capital and management intensive vs. family labor intensive operations	0	0	0	1	1 (0.1%)
Total	534 (47.6%)	250 (22.3%)	121 (10.8%)	216 (19.3%)	**1121 (100%)**
Scholarly product type					
Peer-reviewed journal articles	130 (24.3%)	80 (32.0%)	76 (62.8%)	196 (90.7%)	482 (43.0%)
Technical conference papers	77 (14.4%)	5 (2.0%)	18 (15.0%)	20 (9.0%)	120 (10.7%)
Educational products	327 (61.2%)	165 (66.0%)	27 (22.5%)	-	519 (46.3%)
Total	534 (47.6%)	250 (22.3%)	121 (10.8%)	216 (19.3%)	**1121 (100%)**

* Ag Centers may or may not have worked collaboratively with Cooperative Extension or other units at their Land Grant University.

Table 4 shows that almost 60% (287 of 482) of the all peer-reviewed journal articles identified were published in two journals: "Journal of Agromedicine" (JA) and "Journal of Agricultural Safety and Health" (JASH). This outcome may be partly due to the search being limited to all articles published in JA and JASH and only key word searches for all other journals. Over the study period, neither the number of peer-reviewed journal articles nor technical conference papers changed significantly by year. The number of educational products increased regularly. Interestingly, there were no educational products documented that were produced by Ag Centers located at land grant universities.

Table 4. Number of Scholarly Products per Source per Year

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Peer-Reviewed Journal Articles													
Journal of Agromedicine	0	10	15	3	15	16	19	7	24	11	22	16	158
JASH	10	9	12	18	17	12	6	7	8	7	13	10	129
Am. J. Ind. Med.	4	3	8	4	4	8	3	3	9	11	8	4	69
The Journal of Rural Health	0	2	5	2	1	3	2	0	1	2	1	0	19
Applied Ergonomics	2	1	2	2	0	0	4	0	1	1	1	0	14
Journal of Extension	1	0	2	1	2	1	2	0	1	3	0	0	13
Transactions of the ASABE	0	3	1	3	1	2	0	1	0	0	0	0	11
J of Safety Research	2	1	0	0	2	1	2	0	0	0	2	0	10
American J of Public Health	0	1	1	1	0	0	0	1	0	0	0	2	6
Ergonomics	0	1	0	0	2	1	1	0	0	0	0	1	6
J of Occ& Env Hygiene	0	1	1	1	0	0	1	0	1	0	0	1	6
Accident Analysis & Prevention	0	0	0	0	1	1	2	0	0	0	1	0	5
Traffic Injury Prevention	0	0	0	0	0	1	0	1	0	1	1	0	4
Others	1	0	3	2	3	1	2	3	2	5	4	6	32
Total	20	32	50	37	48	47	44	23	47	41	53	40	482
Technical Conference Papers													
ASABE	1	2	5	5	3	2	2	5	5	3	6	3	42
ISASH	12	3	4	10	10	9	3	7	6	2	7	5	78
Total	13	5	9	15	13	11	5	12	11	5	13	8	120
Educational Products													
Land Grant Universities	6	17	22	11	11	15	31	59	21	52	32	50	327
Ag Centers	2	0	2	4	4	4	1	35	9	32	28	44	165
Ag Centers@ a Land Grant University*	1	0	0	0	3	4	1	1	4	6	3	4	27
Total	9	17	24	15	18	23	33	95	34	90	63	98	519

* Ag Centers may or may not have worked collaboratively with Cooperative Extension or other units at their Land Grant University.

Table 5 shows how the originally ranked priority areas are re-ranked based on the number of the scholarly products identified and reviewed.

Table 5. Original and New Ranks of the Priority Areas

NCR-197 rank	Priority Areas	New rank
#1	Sensors and guarding systems	#8
#2	Operating agricultural equipment on public roads	#5
#3	Agricultural confined spaces	#6
#4	Emerging technologies	#10
#5	Human factors engineering and design	#2
#6	Management of agricultural emergencies	#7
#7	Livestock handling and housing systems	#3
#8	Public policy issues	#9
#9	Capital and management intensive vs. family labor intensive operations	#12
#10	Fire detection and suppression	#11
#11	Agricultural safety education and training	#4
#12	Special population and enterprises	#1

A national map of the distribution of the scholarly products by state is shown in Figure 2. As can be seen from the map, the highest number of the scholarly products over the study period were produced in the states of Pennsylvania (102), Ohio (97), Indiana (90), and Iowa (85). These states represent land grant instutitions that continue to support full-time agricultural safety and health extension positions on their faculty.

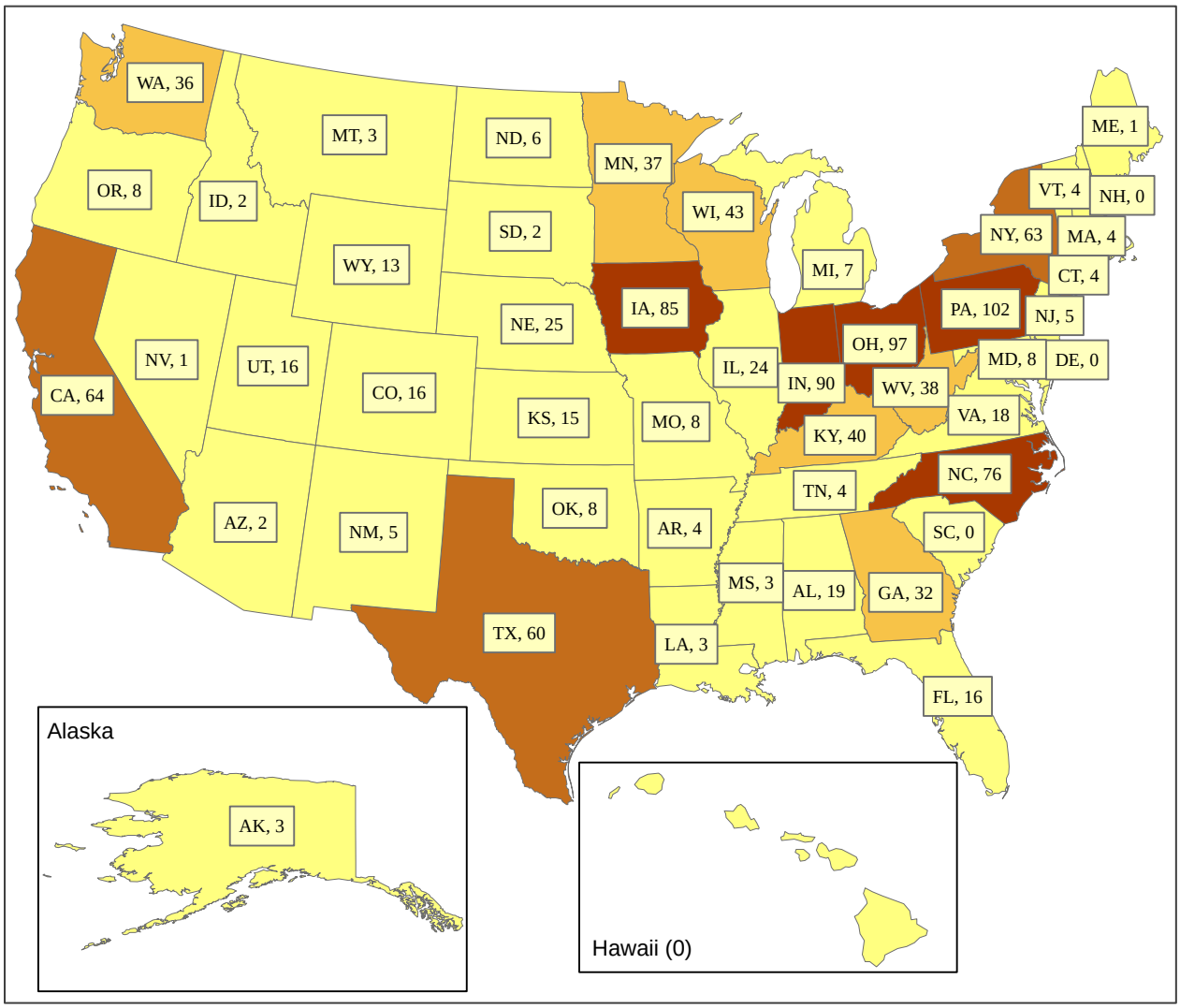


Figure 2. Number of scholarly products per state

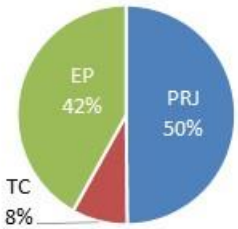
Priority Areas with Topics

The 12 priority areas with abridged topic titles represented by the scholarly products documented are shown in Table 6 by total scholarly products produced. Results show that scholarly products relating to Hispanic/Latinos and Children/Youth represented the most of any topic area. Topics relating to Environmental Conditions and Livestock Handling were also well represented. This analysis also shows that some priority areas were dominated by a specific type of scholarly product. For example, under Priority 6, Management of Agricultural Emergencies, almost 75% of the scholarly products were educational products.

Table 6. Priority Areas with Topics and Scholarly Product Type

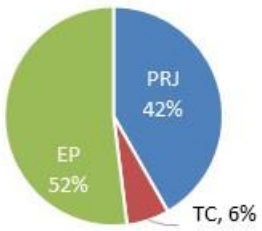
#12 Special Population and Enterprises

Topics	Number
Anabaptist	12
Children/Youth	133
Disability	63
Ethnicity	1
Fishing	20
Forestry, Logging	28
Hispanic/Latino	135
Immigrant	56
Indigenous Populations	3
Native Americans	3
Racial Minority	9
Seniors/Older Farmers	11
Special Enterprises	13
Women	8
Total	**495**



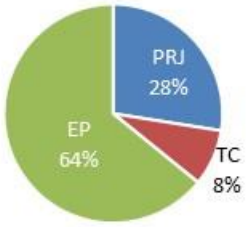
#5 Human Factors Engineering and Design

Topics	Number
Aging	6
Anthropometry	7
Arthritis/Osteoarthritis	21
Environmental Conditions	102
Ergonomics	26
Gender	1
Human Behavior	13
Musculoskeletal Disorders	43
Risk Perception	13
Secondary Injury	2
Shift Work	1
Stress and Behavior Management	18
Total	**254**



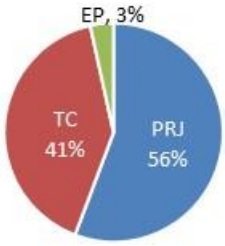
#7 Livestock Handling and Housing Systems

Topics	Number
Accident Prevention	8
Air Quality	6
Beef Cattle Farms	1
Dairy Safety	7
Dust, Air Contaminants Control	3
Housing/ Structures	2
Infectious/Parasitic Diseases	2
Injuries	17
Livestock Handling	57
Milking	3
Sanitation/Screening	3
Ventilation	7
Zoonotic Diseases/ Long-term Exposure	5
Total	**121**



#11 Agricultural Safety Education and Training

Topics	Number
Child/Youth Safety	7
Computer/Web based Training	1
Confined Spaces	1
Evaluation of Teaching/ Training Methodologies	24
Migrant & Seasonal Workers	2
Safe Tractor/ Machinery Operation	6
Safety Training	14
Teaching Safety	8
Tractor Overturns	1
Total	**64**

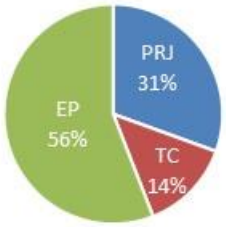


*PRJ: Peer Reviewed Journal Articles, TC: Technical Conference Papers, EP: Educational Products

Table 6. Priority Areas with Topics and Scholarly Product Type continued.

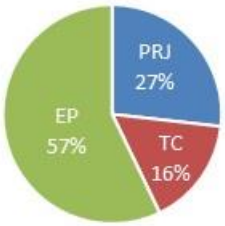
#2 Operating Agricultural Equipment on Public Roads

Topics	Number
Agricultural Equipment Collision	9
ATV/UTV	5
Agricultural Equipment Transport	16
Farm Trucks	1
Horse Drawn Equipment	7
Licensing of Operators	3
Lighting/Marking/Reflector/SMV	17
Rural Roadways	1
Total	**59**



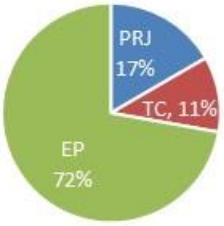
#3 Agricultural Confined Spaces

Topics	Number
Equipment	1
Grain bins	15
Grain handling	5
Injuries/Fatalities	7
Manure pit safety	5
Respiratory hazards	8
Safety Assessments	7
Toxic Gas Monitoring	1
Ventilation	7
Total	**56**



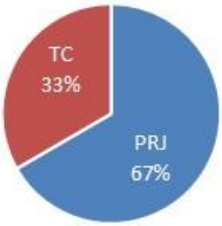
#6 Management of Agricultural Emergencies

Topics	Number
Agro-terrorism	1
Bioterrorism	1
Decontamination	1
Disasters	1
Emergency Notification Systems	3
Emergency Preparedness	5
Emergency Response	14
Entrapment/Entanglements	7
Fire Prevention and Response	2
Rural Communication	1
Total	**36**



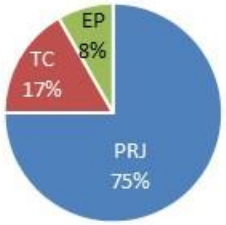
#1 Sensors and Guarding Systems

Topics	Number
Agricultural Safety Sensor	6
Autonomous Vehicles	1
Entanglement Prevention Technology	2
Interlock and Lockout Systems	1
Obstacle Detection	2
Total	**12**



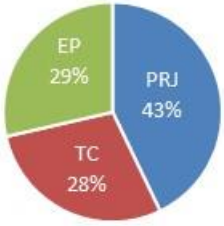
#8 Public Policy Issues

Topics	Number
Agricultural Safety Interventions	3
Child Labor Regulations	3
Hazardous Occupations	1
Retrofitting	2
Worker Compensation	2
Worker Health and Safety	1
Total	**12**



#4 Emerging Technologies

Topics	Number
Engineering Solutions	1
ROPS	1
Warning and Alerting Sensors	5
Total	**7**



#10 Fire Detection and Suppression

Topics	Number
Fire Detection and Monitoring Systems	1
Fire Prevention	4
Total	**5**

#9 Capital and Management Intensive vs. Family Labor Intensive Operations

Topics	Number
Risk Management	1
Total	**1**

PRJ: Peer Reviewed Journal Articles, TC: Technical Conference Papers, EP: Educational Products

Classification Categories of Scholarly Products

Table 7 provides the categorization of peer-reviewed journal articles and educational products. Fifty-five percent of the peer reviewed journal articles were classified as survey types of articles, that is, the article was the collection of information concerning one or more target populations, hazards, practices, knowledge, etc. Experimental studies, which were 19.3% of the journal articles, were studies in which a treatment, procedure, or a program was intentionally introduced and a result or outcome was observed. Literature reviews, 12.4% of the reviewed journal articles, were generally evaluative reports of information found in the literature relating to a specific topic, issue or area of study. Action research, 4.1% of the reviewed publications, involves actively participating in a change situation while simultaneously conducting research. An example of this category is conducting research about changes in safety knowledge or behavior via participating in farm safety day camps.

Educational products were produced mostly as printed materials (59%) and CD/DVD/videos (36%).

Table 7. Scholarly Product Types by Classification Category

Scholarly Product Type		Number	Percentage
Peer-Reviewed Journal Articles (n=482)	Action research	20	4.1%
	Case study	10	2.1%
	Commentary/Editorial	16	3.3%
	Experimental	93	19.3%
	Literature review	60	12.4%
	Modelling	11	2.3%
	Simulation	7	1.5%
	Survey	265	55.0%
Educational Product	Apps	2	0.4%
	CD/DVD/Videos	189	36.4%
	Printed materials	308	59.3%
	Training program	4	0.8%
	Webpage/Power points	16	3.1%

Scholarly Products in Foreign Languages

The language of scholarly products within the priority areas was also entered into the database. As expected, all peer-reviewed journal articles were available in English only. But 23% of educational products were available in languages besides English. Table 8 shows number of educational products in different languages.

Table 8. Language of the Educational Products

Language	Number
English only	401
English and Spanish	58
English and Spanish and French	1
Spanish	58
French	1
Total	519

Summary

The purpose of this review is to provide background data to develop a new national agenda. Scholarly products consisting of peer reviewed journal articles, technical conference papers, and educational products produced between 2004-2015 were identified and reviewed. A total 1121 scholarly products were documented and an increasing trend was observed in the number of scholarly products over the years. Based on the number of the scholarly products produced, the priority area of 'Special Population and Enterprises' was identified as the priority area with the most products produced.

Scholarly products were produced mostly by land grant universities. Two major agricultural safety and health journals (Journal of Agromedicine and Journal of Agricultural Safety and Health) published almost 60% of the all peer-reviewed journal articles identified over the study period. A national map created to show the distribution of the scholarly products by state show that the highest numbers were produced in states with active extension safety specialist faculty.

The majority of the peer-review articles were categorized as survey type of articles and educational materials were produced mostly as printed materials. Some educational products were produced in different languages (Spanish and French).

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APPENDIX

SUMMARY REPORT

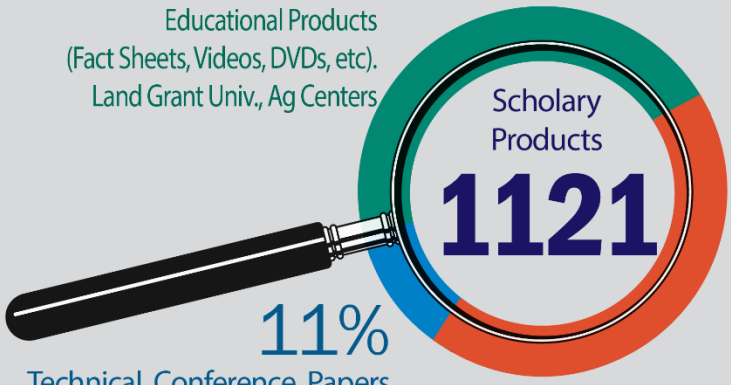
A Review of the National Research & Extension Agenda for Agricultural Safety & Health

2003 *National Agenda for Action*
Developed by NCR-197 Committee

PRIORITY AREAS

1. Sensors and guarding systems
2. Operating agricultural equipment on public roads
3. Agricultural confined spaces
4. Emerging technologies
5. Human factors engineering and design
6. Management of agricultural emergencies
7. Livestock handling and housing systems
8. Public policy issues
9. Capital and management intensive vs. family labor intensive operations
10. Fire detection and suppression
11. Agricultural safety education and training
12. Special population and enterprises

(2004-2015)

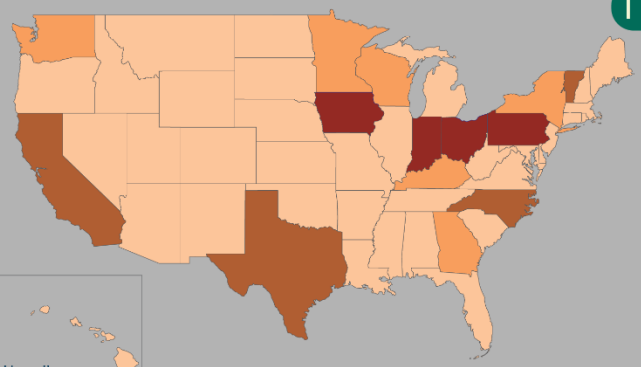


46%
Educational Products
(Fact Sheets, Videos, DVDs, etc).
Land Grant Univ., Ag Centers

11%
Technical Conference Papers
ASABE, ISASH

43%
Peer-reviewed Journal Articles
Journal of Agromedicine
Journal of Agricultural Safety & Health
…

Scholarly Products 2004 - 2015



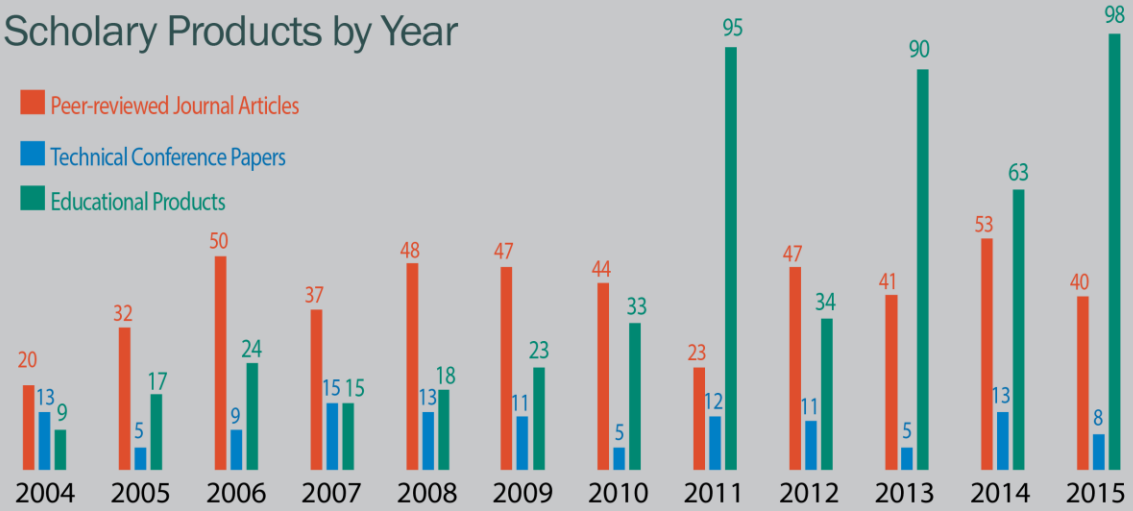
Low 0-25 26-50 51-75 ≥76 High

Scholarly Products by State

44% 1 Special population and enterprises
23% 2 Human factors engineering and design
11% 3 Livestock handling and housing systems
6% 4 Agricultural safety education and training
5% 5 Operating agricultural equipment on public roads
5% 6 Agricultural confined spaces

5%
7 Management of agricultural emergencies
8 Sensors and guarding systems
9 Public policy issues
10 Emerging technologies
11 Fire detection and suppression
12 Capital and management intensive vs. family labor intensive operations

Scholary Products by Year



Topics Contributing to Most Worked on Priority Areas

Special population and enterprises
- Hispanic/Latino
- Children/Youth
- Disability
- Immigrant

Human factors engineering and design
- Environmental Conditions
- Muscoloskeletal Disorders
- Ergonomics
- Arthritis/Osteoarthritis

Livestock handling and housing systems
- Livestock Handling
- Injuries
- Accident Prevention
- Ventilation

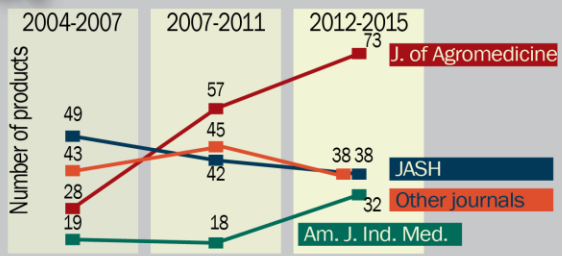
Agricultural safety education and training
- Evaluation of Teaching/Training Meth.
- Safety Training
- Teaching Safety
- Child/Youth Safety

Operating agricultural equipment on public roads
- Lighting/Marking/Reflector/SMV
- Ag Equipment Transport
- Ag Equipment Collision
- ATV/UTV

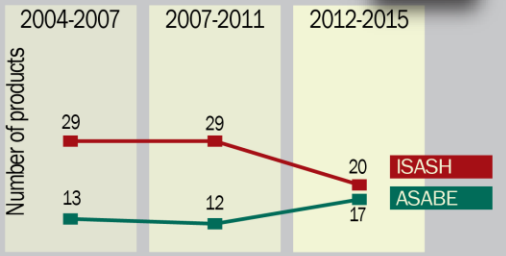
Agricultural confined spaces
- Grain Bins
- Respiratory Hazards
- Safety Assessments
- Injuries/Fatalities

Scholarly Products by Source

Peer-reviewed Journal Articles



Technical Conference Papers



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