

**DRAFT
Version 2**

**NIOSH RECOMMENDATIONS
for
REVISION OF HAZARDOUS ORDERS**

**Agricultural Hazardous Order No. 1
Operating a Tractor Over 20 PTO Horsepower or
Connecting or Disconnecting an Implement or Any of Its
Parts To or From Such a Tractor**

**Cost Benefit Analysis
by
SiloSmashers, Inc.
for
Wage and Hour Division
ESA/DOL**

NOVEMBER 1, 2004

TABLE OF CONTENTS

1.	INTRODUCTION	3
2.	ASSUMPTIONS AND LIMITATIONS	4
3.	METHODOLOGY	4
4.	LITERATURE REVIEW	5
4.1	Review of Illnesses, Injuries, and Fatalities.....	5
4.2	Tractor Usage in the Agriculture Industry	7
4.3	Rollover Protective Structures (ROPS)	8
5.	DATA ANALYSIS AND INTEPRETATION.....	8
5.1	Estimated Number of Youth Affected	9
6.	STATE LABOR LAWS	10
7.	IMPACT ON SMALL AND FAMILY-OWNED BUSINESSES	10
8.	FEASBILITY OF IMPLEMENTATION.....	10
9.	EVALUATION OF COSTS AND BENEFITS.....	11
9.1	Quantitative.....	11
9.1.1	Methodology	11
9.1.2	Assumptions and Constraints (Specific to the Quantitative Analysis).....	12
9.1.3	Results.....	12
9.2	Qualitative.....	14
10.	SENSITIVITY ANALYSIS	15
11.	SUMMARY AND CONCLUSIONS	16
	APPENDIX 1: TRACTOR USAGE DATA.....	18

APPENDIX 2: SUMMARY BY NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM: 2002.....	19
APPENDIX 3: DETAILS OF THE CALCULATION OF COSTS AND BENEFITS.....	20
APPENDIX 4: NET PRESENT VALUE (NPV) CALCULATIONS.....	22
APPENDIX 5: QUALITATIVE COSTS AND BENEFITS	26
APPENDIX 6: ANALYSIS OF STATE CHILD LABOR LAWS	27
REFERENCES	31

1. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) report on recommended changes to child labor Hazardous Orders (HOs) proposes revising the current HO regarding minors operating tractors in the agriculture industry. [NIOSH, 2002] Specifically, the NIOSH recommendation includes the following:

No.	Recommendation	Rationale
1	Retain the HO with the removal of the 20 PTO (power take-off) horsepower thresholds.	Available data sources frequently do not include enough detail to determine the horsepower of tractors or PTOs involved in accidents. Additionally, PTO horsepower differs from tractor engine horsepower and may be difficult to identify by Wage and Hour inspectors, employers, supervisors, and youth workers. Furthermore, available data do not support the notion that a tractor's horsepower (engine or PTO) is related to risk of injury.
2	Revise exemption for 14- and 15-year-olds with tractor certification to require tractors to be equipped with a rollover protective structure (ROPS) and mandate the use of seatbelts.	A ROPS, when used in conjunction with a seatbelt, is the most important safety feature on a tractor in reducing the number of deaths from overturns. The engineering safety measure, in addition to tractor safety training and mandated seatbelt use, should be an effective means of preventing a substantial number of tractor-related injuries and fatalities among young workers.

The current HO is applicable to youths under the age of 16; however, an exemption for 14- and 15-year-olds exists provided they successfully complete the 4-H Federal Extension training program regarding tractor operations. In addition, the NIOSH recommendation for existing HO 7 concerning motor vehicle operations suggests moving the portion of the HO concerning youths riding on tractors as passengers under HO 1. Because such a recommendation does not involve any substantive change to the HO, however, no economic benefit or cost will be derived from implementing such a recommendation

The objective of the cost benefit analysis, therefore, is to more thoroughly analyze the NIOSH recommendation to update the current HO regarding youths operating tractors within the agricultural industry, including the rationale behind the recommendation, to estimate likely costs and benefits associated with implementation, and to evaluate the impact of implementation among the various stakeholders. Finally, this analysis is intended to be a non-budgetary tool and is based on certain assumptions and predictions of costs over time. As a result, dollar estimates are subject to change given changes in both the underlying assumptions and costs and benefit estimates.

2. ASSUMPTIONS AND LIMITATIONS

The following are the general assumptions and constraints that were made for the overall analysis.

1. Data regarding the number of youths employed is based on the NIOSH/National Agricultural Statistics Service (NASS) Childhood Agricultural Injury Survey estimate of 84,570 hired youth workers under the age of 16 (excluding family).
2. Industry will fully implement and comply with the HO, if adopted. Fines and other penalties imposed by the WHD will have a net effect (cost to industry/benefit to government) as a result.
3. The count for injuries and illnesses are separate and mutually exclusive, with each based on a separate incident.
4. Data collected regarding the number of fatalities and injuries/illnesses are exclusive of September 11, 2001 data.
5. Implementation of a new HO will have a direct impact on the number of deaths, injuries, and illnesses and will reduce the rate to zero for the age group under consideration.
6. Costs associated with implementation by the industry will be passed along in the form of higher prices to consumers. There will not be an adverse effect on the size of the industry due to adoption of the HO.
7. State adoption of the HO will occur via an expedited rule adoption process and will not include a lengthy analysis and comment period.
8. Multiplier effects to the economy are not included in the analyses. For example, any increase in prices as a result of industry implementation of the HO will be offset by a decrease in workers' compensation premiums via taxes collected by a state to fund the workers' compensation program. Also, tax savings as a result of the expense incurred to retrofit tractors with ROPS safety devices is not estimated and is also considered a multiplier effect.
9. The analysis is limited to the impact to the industry as a whole and does not measure the economic impact to any particular region.
10. Any implementation costs associated with translation of the HO into multilingual formats are considered to be sunk costs and not considered. This assumption is based on Executive Order 13166, which established mandatory accessibility to government services for individuals with limited English proficient.

3. METHODOLOGY

The following overall approach was used in conducting the cost benefit analysis for this HO:

-
- A. The literature was reviewed and facts and information collected to study tractor usage within the agricultural industry, employment trends, safety and health issues, and economic factors.
 - B. Facts and information were collected and analyzed with regard to fatalities, injuries, and illnesses within the agriculture industry.
 - C. Other factors regarding implementation of the HO were examined, including those associated with the feasibility of implementing the HO, the impact to small and family-owned businesses, and the possible cause-and-effect relationships.
 - D. Quantitative costs and benefits were developed based on the Office of Management and Budget (OMB) guidelines, and in particular, Circular A-4 guidelines. Methodology specific to the quantitative assessment is described further in Section 9.1.1.
 - E. Qualitative costs and benefits (those costs and benefits that are non-quantifiable and/or immeasurable within the scope of this analysis) were determined based on the literature review and information gathering process.
 - F. The relevant stakeholders for the analysis were considered to be the individuals (youth workforce), industry, and government (federal and state). The analysis focused on costs and benefits to each of these stakeholders independently.
 - G. Sensitivity analyses were conducted on those assumptions and variables considered to be the most uncertain to determine the impact of the changes on the overall quantitative results.

4. LITERATURE REVIEW

4.1 Review of Injuries, Illnesses, and Fatalities

Following are statistics regarding occupational injuries, illnesses, and fatalities regarding tractor injuries and fatalities and form the basis for estimating the costs and benefits of HO implementation:

- ? During the period 1992 to 1997, there were a total of 1,421 tractor-related fatalities that occurred to workers of all ages. Nine of the fatalities involved youths aged 14 to 15. [NIOSH; 2002]
- ? There were a total of 162 youth fatalities in the agriculture industry from 1992 to 1997. More than half were transportation-related, and 51 involved tractors. Of the 51 tractor-related fatalities, 38 involved the youth operating the tractor, and 7 of the 38 involved youths under the age of 16 operating the tractor on public roads. Approximately 67 percent of all tractor-related fatalities occurred on the family farm. [Windau J, Sygnatur E, Toscano G; 1999]

-
- ? A review of the Census of Fatal Occupational Injuries (CFOI) data for the period 1997 to 2002 showed a total of 29 fatalities in the age group “< 16” (or an average of 4.83 per year) as a result of source code 853—Tractor. No fatalities were recorded under source code 3123—Mowers, tractors. The data did not provide the youth activity at the time of the fatality (i.e., operator or passenger), nor was the location of the fatality (i.e., highway or off-highway) specified. [CFOI, 2004]
 - ? A review of Bureau of Labor Statistics (BLS) data regarding agricultural injuries as a result of the source “tractors” showed a total of 4,563 injuries over the 10-year period 1992 to 2001. There were an additional 217 injuries related to the source “mowers—tractor” between 1992 and 1995, and 2000. [BLS; 2004]
 - ? Over the six-year period 1996 to 2001, there were less than 3 injuries occurring in the age group 14 to 15 years under both source codes 853—Tractor and 3132—Mowers, tractors. In total, 908 injuries occurred to youths aged 14 and 15 from all sources during the same period. [BLS, 2004]
 - ? According to the National Children’s Center for Rural and Agricultural Health and Safety, the majority of all agricultural-related injuries in youths occur to those who are part of the farm household (15.7 injuries per 1,000 youth). Farm machinery, including tractors, accounts for 36 percent of all fatalities to youths less than 20 years of age. [NCC RAHS; 2003]
 - ? In 2001, there were 724 tractor-related injuries that occurred to youths under the age of 16. Roughly half (334) were “working” tractor injuries, while 390 were “non-working” tractor injuries. [NIOSH/NASS Childhood Agricultural Injury Survey; 2004]
 - ? The median number of Days Away From Work (DAFW) for all age groups attributed to the source “tractor” averaged 11.5 over the 10-year period 1992 to 2001. DAFW attributed to the source “mowers, tractors” averaged 7.1 days for over the same period. [BLS, 2004]
 - ? A review of the Occupational Safety and Health Administration (OSHA) accident database revealed four fatalities in the five-year period 1999 to 2004 involving tractors in agricultural industries. None, however, involved minors. For the period 1995 to 1999, there were 73 accidents involving tractors, 54 of which involved fatalities. One fatality occurred to a minor, aged 16, in 1997. [OSHA, 2004]
 - ? Agricultural injuries account for a significant proportion of occupational long-term disabilities among workers of all ages. Significant long-term disability occurred in 41 percent of farm-related injuries in a Minnesota emergency department. In New York State, permanent disability exceeded temporary disability by a ratio of 1.17:1 in the agriculture industry. [Pediatrics, Vol. 118, No. 4, October 2001]

-
- ? A search of the NIOSH Fatality Assessment and Control Evaluation (FACE) program's database showed five fatalities all involving minor workers related to tractor accidents. Of the five fatalities, two involved 16-year-olds. Details of the three involving minors less than age 16 are as follows:
- In 1995, a 12-year-old employed part-time for a farmer was killed when the tractor he was operating overturned. The tractor was approximately 10 years old and was not equipped with a ROPS or seatbelt.
 - In 2000, a 15-year-old working part-time on a family-owned dairy farm was killed when the tractor he was operating overturned in a manure pit. A passenger riding with the operator was not injured. The tractor involved exceeded the 20 PTO horsepower limit in place under current regulations.
 - In 2003, a 14-year-old helping his grandfather clear farmland was killed when the tractor he was operating rolled over backwards. The tractor was equipped with a self-made, versus factory-installed, ROPS. [NIOSH FACEWeb, 2004]
- ? In 1994, the Kentucky FACE project recorded a fatality for a 15-year-old who was killed while working at his summer job plowing tobacco as a result of a tractor rollover. [MMWR; 1995]
- ? Based on data collected by the Regional Rural Injury Study-I (RRIS-I), a five state, population-based study conducted in Minnesota, Wisconsin, North Dakota, South Dakota, and Nebraska over two, six-month periods in 1990, 83 percent of 77 farming-related injuries to youths aged 0 to 19 required professional medical care, and 34 percent resulted in restrictions from regular activity for one week or more. In addition, increased rate ratios were related to operating tractors. [Gerberich SG, Gibson RW, French LR, Renier CM, Lee TY, Cart WP, Schutske J; 2001] The risk ratio for youth workers operating tractors was 2.2 with a confidence interval of 1.60 to 3.02. [Hard DL; Myers JR; Gerberich SG; 2001]
- ? In 1995, the frequency rate for tractor-related lost-time injuries for workers less than 20 years of age was 2573.9. For family workers, however, the frequency was 6122.5, while the frequency for hired workers was 1779.9. [Myers JR; 2001]
- ? In a study conducted over a nine-year period via a retrospective chart review of 96 hospitalized pediatric patients in Ohio, 14 of the injuries were a result of a tractor-related accident. Tractor injuries accounted for approximately 38 percent of all farm machinery-related injuries included in the study. [Smith GA; Scherzer DJ; Buckley JW; Haley KJ; Shields BJ; 2004]
- ? When compared with all other industries, farm workers' insurance claims for youths aged 13 or younger accounted for 50 percent of all severe injury claims. [Kidd P, Townley K, Cole H, McKnight R, Piercy L; 1997]

4.2 Tractor Usage in the Agricultural Industry

In terms of tractor usage, in 2002 there were 4,592,545 tractors operated on an estimated 1,901,787 farms. Over half (56.5 percent) of these farms owned two or more tractors. The majority of these tractors (4,157,327, or 90.5 percent) were manufactured prior to 1998. [USDA, NASS; 2004] In terms of tractor horsepower, however, data collected is aggregated at the less than- and over-40 PTO horsepower level; although this data reveals the largest proportion of tractor usage on farms as below a 40-horsepower threshold, the impact of this HO amendment can only be loosely extrapolated from such data. (See Appendix 1 for specific data.) Tractors are used in both crop-producing as well as livestock-producing farming operations and are used for a variety of purposes depending on the type of implements attached. To maintain adaptability and flexibility, tractors have a higher center of gravity than most other vehicles, which also increases the likelihood of rollovers. [Murphy DJ; 2002] The use of ROPS, in combination with seat belts, is the most important safety devices to prevent or minimize fatalities as a result of tractor overturns. [Murphy DJ; 2002]

4.3 Rollover Protective Structures (ROPS)

Currently, an OSHA standard (29 C.F.R. §1928.51) regulates ROPS on farm tractors, requiring all tractors (with some exceptions) greater than 20 horsepower and manufactured after October 25, 1976 be equipped with ROPS safety features. Tractors manufactured prior to the 1976 date were determined to be not suitable for ROPS because of design and engineering differences and requirement of ROPS, therefore, would represent an economic hardship to owners. In addition, OSHA standard are not applicable to farms employing less than 10 workers.

Since 1985, ROPS and safety belts are routinely installed on all new tractors produced in the United States as a voluntary effort on the part of tractor manufacturers. [MMWR; 1993] In 1993, it was estimated that more than half of all tractors in the U.S. were equipped with ROPS; of the tractors not equipped with ROPS, approximately 61 percent were manufactured prior to 1971. [MMWR; 1993] A subsequent study, conducted in four states from 1992 to 1997 by the Farm Family Health and Hazard Surveillance (FFHHS) program, found that 80 to 90 percent of tractors were manufactured prior to 1985 (over 55 percent manufactured prior to 1975) with less than 40 percent equipped with ROPS (an average of 18.3 percent of tractors manufactured prior to 1975 were equipped with ROPS). [MMWR; 1997] A later study that examined the age, size, and ROPS utilization in farm tractors in both the U.S. and Canada found that 36.7 percent of the youths surveyed operated a tractor, and the majority of tractors were between 20 and 70 horsepower and manufactured after 1970, with nearly 50 percent equipped with ROPS. [Marlenga B, Pickett W, Berg RL, Murphy D; 2004] The cost of retrofitting older tractors for ROPS varies between \$676 and \$903 (2002 dollars), including three hours of installation time and shipping cost. [Tevis C.; 2002]]

5. DATA ANALYSIS AND INTERPRETATION

The NIOSH recommendation for a revision to the current HO prohibiting youths from operating tractors over 20 PTO horsepower is based primarily on the fact that tractor-related fatalities have been the leading source of agricultural-related fatalities in the U.S. for years. The proposed

amendment is two-fold: 1) removing the > 20 PTO horsepower exemption; and 2) amending the current exemption for 14 and 15-year-olds to require tractors be equipped with ROPS and seatbelts.

The impact of removal of the PTO horsepower exemption is somewhat difficult to determine based on limited data regarding tractor horsepower above and below 20 PTO. Although technically classifiable as motor vehicles, farm tractors are exempt from motor vehicle registration requirements in certain U.S. states, further limiting data collection. In addition, the majority of the fatality and injury data are not specific as to the horsepower of the involved tractor, nor are there specific source codes based on horsepower criteria. The benefit of removal of the exemption, therefore, is to the youth population under the age of 14; current state labor laws with regard to this population vary, however. The likely impact on this age group is difficult to ascertain, however, given the tendency to underreport injuries and fatalities within the industry.

In terms of data availability, there are several sources and a substantial amount of data available from which to determine fatality and injury rates. The methodologies employed in collecting the data, however, vary among the sources, which convolutes the determination of the most accurate number of youths injured each year. For example, tractors can be classified as motor vehicles (on-highway or off-highway) as well as farm machinery, and the classification of the source as “tractor” does not imply that the youth injured was necessarily the operator. Moreover, the scope of the HO is applicable for youth workers under the age of 16, an age group that is typically not segregated in data collection efforts. Finally, because of the large number of family-owned farms, most of the data sources do not segregate hired workers from those who are working for their own family farm. The lack and accuracy of data regarding youth injuries and fatalities has been documented in literature sources for more than a decade.

In view of the above, and in an attempt to most accurately estimate the extent of fatalities and injuries that occur annually to youth workers under the age of 16, an annual fatality rate based on 38 youth fatalities over a six-year period (12.54 of which are assumed to have occurred on non-family-owned farms) equates to an average of 2.09 fatalities annually. An injury rate of 334 per year is based on the 2001 NIOSH/NASS Childhood Agricultural Survey represents a conservative injury rate of 2.2 percent of the under age 16 population operating tractors. Finally, although implementation of this HO amendment may have the residual effect of reducing or eliminating fatalities and injuries in youth workers under the age of 16 who work on family-owned farms, the quantitative aspect of this benefit is difficult to measure and is thus reflected as in the qualitative analysis.

5.1 Estimated Number of Affected Youth

Data regarding the number of hired youth under the age of 16 is varied, in part because of the seasonal nature of the work and extent of family-owned farms. Moreover, the types and nature of work performed in agricultural settings is much more diverse than in other industries with relatively few occupational classifications, especially in the subject population. Based on the 2004 NIOSH/NASS Childhood Agricultural Injury Survey, there were an estimated 166,117

youths under the age of 16 employed on farms during 2001. Of this figure, approximately 19,853 operated a tractor, and 14,979 of these youths were aged 14 and 15.

6. STATE LABOR LAWS

In reviewing the current state child labor laws with regard to minors operating tractors within the agriculture industry and in comparison to NIOSH's proposed HO amendment, it appears that many of the states have adopted child labor laws that mirror federal regulations. However, 17 states specifically exempt agriculture employment from general child labor laws or have no HOs specific to the agricultural industry. Moreover, while the majority of states' agricultural laws mirror the federal practice of limiting or restricting employment to minors under the age of 16, several states apply agricultural regulations to minors under the age of 18. A few states, however, specify a minimum age to work in agriculture-related occupations below the age 14 threshold specified in federal regulations. Specifically in terms of child labor laws regarding tractor operations, none of the states have implemented laws similar to the proposed NIOSH recommendation or that are more stringent than current federal regulations. Appendix 3 provides a synopsis of state child labor laws as relates to the agricultural industry.

7. IMPACT ON SMALL AND FAMILY-OWNED BUSINESSES

Within the agricultural industry and pursuant to 29 C.F.R. §570.70, HOs are not applicable to youths working on farms operated by their own parents, or on farms operated by persons standing in place of their parents. In 2002, there were a total of 2,128,982 farms in the United States, 1,909,598 (89.7 percent) of which were individually- or family-owned. An additional 129,593 (6.1 percent) were partnerships and 73,752 (3.5 percent) were corporate-owned. Of the corporate-owned farms, 66,667 were family-held corporations. The average size of the farms was 426 acres for individually- or family-owned farms, 1,130 acres for partnerships, and 1,469 acres for corporations. [USDA, NASS, Census of Agriculture; 2002] Based on these figures, it is estimated that implementation of this HO amendment will have minimal impact on a significant number of businesses within the industry. Appendix 2 provides additional detail as to the number of farms, broken down by NAICS code, including acreage (aggregate and average).

8. FEASIBILITY OF IMPLEMENTATION

Based primarily on anecdotal versus statistical information regarding the age of tractors used in agricultural operations, it appears that there may be a significant number of older tractor currently in use that are not equipped with ROPS and seatbelt protection. The feasibility and cost of retrofitting such models to meet the proposed regulations may continue to represent an economic burden to some farm owners as was the case when the ROPS tractor initiative was introduced by OSHA in the 1970's. Moreover, while eliminating the over-20 horsepower threshold would ease the burden of uncertainty in determining compliance for both industry as well as child labor government inspectors, the introduction of a ROPS standard for 14- and 15-year-olds in conjunction with operating *any* tractor regardless of horsepower may be economically difficult or infeasible for some agricultural employers.

9. EVALUATION OF COSTS AND BENEFITS

9.1 Quantitative

The objective of the quantitative analysis is to distinguish between two alternatives, maintaining the “status quo” (not implementing the proposed changes to the HO as defined by the NIOSH recommendation) or full implementation of the HO, by systematically identifying the various costs and benefits associated with each alternative and assigning a derived monetized value to compare the net effect. As an end result, both the Net Present Value (NPV) and Benefit to Cost Ratio (BCR) are used as comparison ratios to economically value the alternatives in terms of highest benefit and lowest cost. The NPV ratio shows the discounted effect of the monetized costs and benefits, which include injury, illness, and fatality reduction, promulgation and implementation costs to industry and government, and post-implementation enforcement costs. The BCR ratio reflects the total discounted benefits of implementing the HO divided by the total discounted costs, which are primarily the costs associated with promulgation, implementation, and post-implementation. More specific methodology is discussed below.

9.1.1 Methodology

In conducting the quantitative analysis, the following methodology was used to formulate the various costs and benefits associated with each alternative.

1. Costs and benefits are examined over a 10-year planning horizon.
2. In order to reflect benefits and costs equally, both are presented in constant Fiscal Year (FY) 04 dollars. All prior year, current, and any future costs reflect the level of prices of base year 2004, which has the equivalent effect of inflation removed.
3. Both a 3 percent and a 7 percent discount rate are used. The 3 percent rate is the “social rate of discount,” which attempts to compensate for the social implication of the analysis, while the 7 percent rate is the discount rate as prescribed under OMB guidance.
4. Any adjustments for inflation are made using the GDP Deflator index and are converted to FY04 dollars.
5. The incremental approach examines the net effect of implementing the HO versus not implementing the HO. The full value approach provides the full Net Present Value (NPV) for both alternatives equally.
6. Non-fatal injuries and illnesses are valued to industry using a cost-of-illness approach. Estimates for industry costs are derived from the OSHA “Safety Pays!” database using the categories of “fracture,” “crushing,” “other cumulative trauma,” and “injuries (not specified)” which has an average total direct and indirect cost of \$20,402. Estimates for individual costs are calculated based on average annual number of injuries and illnesses, multiplied by a Willingness-to-Pay (WTP) factor of \$50,000 per injury.

-
7. Fatalities are estimated using a value of \$5 million per life and assuming an average of 2.09 fatalities annually for youths under age 16.
 8. Costs to industry are costs associated with implementing the order based on an average cost of retrofitting a tractor of \$946 (FY04\$) [Tevis, C; 2001] While it is realized that certain tractors will not meet the criteria for a ROPS based on age and possible structural issues, this cost alternatively can represent the cost of worker replacement.
 9. Costs to government include cost to implement the order as well as surveillance costs attributed to enforcing the order. Federal and state enforcement costs are derived using historical data on past child labor investigations, including number of investigations conducted; average time spent on investigations, total man-hours expended and average investigator wages. Average penalties are not calculated as they are assumed to be wash costs for this analysis (cost to industry; benefit to government).

9.1.2 Assumptions and Constraints (Specific to the Quantitative Analysis)

In addition to the general assumptions and constraints described in Section 2 above, the following are more specific assumptions that relate specifically to the quantitative analysis.

1. Implementation of the HO, if adopted, will not occur until FY05. Year 0 (FY04) includes some costs attributed to government implementation; however, the full effects, including benefits, of implementation do not occur until FY05.
2. It is assumed that the injury and illness rate will continue indefinitely without implementation of the HO.
3. The cost to industry is estimated based on an estimated number of youth workers of 14,979.

9.1.3 Results

Table 2 presents the results of the analysis. More in-depth views of the underlying estimates are provided in Appendices 3 and 4.

The overall NPV of the “With Implementation” approach is \$67,699 million (3 percent discount rate) and \$62,928 million (7 percent discount rate), while the overall NPV of the “Without Implementation” approach is \$345,776 million (3 percent discount rate) and \$290,468 million (7 percent discount rate). Table 2 presents the results of the baseline analysis; more in-depth views of the underlying estimates are provided in Appendices 3 and 4.

TABLE 2
WITH IMPLEMENTATION EFFECT - NPV @ 3 PERCENT AND 7 PERCENT
(000s)

Year	NPV @ 3 Percent			NPV @ 7 Percent		
	<i>Benefits/Cost Avoidances (Costs) to Individuals</i>	<i>Benefits/Cost Avoidances (Costs) to Industry</i>	<i>Benefits/Cost Avoidances (Costs) to Government</i>	<i>Benefits/Cost Avoidances (Costs) to Individuals</i>	<i>Benefits/Cost Avoidances (Costs) to Industry</i>	<i>Benefits/Cost Avoidances (Costs) to Government</i>
2004 (Year 0)	\$0	\$0	(\$223)	\$0	\$0	(\$223)
2005 (Year 1)	\$26,359	\$458	(\$1,660)	\$25,374	\$441	(\$1,598)
2006 (Year 2)	\$25,591	\$6,474	(\$1,258)	\$23,714	\$5,999	(\$1,166)
2007 (Year 3)	\$24,846	\$6,285	(\$1,068)	\$22,162	\$5,606	(\$953)
2008 (Year 4)	\$24,122	\$6,102	(\$874)	\$20,713	\$5,240	(\$750)
2009 (Year 5)	\$23,420	\$5,924	(\$674)	\$19,358	\$4,897	(\$557)
2010 (Year 6)	\$22,738	\$5,752	(\$468)	\$18,091	\$4,576	(\$372)
2011 (Year 7)	\$22,075	\$5,584	(\$255)	\$16,908	\$4,277	(\$195)
2012 (Year 8)	\$21,432	\$5,422	(\$35)	\$15,802	\$3,997	(\$26)
2013 (Year 9)	\$20,808	\$5,264	\$193	\$14,768	\$3,736	\$137
2014 (Year 10)	\$20,202	\$5,110	\$430	\$13,802	\$3,491	\$294
Total NPV:	\$231,595	\$52,375	(\$5,893)	\$190,690	\$42,260	(\$5,410)
Overall Net Benefit (Cost):	\$278,077			\$227,540		
BCR:	4.11			3.62		

9.2 Qualitative

Several factors are not captured in the quantitative analysis as a result of other limitations, including overall data issues. These factors, however, are relevant and should also be considered in the overall analysis. Table 3 depicts qualitative factors as well as the potential impact on the individual, industry, and/or government as estimated based on the overall analysis of literature, facts, and information.

- ? *Apprenticeship programs.* The school-to-apprenticeship program is considered to be one of the fastest growing pre-apprenticeship initiatives, allowing high-school students to begin their apprenticeships in their junior and senior years. Although “farm worker,” “farmer,” and “farm equipment mechanic” are included in the list of currently apprenticeable occupations, the minimum age under registered apprenticeship programs is 16. The proposed NIOSH recommendation, therefore, would have no impact on the under-16 age group of the population included in this HO.
- ? *Economic feasibility and impact.* To determine both the economic feasibility and impact of implementing this HO, some factors to consider are 1) average profit margin within the affected industry 2) average annual number of injuries, illnesses, and fatalities; 3) number of businesses affected; 4) current regulatory environment; and 5) nature of the industry, including trends, rate of growth, etc. This particular HO amendment may require a substantive cost to individual farm owners, either to retrofit tractors with ROPS and seatbelt protective devices or in some cases to replace older models that cannot be retrofitted because of design problems. Although both data and literature sources indicate the industry is consolidating somewhat, there still remain a sizeable number of individual farms within the industry for which this HO may have an impact. On the other hand, multiplier effects that extend to youths outside the scope of coverage of this HO (i.e., youths on family-owned farms) may occur as a result of the elimination of the horsepower threshold.
- ? *Alternative to a complete ban.* Further training and safety guidelines, including increased attention to applicable safety standards, most likely will not achieve a similar impact as requiring ROPS and seatbelt protection on tractors. Although 4-H and other similar safety programs stress the importance of safety in tractor operations, the design of tractors inherently poses risk to operators. Response time required to avoid accidental rollovers is also extremely low for any operator, regardless of age.
- ? *Illegal working.* Although there appear to be numerous organizations, including educational institutions and universities with agricultural-related programs that perform outreach activities on a consistent basis, it would appear from existing data that compliance with implementation of this HO may still be difficult, especially across smaller farms. There also exists a large migrant farm population, data on which is more difficult to collect, which also may compound the issue of illegal working.

-
- ? *Technological trends.* In terms of technological advances in tractor design, notable trends include global position systems, which allow operators to use autopilot features, thus reducing the number of tractors required on individual farms. [Funk T; 2002] An additional project underway in 2003 involved developing on-board sensors to detect impending instability and alert operators with sufficient time to avoid a rollover accident. [ASAE; 2003]
- ? *Days Away From School.* Given the severity of the types of injuries that frequently occur within the industry, including the high disability rate, youths involved in tractor accidents may be more seriously injured in comparison to injuries occurring in other industries and occupations. Further, because the minimum age requirements are lower in agriculture industries than non-agriculture industries, it is likely then that the days away from school number is higher than average for youth workers.

TABLE 3
IMPACT OF QUALITATIVE FACTORS

FACTOR	POTENTIAL IMPACT
Apprenticeship programs	No Impact
Economic feasibility and impact	Moderate to High
Illegal working	Moderate
Technological impact	Moderate
Days away from school	Moderate to High

Definitions:

No Impact: Factor has no effect, either positively or negatively, on individuals, industry, and/or government.

Low Impact: Factor may have some effect, either positively or negatively, on individuals, industry, and/or government.

Moderate Impact: Factor will most likely have an effect, either positively or negatively, on individuals, industry, and/or government.

High Impact: Factor will have an effect, either positively or negatively, on individuals, industry, and/or government.

10. SENSITIVITY ANALYSIS

In order to more clearly estimate the effects of certain assumptions and other variables given the degree of overall uncertainty of the data, a sensitivity analysis is conducted on several of these key assumptions. Changing each assumption individually while holding all other variables constant, the sensitivity analysis reflects the overall change to NPV at both the 3 percent and 7 percent discount rates and reflects the level of sensitivity the overall results are to the change. Further, because the quantitative results shown in Section 9 above support the “Without

Implementation” approach, a fortiori approach, whereby the assumptions are weighted against the more favorable approach, is used.

Following is a list of assumptions challenged as well as the supporting rationale. In addition, Table 4 presents the numerical results of the analysis, including the percentage change from the baseline analysis.

- ? *The estimated number of injuries occurring annually is 50 percent lower.*
Because the data reflected in the baseline analysis is presented at an aggregate level and does not specify whether the affected youth was working as an employee of another farm or on his or her own family’s farm, the original estimate is lowered to assume that a proportion of the 334 injuries occur to youths who would be outside the jurisdiction of this HO amendment.
- ? *Fatality rate is reduced by 1 annually.* Again, given the extrapolation used to determine the baseline fatality rate, reducing the number of annual fatalities by approximately half examines the impact given a lower proportion of youths potentially affected by this HO implementation.
- ? *Industry implementation costs are 100 percent higher.* To reflect the fact that many farm owners employ more than one tractor in day-to-day operations, changing this assumption examines the cost of implementation across the industry given a cost twice the original estimate.
- ? *Full implementation occurs by Year 5.* Assuming that contractures within the agriculture industry are already somewhat addressing the youth fatality and injury rate, revising the 10-year horizon to a 5-year horizon predicts that the full impact of implementation of this HO will occur sooner.

TABLE 4
RESULTS OF SENSITIVITY ANALYSIS
(000’s)

Change in Assumption	NPV @ 3%		NPV @ 7%	
	<i>Incremental Benefits (Costs)</i>	<i>% Change from Baseline</i>	<i>Incremental Benefits (Costs)</i>	<i>% Change from Baseline</i>
<i>Injury rate is 50 percent lower.</i>	\$177,303	36.24%	\$144,288	36.59%
<i>Fatality rate is reduced by 1 annually.</i>	\$232,102	16.53%	\$189,253	16.83%
<i>Industry implementation costs are 100 percent higher.</i>	\$271,868	2.23%	\$221,563	2.63%

Change in Assumption	NPV @ 3%		NPV @ 7%	
	<i>Incremental Benefits (Costs)</i>	<i>% Change from Baseline</i>	<i>Incremental Benefits (Costs)</i>	<i>% Change from Baseline</i>
<i>Full implementation occurs by Year 5.</i>	\$143,826	48.28%	\$128,256	43.63%

11. SUMMARY AND CONCLUSIONS

The proposed NIOSH recommendation is to implement an amendment to the existing HO regarding youth tractor usage within the agricultural industry, eliminating the current “over 20 PTO horsepower” threshold as well as limiting tractor usage of 14- and 15-year-old workers with certification to only those with ROPS and seatbelt protection. While general injury and fatality data support the fact that tractors account for the highest number of accidents in the industry, ascertaining the exact numbers, particularly in the subject population, is difficult. Additionally, in reviewing data regarding agricultural-related tractor usage, it is difficult to determine the exact number of both tractors less than 20 PTO horsepower as well as the youth workers who operate them. From a qualitative perspective, eliminating the 20 PTO horsepower threshold requirements will most likely have a multiplier effect on the youth population who work on family-owned farms, the economic burden placed on individual farm owners may be significant.

In terms of quantifiable costs and benefits, from a baseline perspective, implementing an HO as proposed by NIOSH is cost effective, with a net benefit of \$278,077 million at a 3 percent discount rate and \$227,540 million at a 7 percent discount rate. In performing a sensitivity analysis and assuming that the estimated baseline injury rate is 50 percent lower, the result is a net benefit of \$177,303 million (3 percent discount rate) and \$144,288 million (7 percent discount rate). Additionally, revising the assumptions regarding the estimated implementation horizon (from 10 years to 5 years) yields a net benefit of \$143,826 million (3 percent discount rate) and \$128,256 million (7 percent discount rate).

APPENDIX 1: TRACTOR USAGE DATA

Farm Wheel Tractors U.S. Retail Sales - Flash Report and Forecast (Full Year) 2001-2004					
	2001 Flash	2002 Flash	2003 Flash	2004 Forecast (as of June 2003)	2004 Forecast (as of January 2004)
2-Wheel-Drive Tractors					
Under 40 PTO HP	91,004	97,785	125,333	104,591	131,688
40 - 100 PTO HP	54,022	53,771	60,304	54,646	59,693
100 PTO HP & Over	17,063	13,799	14,223	14,462	14,298
Total 2-Wheel-Drive Tractors	162,089	165,355	199,860	173,699	205,679
4-Wheel-Drive Tractors	3,425	2,680	2,837	2,961	3,030
Total Farm Wheel Tractors	165,514	168,035	202,697	176,660	208,709
Total Farm Wheel Tractors Percent Change from Previous Year		1.5%	20.6%	-12.8%	3.0%

(Source: Association of Equipment Manufacturers (AEM), *State of the Agriculture Industry Outlook*, January 2004)

APPENDIX 2: SUMMARY BY NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM: 2002

Item	Total	Oilseed and grain farming (1111)	Vegetable and melon farming (1112)	Fruit and tree nut farming (1113)	Greenhouse, nursery, and floriculture production (1114)	Other Crop Farming (1119)			
						Total	Tobacco farming (11191)	Cotton farming (11192)	Sugarcane, hay, and other crop farming (11193, 11194, 11198)
Farms (Number)	2,128,982	349,023	34,624	95,680	64,366	442,932	37,013	14,476	391,443
(Percent)	100.0	16.4	1.6	4.5	3.0	20.8	1.7	0.7	18.4
Land (acres)	938,279,056	242,218,224	11,215,546	11,525,130	4,819,149	118,327,994	6,473,472	16,850,840	95,003,682
Avg. size (acres)	441	694	324	120	75	267	175	1,164	243

Item	Beef and cattle ranching (112111)	Cattle feedlots (112112)	Dairy cattle and milk production (11212)	Hog and pig farming (1122)	Poultry and egg production (1123)	Sheep and goat farming (1124)	Animal aquaculture and other animal production (1125, 1129)
Farms (Number)	664,431	55,472	72,537	33,655	44,219	43,891	228,152
(Percent)	31.2	2.6	3.4	1.5	2.1	2.1	10.7
Land (acres)	419,821,930	25,984,434	27,351,777	8,317,127	6,153,409	17,910,791	44,633,545
Avg. size (acres)	632	468	377	247	139	408	196

(Source: USDA, NASS, 2002 Census of Agriculture – United States Data)

APPENDIX 3: DETAILS OF THE CALCULATION OF COSTS AND BENEFITS

<i>Without Implementation</i>				TOTAL
	Fatalities and Non-fatalities	Promulgation	Implementation/ Surveillance	
Individuals ¹	\$27,150,000	\$0	\$0	\$27,150,000
Industry ²	\$6,867,954	\$0	\$0	\$6,867,954
Government ³	\$1,381,958	\$0	\$0	\$1,381,958
<p>¹ Individual costs are calculated as follows: { \$5,000,000 (VSL) x 2.09 (avg. number of fatalities) } + { 334 (avg. number of injuries/illnesses) x \$50,000 (WTP injury) }</p> <p>² Industry costs are calculated as follows: { \$20,402 (OSHA "Safety Pays!" database, direct and indirect costs) x 334 (avg. number of injuries/illnesses) } + { \$25,687 (avg. cost to industry per fatality, adjusted for inflation) x 2.09 (avg. number of fatalities) }</p> <p>³ Government cost includes Medicaid and disability income paid to individuals and their beneficiaries and is calculated as follows: \$10,344 (annual cost of Social Security benefit) x { 334 x .4 (percentage of injuries/illnesses estimated to result in long-term disability) }. As an ongoing government cost, and as new workers are assumed to be added to this burden annually, the base cost is escalated by 10 percent annually.</p>				

<i>With Implementation</i>				TOTAL
	Fatalities and Non-fatalities	Promulgation	Implementation/ Surveillance	
Individuals ¹	\$0	\$0	\$0	\$0
Industry ²	\$0	\$0	\$6,396,033	\$6,396,033
Government ^{3,4}	\$0	\$445,423	\$1,625,000	\$2,070,423
<p>¹ Implementation of the HO is assumed to reduce the injury, illness, and fatality rate to zero.</p> <p>² Industry implementation costs are calculated using a cost of retrofitting tractors with ROPS and seat belt protection of FY04\$427 x 14,979 (estimated number of youths affected).</p> <p>³ Government promulgation costs (federal government cost) is based on the equivalent of 3 GS-13s (\$120,000/annual burdened salary) x 1 year} + \$50,000 (cost to publish the order). State government costs for implementation are based on two legal workers per state (51 states) at an avg. hourly rate of \$43.41 x 16 hours.</p> <p>⁴ Government enforcement costs (federal government cost) are based on a burden of 1,000 annual investigations @ a cost of \$1,625/investigation.</p>				

Annual Costs - Without Implementation												
	Fiscal Year											Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Individuals												
Death/Ilnesses/Injuries	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$ 298,650,000
Promulgation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Industry												
Death/Ilnesses/Injuries	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$ 75,547,492
Promulgation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Government												
Death/Ilnesses/Injuries	\$1,381,958	\$1,520,154	\$1,672,170	\$1,839,387	\$2,023,325	\$2,225,658	\$2,448,224	\$2,693,046	\$2,962,351	\$3,258,586	\$3,584,444	\$ 25,609,302
Promulgation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total	\$35,399,912	\$35,538,108	\$35,690,123	\$35,857,340	\$36,041,279	\$36,243,612	\$36,466,177	\$36,711,000	\$36,980,304	\$37,276,539	\$37,602,398	\$ 399,806,794

Annual Costs - With Implementation												
	Fiscal Year											Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Individuals												
Death/Ilnesses/Injuries	\$27,150,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ 27,150,000
Promulgation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Industry												
Death/Ilnesses/Injuries	\$6,867,954	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ 6,867,954
Promulgation	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ -
Implementation	\$0	\$6,396,033	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ 6,396,033
Government												
Death/Ilnesses/Injuries	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$1,381,958	\$ 15,201,542
Promulgation	\$222,711	\$222,711	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ 445,423
Implementation	\$ -	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 1,625,000	\$ 16,250,000
Total	\$35,622,624	\$9,625,703	\$3,006,958	\$3,006,958	\$3,006,958	\$3,006,958	\$3,006,958	\$3,006,958	\$3,006,958	\$3,006,958	\$3,006,958	\$ 72,310,952

APPENDIX 4: NET PRESENT VALUE (NPV) CALCULATIONS

COST/BENEFIT ANALYSIS NET EFFECT (INCREMENTAL APPROACH) (@ 3 PERCENT)												
Fiscal Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Year of Implementation	0	1	2	3	4	5	6	7	8	9	10	
Without Implementation Alternative - Cost to Individuals	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$27,150,000	\$ 298,650,000
With Implementation Alternative - Cost to Individuals	\$27,150,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ 27,150,000
Without Implementation Alternative - Cost to Industry	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$6,867,954	\$ 75,547,492
With Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,396,033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,263,987
Without Implementation Alternative - Cost to Government	\$1,381,958	\$1,520,154	\$1,672,170	\$1,839,387	\$2,023,325	\$2,225,658	\$2,448,224	\$2,693,046	\$2,962,351	\$3,258,586	\$3,584,444	\$ 25,609,302
With Implementation Alternative - Cost to Government	\$ 1,604,670	\$ 3,229,670	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 31,896,965
Net Cost (Cost Savings/Avoidances) - Individual	\$ -	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (271,500,000)
Net Cost (Cost Savings/Avoidances) - Industry	\$ -	\$ (471,921)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (62,283,505)
Net Cost (Cost Savings/Avoidances) - Government	\$ 222,711	\$ 1,709,515	\$ 1,334,789	\$ 1,167,572	\$ 983,633	\$ 781,301	\$ 558,735	\$ 313,912	\$ 44,608	\$ (251,627)	\$ (577,486)	\$ 6,287,663
Discount Factor (@ 3%)	1.00	0.971	0.943	0.915	0.888	0.863	0.837	0.813	0.789	0.766	0.744	
Discounted Cost (Cost Savings/Avoidances) - Individual	\$ -	\$ (26,359,223)	\$ (25,591,479)	\$ (24,846,096)	\$ (24,122,423)	\$ (23,419,828)	\$ (22,737,698)	\$ (22,075,435)	\$ (21,432,461)	\$ (20,808,214)	\$ (20,202,150)	\$ (231,595,007)
Discounted Cost (Cost Savings/Avoidances) - Industry	\$ -	\$ (458,176)	\$ (6,473,705)	\$ (6,285,151)	\$ (6,102,088)	\$ (5,924,357)	\$ (5,751,803)	\$ (5,584,275)	\$ (5,421,626)	\$ (5,263,715)	\$ (5,110,403)	\$ (52,375,298)
Discounted Cost (Cost Savings/Avoidances) - Government	\$ 222,711	\$ 1,659,724	\$ 1,258,166	\$ 1,068,494	\$ 873,945	\$ 673,957	\$ 467,932	\$ 255,240	\$ 35,214	\$ (192,851)	\$ (429,704)	\$ 5,892,827
Net Discounted Cost (Cost Savings/Avoidances)	\$ 222,711	\$ (25,157,675)	\$ (30,807,018)	\$ (30,062,753)	\$ (29,350,566)	\$ (28,670,229)	\$ (28,021,569)	\$ (27,404,470)	\$ (26,818,873)	\$ (26,264,780)	\$ (25,742,256)	\$ (278,077,478)
Cumulative Discounted Costs for Without Implementation Alternative	\$ 35,399,912	\$ 69,902,930	\$ 103,544,294	\$ 136,358,840	\$ 168,381,050	\$ 199,645,108	\$ 230,184,957	\$ 260,034,360	\$ 289,226,953	\$ 317,796,317	\$ 345,776,032	
Cumulative Discounted Costs for With Implementation Alternative	\$ 35,622,624	\$ 44,967,966	\$ 47,802,313	\$ 50,554,106	\$ 53,225,749	\$ 55,819,578	\$ 58,337,858	\$ 60,782,790	\$ 63,156,511	\$ 65,461,094	\$ 67,698,554	
Net Present Value (NPV)	\$ 222,711	\$ (24,934,964)	\$ (55,741,982)	\$ (85,804,735)	\$ (115,155,301)	\$ (143,825,530)	\$ (171,847,099)	\$ (199,251,569)	\$ (226,070,442)	\$ (252,335,222)	\$ (278,077,478)	
Benefits to Cost Ratio (BCR)												4.11

¹ The discount factor is calculated as follows:

$$1/(1 + \text{discount rate})^t \text{ where } t = \text{year of life cycle and the discount rate.}$$

² Assumes no time lag between year of implementation and year cost savings/avoidance begins.

COST/BENEFIT ANALYSIS NET EFFECT (INCREMENTAL APPROACH) (@ 7 PERCENT)												
Fiscal Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Year of Implementation	0	1	2	3	4	5	6	7	8	9	10	
Without Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 298,650,000
With Implementation Alternative - Cost to Individuals	\$27,150,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ 27,150,000
Without Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 75,547,492
With Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,396,033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,263,987
Without Implementation Alternative - Cost to Government	\$1,381,958	\$1,520,154	\$1,672,170	\$1,839,387	\$2,023,325	\$2,225,658	\$2,448,224	\$2,693,046	\$2,962,351	\$3,258,586	\$3,584,444	\$ 25,609,302
With Implementation Alternative - Cost to Government	\$ 1,604,670	\$ 3,229,670	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 31,896,965
Net Cost (Cost Savings/Avoidances) - Individual	\$ -	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (27,150,000)	\$ (271,500,000)
Net Cost (Cost Savings/Avoidances) - Industry	\$ -	\$ (471,921)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (6,867,954)	\$ (62,283,505)
Net Cost (Cost Savings/Avoidances) - Government	\$ 222,711	\$ 1,709,515	\$ 1,334,789	\$ 1,167,572	\$ 983,633	\$ 781,301	\$ 558,735	\$ 313,912	\$ 44,608	\$ (251,627)	\$ (577,486)	\$ 6,287,663
Discount Factor (@ 7%)	1.00	0.935	0.873	0.816	0.763	0.713	0.666	0.623	0.582	0.544	0.508	
Discounted Cost (Cost Savings/Avoidances) - Individual	\$ -	\$ (25,373,832)	\$ (23,713,861)	\$ (22,162,487)	\$ (20,712,605)	\$ (19,357,575)	\$ (18,091,191)	\$ (16,907,655)	\$ (15,801,547)	\$ (14,767,801)	\$ (13,801,683)	\$ (190,690,239)
Discounted Cost (Cost Savings/Avoidances) - Industry	\$ -	\$ (441,048)	\$ (5,998,737)	\$ (5,606,296)	\$ (5,239,529)	\$ (4,896,756)	\$ (4,576,408)	\$ (4,277,016)	\$ (3,997,212)	\$ (3,735,712)	\$ (3,491,319)	\$ (42,260,033)
Discounted Cost (Cost Savings/Avoidances) - Government	\$ 222,711	\$ 1,597,678	\$ 1,165,856	\$ 953,086	\$ 750,409	\$ 557,057	\$ 372,309	\$ 195,489	\$ 25,962	\$ (136,869)	\$ (293,564)	\$ 5,410,124
Net Discounted Cost (Cost Savings/Avoidances)	\$ 222,711	\$ (24,217,201)	\$ (28,546,742)	\$ (26,815,697)	\$ (25,201,725)	\$ (23,697,274)	\$ (22,295,290)	\$ (20,989,183)	\$ (19,772,797)	\$ (18,640,381)	\$ (17,586,567)	\$ (227,540,148)
Cumulative Discounted Costs for Without Implementation Alternative	\$ 35,399,912	\$ 68,613,097	\$ 99,786,233	\$ 129,056,504	\$ 156,552,224	\$ 182,393,418	\$ 206,692,372	\$ 229,554,137	\$ 251,077,011	\$ 271,352,979	\$ 290,468,131	
Cumulative Discounted Costs for With Implementation Alternative	\$ 35,622,624	\$ 44,618,607	\$ 47,245,001	\$ 49,699,575	\$ 51,993,569	\$ 54,137,489	\$ 56,141,152	\$ 58,013,735	\$ 59,763,812	\$ 61,399,398	\$ 62,927,983	
Net Present Value (NPV)	\$ 222,711	\$ (23,994,490)	\$ (52,541,232)	\$ (79,356,929)	\$ (104,558,654)	\$ (128,255,929)	\$ (150,551,219)	\$ (171,540,402)	\$ (191,313,199)	\$ (209,953,580)	\$ (227,540,148)	
Benefits to Cost Ratio (BCR)												3.62

¹ The discount factor is calculated as follows:

$1/(1 + \text{discount rate})^t$ where t = year of life cycle and the discount rate.

² Assumes no time lag between year of implementation and year cost savings/avoidance begins.

COST/BENEFIT ANALYSIS (FULL VALUE APPROACH) (@ 3 PERCENT)												
Fiscal Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Year of Implementation	0	1	2	3	4	5	6	7	8	9	10	
Without Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 298,650,000
With Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 27,150,000
Without Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 75,547,492
With Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,396,033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,263,987
Without Implementation Alternative - Cost to Government	\$ 1,381,958	\$ 1,520,154	\$ 1,672,170	\$ 1,839,387	\$ 2,023,325	\$ 2,225,658	\$ 2,448,224	\$ 2,693,046	\$ 2,962,351	\$ 3,258,586	\$ 3,584,444	\$ 25,609,302
With Implementation Alternative - Cost to Government	\$ 1,604,670	\$ 3,229,670	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 31,896,965
Discount Factor (@ 3%)	1.00	0.971	0.943	0.915	0.888	0.863	0.837	0.813	0.789	0.766	0.744	
Discounted Without Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ 26,359,223	\$ 25,591,479	\$ 24,846,096	\$ 24,122,423	\$ 23,419,828	\$ 22,737,698	\$ 22,075,435	\$ 21,432,461	\$ 20,808,214	\$ 20,202,150	\$ 258,745,007
Discounted With Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 27,150,000
Discounted Without Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,667,916	\$ 6,473,705	\$ 6,285,151	\$ 6,102,088	\$ 5,924,357	\$ 5,751,803	\$ 5,584,275	\$ 5,421,626	\$ 5,263,715	\$ 5,110,403	\$ 65,452,993
Discounted With Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,209,741	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,077,695
Discounted Without Implementation Alternative - Cost to Government	\$ 1,381,958	\$ 1,475,878	\$ 1,576,180	\$ 1,683,299	\$ 1,797,698	\$ 1,919,872	\$ 2,050,349	\$ 2,189,693	\$ 2,338,507	\$ 2,497,435	\$ 2,667,163	\$ 21,578,032
Discounted With Implementation Alternative - Cost to Government	\$ 1,604,670	\$ 3,135,602	\$ 2,834,347	\$ 2,751,793	\$ 2,671,644	\$ 2,593,829	\$ 2,518,280	\$ 2,444,932	\$ 2,373,721	\$ 2,304,583	\$ 2,237,459	\$ 27,470,859
Net Present Value (NPV) - Without Implementation Alternative	\$ 35,399,912	\$ 34,503,018	\$ 33,641,364	\$ 32,814,546	\$ 32,022,210	\$ 31,264,058	\$ 30,539,850	\$ 29,849,402	\$ 29,192,594	\$ 28,569,364	\$ 27,979,716	\$ 345,776,032
Net Present Value (NPV) - With Implementation Alternative	\$ 35,622,624	\$ 9,345,342	\$ 2,834,347	\$ 2,751,793	\$ 2,671,644	\$ 2,593,829	\$ 2,518,280	\$ 2,444,932	\$ 2,373,721	\$ 2,304,583	\$ 2,237,459	\$ 67,698,554
Benefit to Cost Ratio (BCR) - Without Implementation Alternative												(0.80)
Benefit to Cost Ratio (BCR) - With Implementation Alternative												4.11

¹The discount factor is calculated as follows:
 $1/(1 + \text{discount rate})^t$ where t = year of life cycle and the discount rate.

COST/BENEFIT ANALYSIS (FULL VALUE APPROACH) (@ 7 PERCENT)												
Fiscal Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Year of Implementation	0	1	2	3	4	5	6	7	8	9	10	
Without Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 27,150,000	\$ 298,650,000
With Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 27,150,000
Without Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 6,867,954	\$ 75,547,492
With Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,396,033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,263,987
Without Implementation Alternative - Cost to Government	\$ 1,381,958	\$ 1,520,154	\$ 1,672,170	\$ 1,839,387	\$ 2,023,325	\$ 2,225,658	\$ 2,448,224	\$ 2,693,046	\$ 2,962,351	\$ 3,258,586	\$ 3,584,444	\$ 25,609,302
With Implementation Alternative - Cost to Government	\$ 1,604,670	\$ 3,229,670	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 3,006,958	\$ 31,896,965
Discount Factor (@ 7%)	1.00	0.935	0.873	0.816	0.763	0.713	0.666	0.623	0.582	0.544	0.508	
Discounted Without Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ 25,373,832	\$ 23,713,861	\$ 22,162,487	\$ 20,712,605	\$ 19,357,575	\$ 18,091,191	\$ 16,907,655	\$ 15,801,547	\$ 14,767,801	\$ 13,801,683	\$ 217,840,239
Discounted With Implementation Alternative - Cost to Individuals	\$ 27,150,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 27,150,000
Discounted Without Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 6,418,648	\$ 5,998,737	\$ 5,606,296	\$ 5,239,529	\$ 4,896,756	\$ 4,576,408	\$ 4,277,016	\$ 3,997,212	\$ 3,735,712	\$ 3,491,319	\$ 55,105,588
Discounted With Implementation Alternative - Cost to Industry	\$ 6,867,954	\$ 5,977,601	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 12,845,555
Discounted Without Implementation Alternative - Cost to Government	\$ 1,381,958	\$ 1,420,705	\$ 1,460,538	\$ 1,501,487	\$ 1,543,585	\$ 1,586,863	\$ 1,631,355	\$ 1,677,094	\$ 1,724,115	\$ 1,772,455	\$ 1,822,150	\$ 17,522,305
Discounted With Implementation Alternative - Cost to Government	\$ 1,604,670	\$ 3,018,383	\$ 2,626,394	\$ 2,454,574	\$ 2,293,994	\$ 2,143,920	\$ 2,003,663	\$ 1,872,583	\$ 1,750,077	\$ 1,635,586	\$ 1,528,585	\$ 22,932,429
Net Present Value (NPV) - Without Implementation Alternative	\$ 35,399,912	\$ 33,213,185	\$ 31,173,136	\$ 29,270,271	\$ 27,495,719	\$ 25,841,194	\$ 24,298,954	\$ 22,861,766	\$ 21,522,874	\$ 20,275,968	\$ 19,115,152	\$ 290,468,131
Net Present Value (NPV) - With Implementation Alternative	\$ 35,622,624	\$ 8,995,984	\$ 2,626,394	\$ 2,454,574	\$ 2,293,994	\$ 2,143,920	\$ 2,003,663	\$ 1,872,583	\$ 1,750,077	\$ 1,635,586	\$ 1,528,585	\$ 62,927,983
Benefit to Cost Ratio (BCR) - Without Implementation Alternative												(0.78)
Benefit to Cost Ratio (BCR) - With Implementation Alternative												3.62

¹The discount factor is calculated as follows:
 $1/(1 + \text{discount rate})^t$ where t = year of life cycle and the discount rate.

APPENDIX 5: QUALITATIVE COSTS AND BENEFITS

ISSUE	Qualitative Cost	Qualitative Benefit
1. Promulgating the Rule	? Public awareness of the need to have a new HO	
2. Implementing the Rule	? Time necessary for analysis the new rule and adjust to new standards	
3. Post-Implementation Impact		
a. Impact on youth/families	? Decreased job opportunities for youth	? Decrease in pain and suffering to youth workers, including those in family-owned businesses
b. Impact on businesses (effectiveness, efficiency, and other impacts)	? Potential loss of youth labor pool	? Potential decrease in tax liability (capitalization and expense of cost of retrofitting tractors)
c. Other impacts	? Fairness and equity	

APPENDIX 6: ANALYSIS OF STATE CHILD LABOR LAWS

Purpose

An analysis of current state laws regarding child labor was undertaken with the goal of determining whether states currently have more stringent laws than the proposed new HO with regard to minors operating tractors in the agricultural industry.

Overall Findings

There are very few states that do not have child labor HOs. Generally, many of the states' agriculture-related child labor laws mirror federal regulations. Seventeen states either have no specific agriculture HOs or exempt agriculture employment from general child labor laws.

State ¹	Prohibited hazardous occupations (HOs) in agriculture to age:
Federal: Fair Labor Standards Act (FSLA) applies to migrants and local residents regardless of farm size or number of man-days of farm labor used on that farm.	(Applicable to minors under age 16.) Numerous occupations have been declared hazardous in 11 categories of employment including, among others, operating tractors of over 20 PTO horsepower; operating or assisting to operate corn pickers, grain combines, hay movers, potato diggers, trenchers or earthmoving equipment, or power-driven circular, hand or chain saws; working in a yard, pen or stall occupied by a stud animal or a sow with suckling pigs; working inside a silo or manure pit; handling or applying certain agricultural chemicals; and handling or using a blasting agent such as dynamite or black powder.
Alaska	No specific agriculture HOs. Those of general application under 18 are considered as covering agriculture where applicable (e.g. working with power-driven machinery).
Arizona	Applicable to minors under age 16. (similar to Federal HOs)
Arkansas	No specific agriculture HOs. Those of general application for under 16 are considered as covering agriculture where applicable (e.g. working with unguarded belts and adjustable belts)
California	(Applicable to minors under age 16.); adopts Federal HOs 12 work prohibited in any agriculture danger zone (areas in or about moving equipment, unprotected chemicals, and unprotected water hazard).
Colorado	No specific agric. HOs. Those of general application for under 18 are considered as covering agric. where applicable (e.g. work 20 feet above ground, operation of power-driven machinery).
Connecticut (separate agriculture	No specific agric. HOs. Those of general application for under 18 are considered as covering agric. where applicable (e.g. work on ladders,

State¹	Prohibited hazardous occupations (HOs) in agriculture to age:
child labor law)	operation of power-driven machinery).
Delaware (farm work exempt unless performed in hazardous occupations)	Applicable to minors under age 16; (adopts, by reference, the Federal HOs). Law exempts those working with adult supervision.
Florida	Applicable to minors under age 18; operating or assisting to operate a tractor over 20 PTO horsepower, any trencher or earthmoving equipment, forklift, or any harvesting, planting, or plowing machinery, or any moving machinery. 16, operation of power-driven machinery.
Hawaii	Applicable to minors under age 16; (several), age 15 pineapple harvesters prohibited from being on the harvesting machine or the truck attached to it, age 12 prohibited from using any harvesting equipment while engaged in coffee harvesting except holding hooks which are free of any attachments or accessories and baskets or containers used to carry coffee berries. They are not allowed to carry loads in excess of 15 pounds.
Idaho	---
Illinois (minimum age only)	---
Indiana (Exempt except for minimum age or when school is in session)	---
Iowa (law exempts part-time work in agriculture (less than 20 hours a week when school is not in session and less than 14 hours a week while school is in session) It covers all migratory labor)	No specific agric. HOs. Those of general application for under 18 and under 16 are considered as covering migrant labor where applicable (e.g. power-driven hoisting apparatus - under 18, power-driven machinery - under 16).
Maine (exempt if not in direct contact with hazardous machinery or substances)	- (hazardous machinery or substances mentioned in exemption refers to occupations prohibited under Federal law)

State¹	Prohibited hazardous occupations (HOs) in agriculture to age:
Massachusetts	Applicable to minors under age 16; operation of saw or cutter on a farm except family farm; stripping, sorting, manufacturing or packing tobacco.
Michigan (exempt except for operations involving detasseling, rouging, hoeing, or similar in production of seed)	No specific agriculture HOs. Those of general application under 18 are considered as covering agriculture where applicable (e.g. working with power-driven machinery).
Minnesota	Age 18 (a few); age 16 (several including, by reference, the Federal HOs)
Missouri	No specific agriculture HOs. Those of general application under 16 are considered as covering agriculture where applicable (e.g. working with power-driven machinery, ladders, toxic or hazardous chemicals).
Nevada (exempt except for minimum age when school in session)	---
New Hampshire	Applicable to minors under age 16; (adopts, by reference, the Federal HOs)
New Jersey	Age 18 (a few); age 16 (a few)
New Mexico	No specific agriculture HOs. Those of general application under 16 are considered as covering agriculture where applicable (e.g. belted, moving, machinery).
New York	Applicable to minors under age 16; adopts Federal HOs
North Dakota	-(Law specifies that minors under 16 are not to be prohibited from doing ordinary farm work or from operating farm machinery.)
Ohio	Applicable to minors under age 16 (same as Federal HOs)
Oregon	Applicable to minors under age 18 (16 with Certificate of Training);operating power-driven farm machinery of any kind; riding in or on power-driven farm machinery for the purpose of transporting, sorting, delivering, or otherwise processing farm products. State adopts Federal HOs.
Pennsylvania (exempt from child labor law. Separate law covers seasonal	---

State¹	Prohibited hazardous occupations (HOs) in agriculture to age:
farm workers).	
South Carolina	Applicable to minors under age 16 (same as Federal HOs)
South Dakota	---
Utah	With parental consent, no age limit for agriculture work, including operation of power-driven farm machinery. Otherwise, HOs of general application for under 18 are considered as covering agriculture where applicable (e.g. power-driven hoisting apparatus).
Vermont	No specific agriculture HOs. Those of general application under 16 are considered as covering agriculture where applicable (e.g. operating a machine having an unguarded belt, adjusting belt- driven equipment, and cleaning machinery).
Virginia	Age 18 (several) age 16 (a few) (Generally the same as Federal HOs) Children 16 may operate, assist in operating, or otherwise perform work involving a truck, excluding a tractor trailer, or farm vehicle. Children 14 may perform work as a helper on a truck or commercial vehicle, while engaged in such work exclusively on a farm.
Washington	Age 18 (some) age 16 (same as Federal HOs)
Wisconsin	Applicable to minors under age 16 (same as Federal HOs)

--- No provision

¹ Agricultural employment is exempted from or is not listed among the covered sectors in the child labor laws of 17 states: Alabama, Delaware (non-hazardous employment), Georgia, Kansas, Kentucky, Louisiana, Maryland (non-hazardous employment), Mississippi, Montana, Nebraska (covers only work in detasseling and beet fields), North Carolina, Oklahoma, Rhode Island, Tennessee, Texas, West Virginia (non-hazardous employment) and Wyoming. Laws generally exclude minors employed by parents on family farms.

² California. Until January 1, 2005, 16- and 17-year olds in Lake County who are employed in agricultural packing plants may work more than 48 hours, but no more than 60, in any 1 week with written approval of the Lake County Board of Education.

Table found at: <http://www.dol.gov/esa/programs/whd/state/agriemp2.htm#prohibited>

REFERENCES

Department of Labor (DOL), Bureau of Labor Statistics (BLS), Census of Fatal Occupational Injuries (CFOI). Found at: <http://www.bls.gov/oshhome.htm>

DOL, BLS, *Nonfatal cases involving days away from work: selected characteristics (1992-2001)*. Found at: <http://data.bls.gov/cgi-bin/dsrv>

National Institute for Occupational Safety & Health (NIOSH), Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders Report. May 3, 2002. http://youthrules.dol.gov/niosh_recs_to_dol_050302.pdf

OMB Circular A-4, Regulatory Analysis, Office of Management and Budget, September 17, 2003. Found at: <http://www.whitehouse.gov/omb/circulars/a004/a-4.html>.

Leigh, JP, McCurdy, SA, Schenker, MB. *Costs of Occupational Injuries in Agriculture*. Public Health Reports. May 2001, Vol. 116, Issue 3, pp235-248.

Castillo, D. N., Adekoya, N. & Myers, J. R. (1999). *Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992-96*. Journal of Agromedicine, 6(3), 27-41.

USDA-National Agricultural Statistics Service (2002). Statistical Highlights of U.S. Agriculture: 2001-2002. Available at <http://www.usda.gov/nass/pubs/stathigh/2002/stathi2002.pdf>.

USDA-National Agricultural Statistics Service (2004). 2001 Childhood Agricultural-Related Injuries. Available at <http://jan.mannlib.cornell.edu/reports/nassr/other/injury/injr0104.pdf>.

Myers, J. R., & Hendricks, K.J. (2001). *Injuries Among Youth on Farms in the United States, 1998* (DHHS/NIOSH Publication No. 2001-154). Cincinnati, OH: National Institute for Occupational Safety and Health. Available at <http://www.cdc.gov/niosh/childag/pdfs/2001154.pdf>.

Rivara F. *Fatal and non-fatal farm injuries to children and adolescents in the United States 1990-1993*. Injury Prevention, 3, 190-194.

Runyan, C. W. and Zakocs, R. C. (2000). *Epidemiology and prevention of injuries among adolescent workers in the United States*. Annual Review of Public Health, 21, 247-269.

Cooper, S.P. and Rothstein, M.A. (1995). *Health-hazards among working children in Texas*. Southern Medical Journal, 88 (5), 550-554.

Schenker, M. B., Lopez, R, and Wintemute, G. (1995). Farm-related fatalities among children in California, 1980 to 1989. American Journal of Public Health, 85 (1), 89-92.

Hartling L, Pickett W, Dorland J Brison RJ (1997). *Hospital Costs Associated with Agricultural Machinery Injuries in Ontario*. American Journal of Industrial Medicine 32:502-509

Locker AR, Dorland JL, Hartling L, Pickett W (2003). *Economic Burden of Agricultural Machinery Injuries in Ontario, 1985 to 1996*. The Journal of Rural Health. 19(3): 285-291

Etherton JR, Myers JR, Jensen RC, Russell JC, Braddee, RW. *Agricultural machine-related deaths*. Am J Public Health 1991;81: 766-768

Smith GA, Scherzer DJ, Buckley JW, Haley KJ, Shields BJ. *Pediatric Farm-related injuries: a series of 96 hospitalized patients*. Clinical Pediatrics. 1997.

Morbidity and Mortality Weekly Report (MMWR). *Public health focus: effectiveness of rollover protective structures for preventing injuries associated with agricultural tractors*. Jan 29, 1993 v42 n3 p57(3)

American Society of Agricultural Engineers (ASAE). *Engineering & Technology for a Sustainable World. Tractor safety studied*. Dec 2003 v10 i12 p6(1)

Browning SR, Westneat SC, Truszczynska H, Reed D, McKnight R. *Farm Tractor Safety in Kentucky, 1995*. Public Health Reports, Jan 1999 v114 i1 p53(1)

Centers for Disease Control and Prevention (CDC). *Farm tractor-related fatalities – Kentucky, 1994*. The Journal of the American Medical Association. Sept 27, 1995 v27 n12 p936(2).

Tevis C. *Adding roll bars saves lives*. Successful Farming. February 2002, Vol 100, No 2.

Association of Equipment Manufacturers (AEM). *State of the Agriculture Industry Outlook*. January 2004.

U.S. Department of Commerce (DOC), Economics and Statistics Administration (ESA), Bureau of the Census (BOC). *Farm Machinery and Lawn and Garden Equipment – 1997*. MA35A(97)-1 Issued August 28, 1998

Gerberich SG, Gibson RW, French LR, Renier CM, Lee T-Y, Carr WP, Shutske J. *Injuries among children and youth in farm households: Regional Rural Injury Study-I*. Injury Prevention 2001;7:117–122

American Academy of Pediatrics, Committee on Injury and Poison Prevention and Committee on Community Health Services. *Prevention of Agricultural Injuries Among Children and Adolescents*. Pediatrics. Vol. 108, No. 4, October 2001.

Funk F. *Views from the field*. Engineering & Technology for a Sustainable World. Nov 2002 v9 i11 p13