Economic Impact of a Death from a Tractor Rollover

Prepared for: I-CASH | Iowa's Center for Agricultural Safety and Health

Prepared by: Decision Innovation Solutions™
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Table 1, Acronyms

Acronym	Description
USDA	United States Department of Agriculture
USDA/NASS	USDA /National Agricultural Statistics Service
USDA/ERS	USDA /Economic Research Service
NIOSH	National Institute for Occupational Safety and Health

Executive Summary

Agriculture ranks among the most hazardous industries. Farmers are at very high risk for both fatal and nonfatal injuries. In 2013, 459 U.S. farmers and farm workers died from a work-related injury, resulting in a fatality rate of 21.7 deaths per 100,000 workers. Notably, tractor overturns are the leading cause of death for farmers and farm workers. The primary method for reducing deaths from tractor rollovers is the installation of a Rollover Protective Structure (ROPS). Between 1967 and 1985 U.S. farm tractor manufacturers provided ROPS as optional equipment on most tractor models, but it wasn't until 1986 that American tractor manufacturers began adding ROPS or ROPS-equipped cabs on all farm tractors (over 20 horsepower) sold in the United States.

Given that we are now thirty years removed from the near universal adoption of ROPS on new tractors, significant progress has been made. However, there are a few reasons the number of tractors with installed (as-built or retrofitted) ROPS has not approached 100%. The primary reason being that natural replacement of older tractors with newer ones has not occurred as fast as expected.

With the prevalence of deaths occurring in agriculture in general and from tractor rollovers in particular, the question of what impact this has on the local economy is worth considering. Over the years, there have been analyses completed which estimate lost income or, as typically used in courts of law, estimating the loss of earnings for a wrongful death (Tinari, 2015). While these approaches serve a useful purpose, they do not attempt to understand the economic impact of a tractor rollover on the economy at large. This research serves to answer this question from an Iowa perspective.

Key Findings

Under assumptions outlined in the text of this report, the premature death of a primary farm operator from a tractor rollover is estimated to result in the following reduction in economic activity:

- **3.1 jobs**
- **$635,000** in sales[1]
    - **$299,000** in value-added
    - **$182,000** in labor income
- **$18,885** in state and local taxes
- **$38,143** in federal taxes

[1] **Sales:** The broadest measure of economic activity – sometimes referred to as "output"; **Employment (Jobs):** A measure of job positions without regard to whether they are full-time equivalents**; Value-Added:** Sales (output) minus the cost of inputs; **Labor Income** includes proprietor income and employee compensation and is a sub-component of value-added.

Background

According to the National Institute for Occupational Safety and Health (NIOSH 2016), agriculture ranks among the most hazardous industries. Farmers are at very high risk for both fatal and nonfatal injuries. Farming is one of the few industries in which family members (who often share the work and live on the premises) are also at risk for fatal and nonfatal injuries. Consider the following:

- Approximately 5,966,000 operators and full-time workers were employed in production agriculture in the U.S. in 2012. For Iowa this number was 211,373.
- Approximately 1.4 to 2.1 million hired crop workers are employed annually on crop farms in the U.S.
- An estimated 955,000 youth under 20 years of age resided on farms in 2012, with about 472,000 youth performing farm work. In addition to the youth who live on farms, an estimated 259,000 youth were hired to work on U.S. farms in 2012.

According to the National Safety Council (2015), in 2013, 459 U.S. farmers and farm workers died from a work-related injury, resulting in a fatality rate of 21.7 deaths per 100,000 workers. Notably, tractor overturns are the leading cause of death for farmers and farm workers. Figure 1 illustrates the death rates in the riskiest occupations in the U.S. (ranked by death rates in 2013). These occupations are: 1) Agriculture, 2) Mining & Quarrying, 3) Construction and 4) Transportation and Public Utilities.

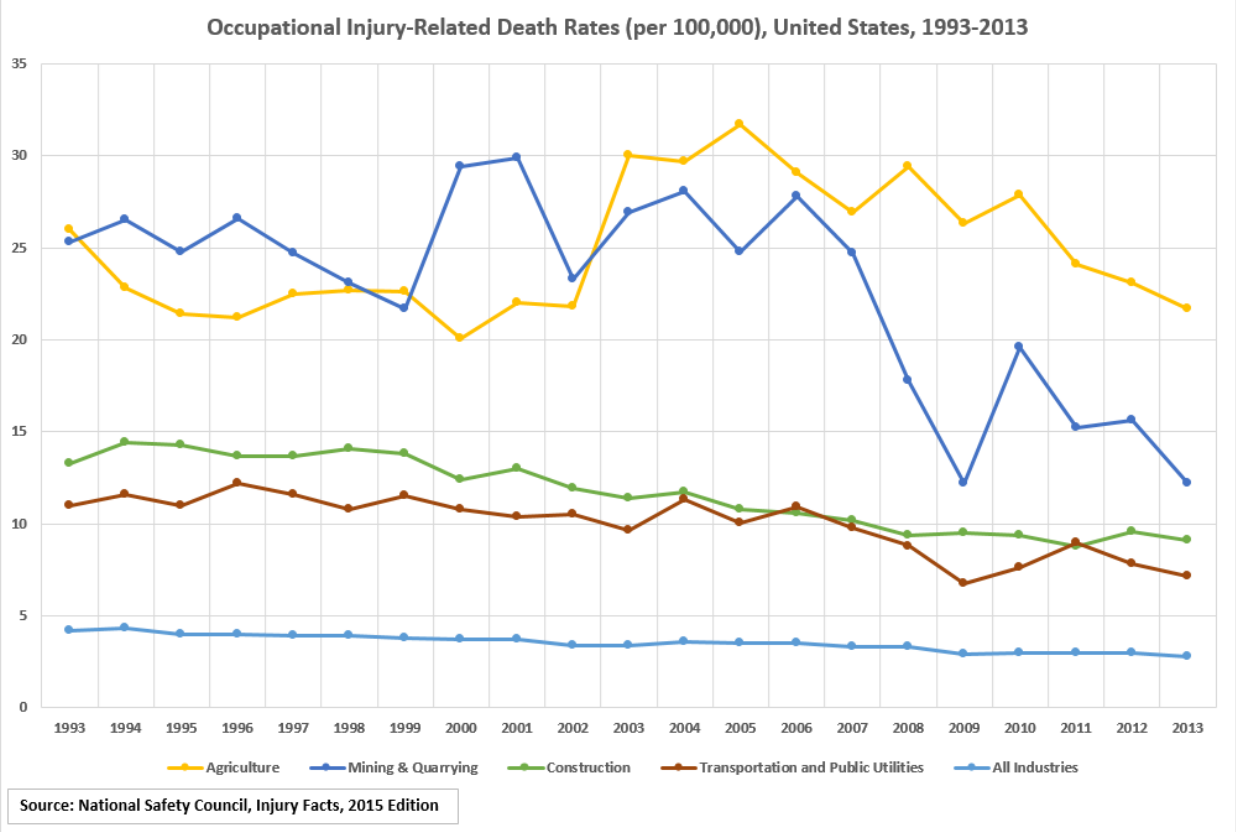

Figure 1, Death Rates in Riskiest U.S. Industries (1993-2013)

As shown in Figure 1, Agriculture has not always been the riskiest occupation. Mining & Quarrying is also very risky, but the death rate has fallen substantially faster than that of Agriculture. Overall, all death rates have fallen in the last twenty years.

Figure 2 shows death and death rate data from the year 2013. While agriculture's death rate is the highest, the total number of deaths in the construction industry (773) was the largest in 2013.

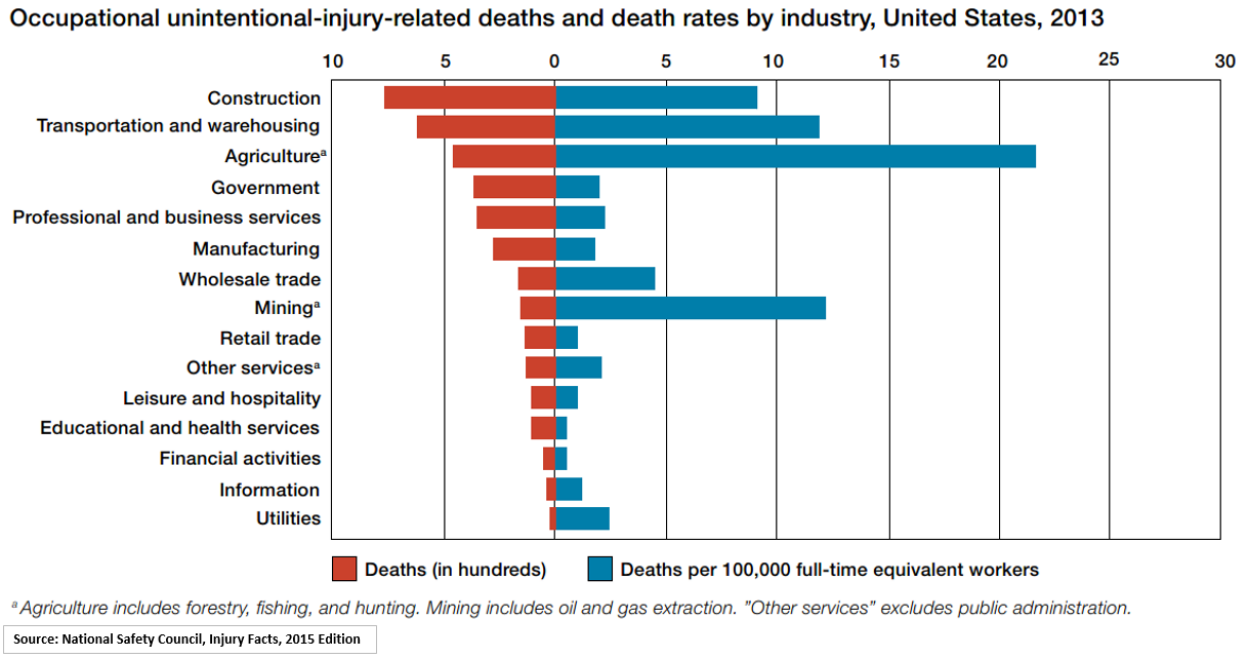

Figure 2, Deaths and Death Rates By Major U.S. Industry (2013)

The primary method for reducing deaths from tractor rollovers is the installation of a Rollover Protective Structure (ROPS) and use of a seatbelt. Between 1967 and 1985 U.S. farm tractor manufacturers provided ROPS as optional equipment on most tractor models. This meant that new tractor purchasers had to add the cost of a ROPS onto the base price of a tractor. Because most farmers are cost conscious, few added ROPS as an option. Even fewer pre-1967 tractors have ROPS, yet many of these tractors are still in use today (Penn State, 2016). Many of the cabs introduced in the aftermarket provided little or no protection from a rollover. Beginning in 1986, American tractor manufacturers began adding ROPS or ROPS-equipped cabs on all farm tractors (over 20 horsepower) sold in the United States. The two primary reasons for not installing a retrofitted ROPS are: 1) tractor owners do not see a need and 2) cost.

Given that we are now thirty years removed from the adoption of ROPS on new tractors, significant progress has been made. However, there are a few reasons the number of tractors with installed (as-built or retrofitted) ROPS has not approached 100%. The primary reason being that natural replacement of older tractors with newer ones has not occurred as fast as expected. This is because older tractors are typically not retired, but tend to be purchased by non-farmers who have acreages. These owners are normally less able to afford, or see the need for, a retro-fitted ROPS and are more likely to understate the rollover risk of a tractor not equipped with a ROPS. Furthermore, deaths from tractor rollovers are

likely understated because a number of deaths from a tractor rollover are from non-farmers whose deaths are not fully counted as occurring in the agricultural industry (Kelsey 1992). Secondly, tractors equipped with ROPS require more space and oftentimes won't fit in space-constrained situations. Owners of tractors who encounter space issues are less likely to install a ROPS.

With the prevalence of deaths occurring in agriculture in general and from tractor rollovers in particular, the question of what impact this has on the local economy is worth considering. Over the years, there have been analyses completed which estimate lost income (Kelsey, 1992) or, as typically used in courts of law, estimating the loss of earnings for a wrongful death (Tinari, 2015). While these approaches serve a useful purpose, they do not attempt to understand the economic impact of a tractor rollover on the economy at large. This research serves to answer this question from an Iowa perspective.

Methodology

This analysis was completed with a combination of the 2015 Iowa IMPLAN dataset, data from the USDA 2012 Census of Agriculture, and other USDA/NASS and USDA/ERS sources. The IMPLAN modeling system and Microsoft Excel were used for calculating and tabulating the results of this analysis. While the 2015 IMPLAN dataset was used to calculate the economic impact results, they have been adjusted forward to 2016 dollars using inflation factors within the IMPLAN modeling system. Results shown throughout this report are presented using these common economic modeling terms:

- **Sales (Output)**
  - The broadest measure of economic activity – sometimes referred to as "output"
- **Employment (Jobs)**
  - A measure of job positions without regard to whether they are full-time equivalents
- **Value-Added**
  - Sales (output) minus the cost of inputs
- **Labor Income**
  - Proprietor income plus employee compensation; a sub-component of value-added

Scenario Definition

The defined scenario is that a primary farm operator prematurely dies from a tractor rollover at age 50. This leads to the following assumed response by remaining family[2]:

- No succession plan for farm in place, which implies a major disruption to farm operation
- Surviving spouse is without at least a portion of normal/expected income and therefore reduces household expenditures due to a smaller household
- No life insurance on deceased primary farm operator

[2] While not directly quantified in this study, repairs to damaged equipment will almost certainly be incurred. Additionally, the surviving spouse may, and often does, sell the farm equipment, which then requires the child to rent or buy equipment.

- Assume a reduction in purchases for the farm in the short term (1 yr) due to disruption
- In the absence of their spouse, the child and their family leaves their (and spouse's if working) current employment, leases the farm and assumes the responsibilities of the farm from the widow(er).
- The child's lease payments cover the widow(er)'s (reduced) living expenses

In this case the best approach to answer the research question is to model the loss of household income from the primary wage-earner's accidental death, which would be defined as the difference between what the farm net income was prior to his death and the lease payments to the widow(er) from the child. In our opinion, it is a safe assumption that after "the dust settles" (child fully assumes responsibilities) the farm-related expenditures (now made by the child and not the deceased parent) will be the same as prior to the deceased parent's death. Assuming a typical Iowa corn/soybean farm, the best option within IMPLAN for modeling reduced farm purchases and reduced household expenditures detailed below.

Reduced Purchases in Year 1

To model reduced purchases in year one within the IMPLAN modeling system, it is necessary to determine the sales per employee for Sector 1 (Oilseed Farming) and Sector 2 (Grain Farming) and factor that by 75% (implied 20% reduction in purchases). Sales per employee figures are found by using the "Customize Study Area Data" dialogue box within the IMPLAN software. Table 2 shows the default "per-worker) values for Sectors 1 and 2.

Table 2, Default Values per Worker by Sector

	Sector 1 (Oilseed Farming)		Sector 2 (Grain Farming)	
Output	$	1,178,946	$	563,045
Value-Added	$	396,431	$	139,223
Employee Compensation	$	4,705	$	7,545
Proprietor Income	$	336,690	$	44,003
Other Property Type Income	$	61,676	$	88,730
Tax on Production and Imports	$	(6,640)	$	(1,055)
Intermediate Expenditures	$	782,515	$	423,822

As described previously, we make the assumption that expenditures by the farm in transition will be reduced by 20% in year one following the premature death of the primary operator. Table 3 shows the resulting reduction in expenditures. These values are assumed to be the reduced expenditure "direct" effects of a premature death from a tractor rollover. IMPLAN is used to calculate the indirect and induced effects of this reduction and are included in the "Results" section of this report.

Table 3, IMPLAN Model Input Values

	Sector 1 (Oilseed Farming)		Sector 2 (Grain Farming)	
Output	$	235,789	$	112,609
Value-Added	$	79,286	$	27,845
Employee Compensation	$	941	$	1,509
Proprietor Income	$	67,338	$	8,801
Other Property Type Income	$	12,335	$	17,746
Tax on Production and Imports	$	(1,328)	$	(211)
Intermediate Expenditures	$	156,503	$	84,764

Reduced Household Expenditures

The second component of the analysis deals with the effects of reduced household expenditures by the surviving spouse .For the reduced household expenditures component, we can project what household expenditures would be during years 50-65 of the deceased farmer's life. To account for the time value of money, we calculate a discounted annual average (not the total discounted amount from all 15 years since that would artificially inflate the results) and reduce the corresponding household category within the IMPLAN modeling system. The assumed discount rate is 4%.

Figure 3 shows net cash income statistics for corn and soybean farms from 2010-2016F. Under the assumption of a 50/50 split toward each of corn and soybeans, we calculate an average for projecting net cash income per farm for what would have been ages 50-65 of the deceased primary farm operator. Using simple linear regression, we projected the “Average” net cash income series forward 15 years and discount (4%) each year back to 2016. Upon discounting each year back to 2016, we average these net cash income figures and obtain the discounted annual average net cash income. In keeping with the above assumptions, we reduce this net cash income by half to arrive at lower household expenditures by the surviving spouse. Our discounted annual average net cash income is $124,800; half of this is $62,400, which is used as a model input.

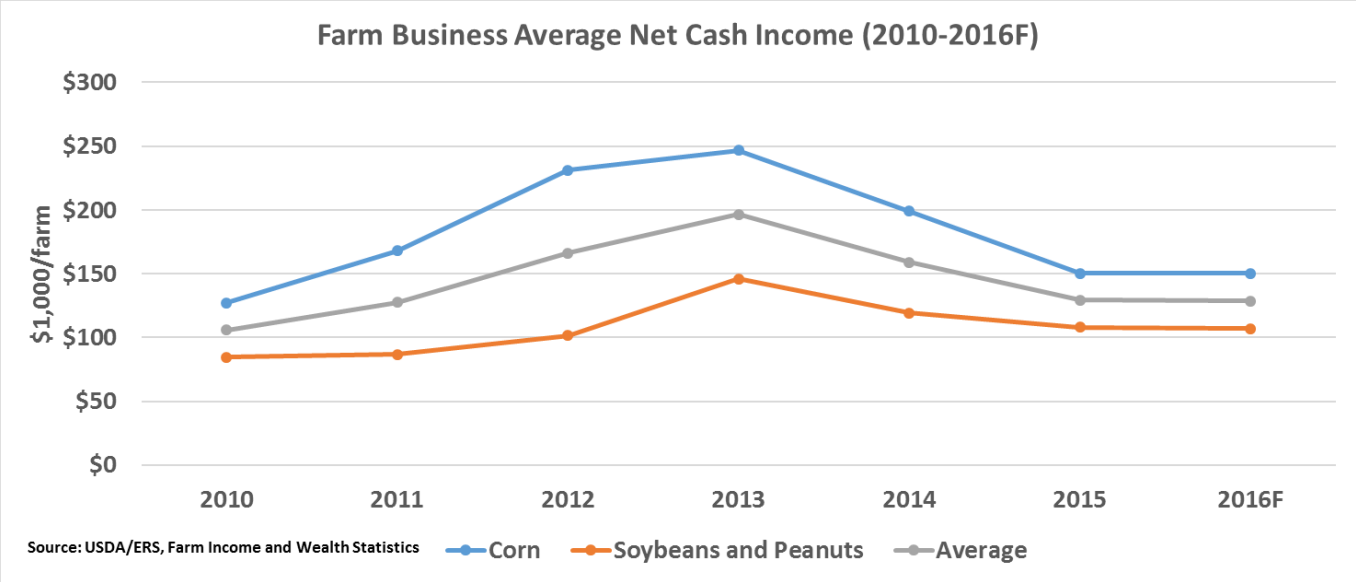

Figure 3, Farm Business Average Net Cash Income (2010-2016)

The IMPLAN modeling system has assumed household expenditure patterns by size of household income. The assumption being that households of differing size (measured monetarily) spend their income differently. To estimate the impact of reduced household expenditures, we created a "Household Income Change" activity and reduced the "Households 100-150k" category by $62,390. By definition, household expenditures are considered induced effects so there are no "direct" or "indirect" effects from reduced household spending. IMPLAN is used to calculate the effects of this household spending reduction and are included in the "Results" section of this report.

Results

The results of the economic impact study are presented in three formats: 1) a 20% reduction in farm expenditures, 2) a 50% reduction in household expenditures and 3) the total of a 20% reduction in farm expenditures and a 50% reduction in household expenditures.

Reduction in Farm Expenditures

As defined in the Methodology section, Table 4, Table 5 and Table 6 show the impact of a 20% reduction in farm expenditures in the first year following the tractor rollover death of the primary farm operator. As shown, the total impact from reduced farm expenditures is a reduction of 2.3 jobs, $148,000 in labor income, $241,000 in value-added and $537,000 in output. Tax impact results suggest a reduction of $13,844 and $30,166 at the state/local and federal levels, respectively (total of last row in Table 5 and Table 6).

Table 4, Reduction in Farm Expenditures Impact Summary

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	(0.3)	(53,064)	(73,563)	(241,267)
Indirect Effect	(0.5)	(28,889)	(57,520)	(108,820)
Induced Effect	(1.5)	(66,362)	(110,290)	(186,867)
Total Effect	(2.3)	(148,315)	(241,373)	(536,953)

Table 5, Reduction in Farm Expenditures State/Local Impact Summary

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Dividends					(55)
Social Ins Tax- Employee Contribution	(70)	0			
Social Ins Tax- Employer Contribution	(141)				
Tax on Production and Imports: Sales Tax			(4,203)		
Tax on Production and Imports: Property Tax			(3,979)		
Tax on Production and Imports: Motor Vehicle Lic			(200)		
Tax on Production and Imports: Severance Tax			0		
Tax on Production and Imports: Other Taxes			(300)		
Tax on Production and Imports: S/L NonTaxes			(17)		
Corporate Profits Tax					(669)
Personal Tax: Income Tax				(3,161)	
Personal Tax: NonTaxes (Fines- Fees				(516)	
Personal Tax: Motor Vehicle License				(352)	
Personal Tax: Property Taxes				(69)	
Personal Tax: Other Tax (Fish/Hunt)				(111)	
Total State and Local Tax	(212)	0	(8,699)	(4,209)	(724)

Table 6, Reduction in Farm Expenditures Federal Impact Summary

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Social Ins Tax- Employee Contribution	(4,965)	(2,874)			
Social Ins Tax- Employer Contribution	(4,847)				
Tax on Production and Imports: Excise Taxes			(748)		
Tax on Production and Imports: Custom Duty			(282)		
Tax on Production and Imports: Fed NonTaxes			(46)		
Corporate Profits Tax					(6,564)
Personal Tax: Income Tax				(9,842)	
Total Federal Tax	(9,811)	(2,874)	(1,075)	(9,842)	(6,564)

Reduction in Household Expenditures

As defined in the Methodology section, Table 7, Table 8 and Table 9 show the impact of a 50% reduction in household expenditures in the first year following the tractor rollover death of the primary farm operator. As shown, the total impact from reduced farm expenditures is a reduction of 0.8 jobs, $34,000 in labor income, $58,000 in value-added and $98,000 in output. Tax impact results suggest a reduction of $5,042 and $7,977 at the state/local and federal levels, respectively (total of last row in Table 8 and Table 9).

Table 7, Reduction in Household Expenditures Impact Summary

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.0	0	0	0
Indirect Effect	0.0	0	0	0
Induced Effect	(0.8)	(33,561)	(57,776)	(98,300)
Total Effect	(0.8)	(33,561)	(57,776)	(98,300)

Table 8, Reduction in Household Expenditures State/Local Impact Summary

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Dividends					(13)
Social Ins Tax- Employee Contribution	(26)	0			
Social Ins Tax- Employer Contribution	(52)				
Tax on Production and Imports: Sales Tax			(1,869)		
Tax on Production and Imports: Property Tax			(1,769)		
Tax on Production and Imports: Motor Vehicle Lic			(89)		
Tax on Production and Imports: Severance Tax			0		
Tax on Production and Imports: Other Taxes			(133)		
Tax on Production and Imports: S/L NonTaxes			(7)		
Corporate Profits Tax					(160)
Personal Tax: Income Tax				(694)	
Personal Tax: NonTaxes (Fines- Fees				(113)	
Personal Tax: Motor Vehicle License				(77)	
Personal Tax: Property Taxes				(15)	
Personal Tax: Other Tax (Fish/Hunt)				(24)	
Total State and Local Tax	(78)	0	(3,868)	(923)	(173)

Table 9, Reduction in Household Expenditures Federal Impact Summary

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Social Ins Tax- Employee Contribution	(1,825)	(167)			
Social Ins Tax- Employer Contribution	(1,782)				
Tax on Production and Imports: Excise Taxes			(333)		
Tax on Production and Imports: Custom Duty			(125)		
Tax on Production and Imports: Fed NonTaxes			(20)		
Corporate Profits Tax					(1,566)
Personal Tax: Income Tax				(2,159)	
Total Federal Tax	(3,607)	(167)	(478)	(2,159)	(1,566)

Reduction in Farm and Household Expenditures

As defined in the Methodology section, Table 10, Table 11 and Table 12 show the impact of a 20% reduction in farm expenditures and a 50% reduction in household expenditures in the first year following the tractor rollover death of the primary farm operator. As shown, the total impact from reduced farm expenditures is a reduction of 3.1 jobs, $182,000 in labor income, $299,000 in value-

added and $635,000 in output. Tax impact results suggest a reduction of $18,885 and $38,143 at the state/local and federal levels, respectively (total of last row in Table 11 and Table 12).

Table 10, Reduction in Farm and Household Expenditures Impact Summary

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	(0.3)	(53,064)	(73,563)	(241,267)
Indirect Effect	(0.5)	(28,889)	(57,520)	(108,820)
Induced Effect	(2.3)	(99,923)	(168,066)	(285,167)
Total Effect	(3.1)	(181,876)	(299,149)	(635,254)

Table 11, Reduction in Farm and Household Expenditures State/Local Impact Summary

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Dividends					(68)
Social Ins Tax- Employee Contribution	(96)	0			
Social Ins Tax- Employer Contribution	(194)				
Tax on Production and Imports: Sales Tax			(6,073)		
Tax on Production and Imports: Property Tax			(5,748)		
Tax on Production and Imports: Motor Vehicle Lic			(289)		
Tax on Production and Imports: Severance Tax			0		
Tax on Production and Imports: Other Taxes			(433)		
Tax on Production and Imports: S/L NonTaxes			(24)		
Corporate Profits Tax					(828)
Personal Tax: Income Tax				(3,855)	
Personal Tax: NonTaxes (Fines- Fees				(630)	
Personal Tax: Motor Vehicle License				(429)	
Personal Tax: Property Taxes				(84)	
Personal Tax: Other Tax (Fish/Hunt)				(135)	
Total State and Local Tax	(289)	0	(12,567)	(5,133)	(896)

Table 12, Reduction in Farm and Household Expenditures Federal Impact Summary

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Social Ins Tax- Employee Contribution	(6,790)	(3,041)			
Social Ins Tax- Employer Contribution	(6,628)				
Tax on Production and Imports: Excise Taxes			(1,080)		
Tax on Production and Imports: Custom Duty			(407)		
Tax on Production and Imports: Fed NonTaxes			(66)		
Corporate Profits Tax					(8,130)
Personal Tax: Income Tax				(12,001)	
Total Federal Tax	(13,418)	(3,041)	(1,553)	(12,001)	(8,130)

Additional Considerations

Given the adoption of ROPS began in earnest in 1986, the number of tractors without ROPS continues to decline. However, due to the continued use of older tractors by farmers and non-farmers alike, the number of tractors without ROPS remains higher than what was expected at this point in the 1980s. To continue the pace of ROPS adoption, and perhaps accelerate their installation, additional communication attempts should be made with groups of tractor owners less likely to see a need for ROPS. A prime group which falls into this category are older farmers who are normally less likely to see the need for a retro-fitted ROPS and are more likely to understate the rollover risk of a tractor not equipped with a ROPS.

To address the cost issue, a rebate program in conjunction with additional communication efforts would further increase the number of ROPS-equipped tractors. For example, in at least five states (New York, Vermont, New Hampshire, Wisconsin and Massachusetts), there is a rebate program which helps defray the cost of installing a retro-fitted ROPS. By offering and using this rebate program, one of the two primary objections (seeing a need and cost) for installing a retrofitted ROPS is directly addressed, which allows the focus to turn to addressing objections related to seeing a need.

Also critical to reducing the number of deaths attributed to tractor rollovers is an emphasis on safe tractor operation techniques, *including the proper use of seatbelts*, particularly with regard to tractors with narrow front tire spacing. These types of tractors are especially prone to rollover on uneven or sloped terrain.

A final consideration related to premature deaths from tractor rollovers is the loss of expertise, which is difficult to quantify, but is a real consideration given that the average age of Iowa farmers is approaching 60. If a farmer prematurely dies from a tractor rollover, there will be direct/indirect costs for training and at least temporary poor farm outcome due to lack of experience.

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