Nonfatal Farm Injuries in North Dakota: A Sociological Analysis*

Jack M. Geller, Richard L. Ludtke, and Terry Stratton

ABSTRACT: The 1980s has not been a particularly prosperous decade for many farm operators. Due to shifts in the agricultural economy, many farmers have experienced farm foreclosure and rural displacement; while many more are at serious risk of losing their farms. Within the context of the agricultural crisis, this study examines the impact of economic hardship on the probability of experiencing a farm injury. Specifically, we hypothesized that farm operators who were experiencing economic distress would be more likely to experience a farm injury. Data from the North Dakota Rural Life Poll (n=450) was used to estimate the incidence of farm accidents, as well as examine the relationship between selected farm operator characteristics and the incidence of a farm accident. The data suggests that younger farm operators with higher debt-to-asset ratios are significantly more likely to experience a farm accident. The study goes on to examine some of the dynamics of this relationship, and implications for farm safety education are addressed.

Recently, much attention has been focused on agricultural health and safety. Specifically, interest has grown as we have come to realize that with 49 deaths per 100,000 workers in 1987, agriculture is, and has been for some time, the nation's most dangerous industrial division (National Safety Council, 1985-1988). Additionally, it is interesting to note that occupational death rates among the three most dangerous industrial divisions (i.e. agriculture, mining and construction) indicate that agriculture has witnessed the greatest proportional increase since 1984 (see Table 1). Even more interesting is the fact that the increase occurred during a period in which the number of persons actively engaged in farming decreased.

In addition to being the most dangerous industrial division, agriculture is unique for several reasons. First, unlike many other industries, agricultural work must often be performed under the most adverse conditions, such as snow, mud, extreme temperatures and long hours. Second, the agricultural labor force is extremely diverse. Because most farm enterprises are categorized as "family farms" (U.S. Bureau of the Census, 1984), the use of spouses, children, and other relatives as laborers is common. Furthermore, these family members are often utilized without regard to any established guidelines for their competency, training, or safety. Conse-

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Table 1. Occupational Death Rates* of the Three Most Dangerous Industrial Divisions.

Industrial Division	1984	1985	1986	1987	Percent Change 1984-1987
Mining	60	50	50	38	-36.7
Construction	39	37	33	35	-10.3
Agriculture 46	49	52	49	+6.5	

* Death rates are deaths per 100,000 workers.

Source: Accident Facts. 1985-1988, National Safety Council.

quently, as an industrial division, agriculture has, by far, the highest reported number of injuries and deaths to children (Field & Tormoehlen, 1982; Stallones, 1989; Tormoehlen, 1986). In a recent Wisconsin study (Tormoehlen, 1986) it was reported that 24 percent of the farm fatalities from tractor accidents between 1970 and 1984 involved children under the age of 14. Third, unlike other industries, there is no uniform system for reporting nonfatal farm accidents in the United States. Farms are only required to follow Occupational Health and Safety Administration (OSHA) reporting regulations if the operation employs 11 or more employees. According to the last Census of Agriculture, less than 5 percent of all farms met that requirement. Consequently, in most cases, when a farmer has a nonfatal accident, it is likely to remain unreported.

Finally, Purschwitz and Field (1987a) have reported that when federal funding levels for occupational safety are calculated on a per worker, per fatality, or per-disabling injury basis, the discrepancy in funding between agriculture and all other industries is striking. For example, they reported that while federal spending on occupational safety per worker in 1986 averaged $4.34 per worker across all industrial divisions, only $0.30 was spent per agricultural worker. Mining received the highest federal expenditures in occupational safety, $181.68 per worker (see Table 2).

Much of the literature on agricultural health and safety tends to approach the issue from either a medical or an epidemiological perspective. The medical perspective, tends to examine the farm as an environment where workers have a high exposure to many specific illnesses or conditions (Braun, 1980; National Rural Health Care Association, 1986; Whiting, 1975). These studies tend to chronicle environmentally induced conditions or illnesses in which the farmer's risk is especially high (such as farmer's lung disease, chronic hearing loss, skin cancer, and organic dust toxicity syndrome).

Table 2. Federal Dollars Spen

Industrial Sector	$/Worker
Agriculture	0.30
Mining	181.68
All	4.34

Source: Purschwitz and Field (1987).

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Table 2. Federal Dollars Spent on Occupational Safety (1986).

Industrial Sector	$/Worker	$/Deaths	$/Disabling Injury
Agriculture	0.30	606.25	5.71
Mining	181.68	363,366.00	542.00
All	4.34	39,769.57	230.66

Source: Purschwitz and Field (1987).

The epidemiological perspective (Fanning, 1982; 1987; Kinde, 1988; Layde, 1989; Murphy, 1985; Purschwitz & Field, 1987b) tends to focus on the agricultural accident as the unit of analysis. Detailed data on the type of accident, location of the accident, the external agent involved in the accident, the time of day, month of the year, and the part of the body affected are analyzed to discern trends in accident patterns.

The purpose of this study is to attempt to analyze farm accidents from a sociological perspective—specifically, to examine farm accidents within the greater context of the agricultural crisis of the 1980s. Since 1981, the combination of Iowa farm prices, low farm income, and slumping land values has created a serious debt problem in agriculture (Boehlje, 1984; Jennings, 1984; Jolly & Barkema, 1985; U.S. Department of Agriculture, 1985). A dramatic example of this economic decline was a report that estimated that the average net worth of farm operators in Iowa declined 25 percent between 1984 and 1985 (Jolly & Barkema, 1985).

Sociological analyses of the "farm crisis" have chronicled many of the psychological and familial effects of economic hardship on farm operators and farm families (Bultena, Lasley & Geller, 1986; Geller, 1986; Geller, Bultena & Lasley, 1988; Heffernan & Heffernan, 1986; Kettner, Geller, Ludtke & Kelly, 1988). In a study of recently displaced farm families, Heffernan and Heffernan (1986) described the upheaval in these families as they withdrew from family and friends, experienced depression, mood swings, and an uncertain future. Geller (1986) and Bultena et al. (1986) found that financial distress among farm families significantly impacted the number of financial adjustments operators were making at home, stress levels of farm operators, feelings of alienation, and the political orientation of farm operators. It is also interesting to note that many of these psychological and familial impacts are found in the literature on mass unemployment, e.g. unemployed steelworkers in Ohio, or autoworkers in Michigan (Buss, Redburn & Waldron, 1983).

Many of the sociological studies have also found that although economic hardship was being experienced throughout the farm population, it was the

younger farmers that were being disproportionately affected. This was primarily due to the fact that many of these younger operators entered into farming in the mid- to late 1970s when land prices were soaring along with inflation. These operators had to pay highly inflated prices and borrow at high interest rates to gain their entry into agriculture. Subsequently, as the farm economy declined in the early 1980s, it was these same operators who were most at-risk of foreclosure (Campbell, Heffernan & Gilles, 1984).

Although the literature cited above has examined many of the psychological and familial impacts of the farm crisis, we were unable to find any discussion regarding the association between economic hardship and farm injuries. We found this somewhat surprising in that we would suspect that operators who are experiencing financial and family problems may be preoccupied while working and, consequently, be more susceptible to experiencing a farm injury. Additionally, previous studies (Geller, McDonald & Kettner, 1987; Stofferahn, 1988) have documented that in an attempt to save money, many farmers have reduced spending in areas they perceive as nonessential (e.g. entertainment expenses, medical and life insurance). We suspect that farmers who are experiencing financial distress may perceive the financial costs associated with safety as nonessential. Consequently, we hypothesized that operators who were experiencing financial distress would be more likely to experience a farm injury.

Methodology

Data for this study came from the 1987 North Dakota Rural Life Poll. The poll is an annual statewide survey of North Dakota's rural residents. Questionnaires are mailed out to two target groups: farm operators and small-town residents (population fewer than 2,500). Data for this specific study came from the 450 respondents who were farm operators.

In January and February of 1987, questionnaires were mailed to a sample of 1,000 North Dakota farm operators. The sampling frame was developed through county-generated Agricultural Conservation and Stabilization (ASCS) farm operator lists from all North Dakota counties. These lists contain names of all farm operators in the county who participate in any part of the federal farm program.

Of the 1,000 farmers sampled, 46 were either retired, deceased, or sent the questionnaire back refusing to fill it out. Of the 954 valid questionnaires, 450 were returned, yielding a response rate of 47 percent. Due to the marginal response rate, comparisons between the survey sample and the Census of Agriculture were made for the purpose of assessing the representativeness of the sample (See Table 3). Variables that were comparatively analyzed were age of operator, size of farm and commodities produced. The analysis suggested an underenumeration of farms in the smallest size category. However, this is not surprising as many small, less mechanized

Table 3. Comparison between of Agriculture on Sel Characteristics.

Characteristic
Mean Age of Operator (years)
Percent Farms Raising:
Barley
Wheat
Edible Beans
Dairy
Sugar Beets
Potatoes
Means Size of Farm (acres)
Percent of Farms by Size:
under 50 acres
50 - 179 acres
180 - 499 acres
500 - 999 acres
1,000 - 1,999 acres
2,000 acres or more

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Table 3. Comparison between Study Sample and 1982 Census of Agriculture on Selected Operator and Farm-Firm Characteristics.

Characteristic	Census of Agriculture	Study Sample
Mean Age of Operator (years)	47.3	47.1
Percent Farms Raising:		
Barley	33.7	32.9
Wheat	80.4	89.6
Edible Beans	4.9	2.5
Dairy	10.1	7.4
Sugar Beets	2.3	3.9
Potatoes	1.8	1.1
Means Size of Farm (acres)	1,104	1,486
Percent of Farms by Size:		
under 50 acres	6.2	0.7
50 - 179 acres	8.7	1.5
180 - 499 acres	18.0	12.1
500 - 999 acres	26.8	24.5
1,000 - 1,999 acres	27.6	40.3
2,000 acres or more	12.7	20.9

farm operators are not likely to participate in the farm program and consequently not be in the sampling frame. Additionally, some of the differences between the census and the sample statistics may be a function of the changes in the structure of agriculture in North Dakota during the five-year period since the census was conducted (1982-1987). Given these factors, we would suggest that the sample is a reasonably good representation of the 1987 North Dakota farm population.

Operational Definitions

The primary dependent variable was the incidence of a farm accident during the 12 months preceding the receipt of the survey. This variable was operationalized using two dichotomous questions. The first asked whether the operator had experienced a major farm accident requiring hospitalization and/or a physician's care during the previous 12 months. The second question asked operators if they had experienced a minor farm accident which was treated at home during the previous 12 months.

It should be noted that this is a very simple measure, and the potential for error is difficult to assess. First, some injuries, such as a sprained ankle or knee can disable a farmer for several days without being treated by a professional health care provider. Thus, the major-minor distinction may not be as precise as we would like. Second, and perhaps more important, is the fact that injuries are recorded through self-reports by farm operators. Consequently, it is difficult to assess how accurate these self-reports may be.

Independent variables in the study were sociodemographic, financial, and attitudinal in nature. Specific variables examined were: age of operator, financial status of farm operation, financial orientation toward farm safety, and ability to concentrate on farm work. These variables were operationalized in the following manner.

1. The age of the operator was recorded in chronological years.

2. The financial status was operationalized using the debt-to-asset ratio of the farm operation. Respondents were asked to estimate the current market value of their farm assets, as well as their total liabilities. Liabilities were then divided by assets to create a ratio. Debt-to-asset ratios are routinely used by agricultural economists to estimate a farmer's equity in his or her operation (Bultena et al., 1986; Jolly, 1984; Lasley, 1984; Melichar, 1984). If an operation has assets of $500,000 and a 0.50 debt-to-asset ration, essentially the operator owns $250,000 of the operation, and his or her creditors own the other $250,000. The larger the ratio, the less equity the farmer has in the operation. As a general rule of thumb, operators with debt-to-asset rations less than 0.10 are thought to be virtually debt free. Ratios between 0.10 and 0.40 are thought to be manageable. Ratios between 0.41 and 0.70 generally indicate financial strain in the farm operation. And operators with debt-to-asset ratios greater than 0.70 are thought to be at serious risk of foreclosure (Lasley, 1984; Melichar, 1984).

3. Financial orientation to farm safety was operationalized by asking farmers if they believed that it was necessary under current economic conditions to "cut corners" on safety to save money. Respondents selected from a five-point Likert scale ranging from strongly agree to strongly disagree.

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4. Finally, ability to concentrate on farm work was operationalized by asking operators if they had found it more difficult to concentrate on their farm work this year than last year. Again, as in the previous question, respondents selected from a five-point Likert scale ranging from strongly agree to strongly disagree.

Statistical Analysis

Congruent with the study objectives, two types of analyses are presented. First, univariate statistics are presented to document the incidence of farm accidents among the sample population. Univariate statistics using both farm operators and farm accidents as the unit of analysis are presented. Second, bivariate cross tabulations between the independent variables and the incidence of farm accidents are presented to examine the strength and direction of the hypothesized relationships. Chi-square statistics are utilized to test the statistical significance of these relationships.

Findings

Table 4 presents data on the incidence of farm accidents among the sample of North Dakota farm operators. Approximately one out of every five farm operators (20.9%) experienced some type of farm accident in 1986. Of those operators reporting an accident, 8.5 percent experienced a major farm accident, 18.0 percent experienced a minor farm accident and 5.5 percent percent experienced both a major and a minor farm accident in 1986. In examining the accidents themselves, 119 accidents were reported, of which 32 percent were major accidents and 68 percent were minor.

Table 5 presents the bivariate analysis between the independent variables and the incidence of farm accidents. Each analysis is described below.

Age. The age of the farm operators averaged 47 years, with 24 years of farming experience (Note 1). As one can readily see, the probability of experiencing a farm accident is not equally distributed across all age cohorts ($p < 0.01$). Younger farm operators consistently reported a greater incidence of accidents approximately four times as often as the cohort of farmers who were aged 61 years and more. This finding is consistent with previous studies documenting that younger farmers are also more likely to experience financial distress. It should also be noted that the relationship is monotonic.

Financial status. Debt-to-asset ratios among the sample ranged from 0.0 to well over 1.0 (where operators had more debt than assets). Thirty-one percent of the operators had ratios less than 0.10; 25 percent had ratios ranging from 0.11 to 0.40; 24 percent had ratios ranging from 0.41 to 0.70; and

Table 4. Frequency of Farm Accidents among Surveyed North Dakota Farm Operators (1986).

Unit of Analysis	Number	Percent
Operators		
Total reporting a major accident	38	8.5
Reporting only a major accident	13	2.9
Total reporting a minor accident	81	18.0
Reporting only a minor accident	56	12.4
Reporting both a major and a minor accident	25	5.6
Total reporting an accident	94	20.9
Did not report an accident	356	79.1
Accidents		
Major accidents reported	38	31.9
Minor accidents reported	81	68.1
Total accidents reported	119	100.0

20 percent had ratios that were 0.71 or greater. Again, as one can readily observe from the data in Table 5, there is a significant relationship ($p < 0.01$) between these variables. Operators with debt-to-asset ratios greater than 0.70 are more than twice as likely to report a farm accident than operators who reported debt-to-asset ratios of less than 0.10. Again, it should be noted that the relationship is monotonic.

Financial orientation toward farm safety. When asked if they believed that it was necessary to cut corners on safety to save money, approximately 23 percent agreed with this statement, while 72 percent disagreed, and 5 percent were uncertain. As Table 5 indicates, approximately 27 percent of those operators who agreed with the statement experienced a farm accident, while only 19 percent of those operators who disagreed with the statement experienced a farm accident. Although the 8 percentage point difference is important, statistical tests failed to support the hypothesis that these two groups were statistically different ($p = 0.167$).

Table 5. Incidence of Farm A Financial Orientati to Concentrate.

Independent Variable
Age
< 30
30 - 40
41 - 50
51 - 60
61 and over
Chi-Square = 23.71 P = 0.0001
Debt-to-Asset Ratio
≤ 0.10
0.11 - 0.40
0.41 - 0.70
0.71 and over
Chi-Square = 14.64 P = 0.0022
Financial Orientation toward Farm
Agree with need to cut corners
Uncertain
Disagree with need to cut corners
Chi-Square = 3.58 P= 0.1673
Ability to Concentrate
Had more difficulty
Uncertain
Had no more difficulty
Chi-Square = 9.71 P = 0.0078

ong Surveyed North Dakota

ber	Percent
	8.5
	2.9
	18.0
	12.4
	5.6
	20.9
	79.1
	31.9
	68.1
9	100.0

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Table 5. Incidence of Farm Accident by Age, Debt-to-Asset Ratio, Financial Orientation toward Safety and Ability to Concentrate.

Independent Variable	Had an Accident	No Accident	(N)
Age			
< 30	39.0	61.0	(59)
30 - 40	27.6	72.4	(105)
41 - 50	20.2	79.8	(94)
51 - 60	14.1	85.9	(99)
61 and over	9.5	90.5	(84)
Chi-Square = 23.71 P = 0.0001			
Debt-to-Asset Ratio			
≤ 0.10	14.9	85.1	(114)
0.11 - 0.40	17.0	83.0	(94)
0.41 - 0.70	24.2	75.8	(91)
0.71 and over	36.8	63.2	(76)
Chi-Square = 14.64 P = 0.0022			
Financial Orientation toward Farm Safety			
Agree with need to cut corners	27.2	72.8	(103)
Uncertain	26.1	73.9	(23)
Disagree with need to cut corners	18.8	81.2	(318)
Chi-Square = 3.58 P= 0.1673			
Ability to Concentrate			
Had more difficulty	25.0	75.0	(180)
Uncertain	2.7	97.3	(37)
Had no more difficulty	20.1	79.9	(159)
Chi-Square = 9.71 P = 0.0078			

Ability to concentrate. Finally, farm operators were asked if they were having more difficulty concentrating on their farm work this year than last year. Approximately 55 percent of the respondents agreed with this statement, 36 percent disagreed, and 8 percent were uncertain. Again, Table 5 presents the cross tabulation of farmers' ability to concentrate by the incidence of a farm accident. In this analysis, there is a significant difference in the incidence of reported accidents across these two groups ($p < 0.01$). While 20 percent of the respondents who disagreed with the statement reported experiencing a farm accident, 25 percent of those who agreed with the statement similarly reported an accident. It should also be noted that only 2.7 percent of those respondents who reported that they were uncertain experienced a farm accident, and this appears to disrupt the monotonic trend. However, one must recognize that only 37 respondents (8%) reported being uncertain. Of these, only one respondent reported an accident. Consequently, the percentages appear to be extreme. Further analysis comparing just those operators who agreed with those who disagreed failed to meet the statistical criteria for significance ($p = 0.312$).

Discussion

The purpose of this study was to examine the incidence of farm accidents and specifically test the hypothesis that farm operators who are experiencing financial distress are more likely than other farmers to experience a farm accident. The findings suggest that farm accidents are not random incidents, i.e., they are not randomly distributed throughout the farm population. Rather, there are discernable patterns that distinguish high-risk operators from low-risk operators. Specifically, high-risk operators tend to be younger and have higher debt-to-asset ratios. These findings appear to support the hypothesis that financially distressed farmers are more likely to experience a farm accident.

The study also provides some insight as to why financially distressed farmers are experiencing higher rates of farm injuries. In many ways, the findings suggest that the increasing death rates in agriculture is somewhat a function of working in an industry on the margin. Farming in the 1980s has not been particularly profitable for many farmers. This decade has witnessed a substantial amount of farm foreclosures and rural displacement. Farmers, possibly preoccupied with their finances, may be finding it more difficult to concentrate on their farm work and may be needlessly placing themselves at risk. Additionally, while not statistically significant, the analysis discerned a trend that suggested that many farmers in an attempt to save money wherever they can, may be cutting corners on safety and placing themselves at greater risk.

This study has direct implications for the development of strategies to reduce the number of farm accidents. Most of the thrust in farm safety today

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focuses on education to teach farm operators about the dangers of their occupation, and engineering designs oriented toward building better safety equipment. However, this study suggests that a significant number of farmers may be intentionally choosing to disregard safety equipment. Almost one in four farmers surveyed agreed that it was necessary to cut corners on safety to save money. Consequently, it can be argued that traditional safety education will not likely be effective for this segment of the farm population.

The same argument can be made regarding safety equipment. The most innovative safety advances in agricultural engineering will be ineffective if farmers choose not to use or maintain the equipment. Farm operators must somehow be convinced that the costs of cutting corners and not maintaining safety equipment is higher than the costs of keeping their safety equipment in good working order.

In its report "Agriculture at Risk: A Report to the Nation," (1989), the National Coalition for Agricultural Safety and Health called for a federal response to the need for more education and research on agricultural safety. Given the relatively meager amount of federal funds that have been spent on occupational safety in agriculture, we believe that a federal response is in order.

NOTES

1. Data were also collected and analyzed on the number of years the operators had been actively farming. However, this variable correlated so strongly with age ($r = 0.88$) that reporting its association with the incidence of farm accidents would have added no new information. Consequently, it was omitted from the text.

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Book Reviews

Michael E. Samuels*
Book Reviews Editor

HENK, MATTHEW L. (Ed
Park, CA: Sage Publicatio
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Social workers and othe
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