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Safe behavior and level of knowledge regarding safe work practices on farms

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Abstract

The dangers in agriculture are lately being increasingly discussed; each farm has to complete a risk assessment. People living on a farm have to be aware of the hazards associated with agricultural work and search for ways to address those risks. The poll was based on the questionnaire which included questions regarding the knowledge of safe behavior and safe work practices. The survey showed the state of safety culture on farm, attitudes towards safety and frequency of use of safer methods of work. The survey was conducted among farmers in the Republic of Slovenia. The sample was relatively small, but sufficiently representative to show the situation in this area. We should be aware that Slovenia is a country with little more than two million inhabitants and a small representative sample was enough to find characteristic statistical variables. Overall rating following the results of the survey is that farmers are aware of the hazards at their work, they acknowledge the dangers, but they do not take steps to minimize the threat. The relationship between knowledge and behavior was determined by means of structural equation modeling.

Keywords: Safety, danger, risk, farm.

Introduction

Risks and hazards in agriculture, resulting in injuries and deaths are a global problem. The level of awareness in this area is linked to the overall level of development of the country or region. However, research shows that even in developed countries, the level of safety culture in the areas of agriculture is at a low stage. An American research[1] conducted in two agricultural high schools showed inadequate knowledge of students regarding safety work practices on farms. It is asserted that the farm tractors are the major cause of fatalities in Turkey agricultural regions[2]. The frequency of occupational accidents on Swedish farms is also high[3]. Yearly, in Sweden, per 1,000,000 persons, 11.6 fatal accidents happen among those with farming as a main occupation[4]. Inadequate knowledge and poor attitude to safety in agriculture is reflected in the regulations and rules for safety at work. It is also reflected in Slovenia. The small country with a long agricultural tradition of small farms has low awareness of safety culture in particular in the segment of small farms. The high number of accidents (with very high casualties and non-registered injuries) sometimes with high fatal rates requires a more thorough assessment of the situation in agriculture.

The farmer acts as an employer and an employee at the same time, so the relationship to safety at work can simply not be regulated by simple written instructions for safety at work. Only when the farmer recognizes that the risk assessment reveals a dangerous working environment and dangerous method of work, he will decide to eliminate this risk. He will follow the instructions for safety at work and he will act upon them, but the real impact will be achieved with the Law Regulations on safe and healthy work. For a concept it is necessary, to first gain the knowledge and have the desire to protect the health and life of their nearest, usually associates, on the farm. Relations on the farm are significantly different than in a factory, shop, laboratory or school. Before anyone prepares for training it is necessary to know what the Slovenian farmer already knows, what hazards that surround him and how he tries to reduce risk at work.

Material and Methods

Sample of farms: We tried to determine the status of safety at work in agriculture. We selected a small sample which is sufficiently representative. We interviewed 94 farmers in the entire country; the pattern was consistent across all types of farms in terms of surface area, composition and location. The selection was done randomly without any specific plan of selection. The purpose of this investigation was to direct safety experts on the field with a definitive approach to assess the true risks and eliminate hazards on farms.

The present sample represents only 0.129% of farms (according to the 2007 census 72,341 farms had more land than 1hc). The relation between farms with basic and supplementary activity is therefore 30:70 in the year 2001. In our survey, 37 farms are engaged in core business and 57 farms in gainful activities. The relationship is therefore 40:60. Given the changes in the last nine years, we can conclude that this ratio is close to the actual proportions in the farm population.

The division of farms by size indicates that the sample approximates a normal distribution with an average of 15.7 hc total area, 9 hc of tilled ground and grassland. In comparison to the data in the 2001 census the survey covers a large proportion of farms with large land. Only tilled ground and grassland areas are considered. With the

exception of the first column the distribution of farms by area in the survey and 2007 census are comparable.

Farms in Slovenia are numerically well-equipped with machines, the number of tractors is relatively high, but the quality and appropriateness of these tractors is questioned.

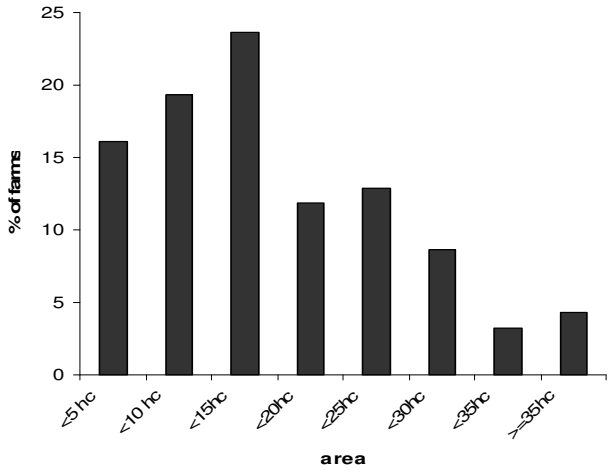

Figure-1
Proportion of farms from the surface in the sample

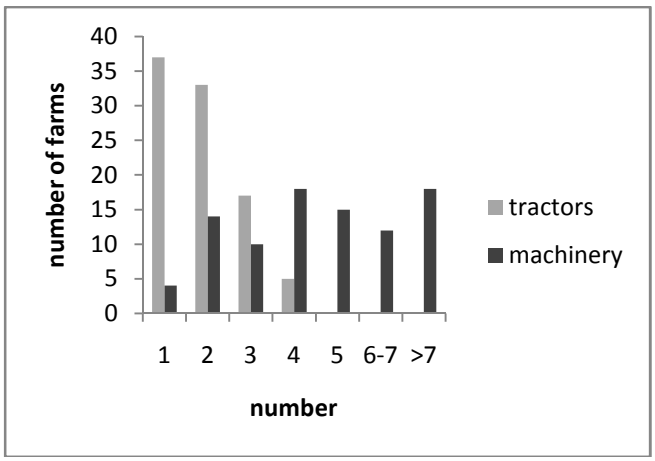

Figure-2
Number of farms, depending on the number of tractors and other machinery

General information about safety at work: The questionnaire consisted of general questions about safe work on farms and safe work with the farm's machinery. The answers have no objective quantitative but subjective quality values; they are a result in the sense of individual or even a general belief which is created by the media or public opinion. However, responses measured the respondent's feelings to several related questions. Therefore, we set a few questions in the survey that are associated with the level of danger at work. We asked farmers what they think in general about work on the farm, working with a tractor and working with livestock. The results of the answers are shown in the next histogram.

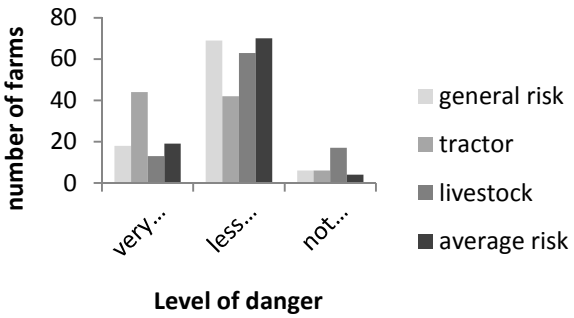

Figure-3
The level of dangers at work in the farm

The histogram shows that only work on a tractor is dangerous, all the other jobs based on the view of respondents are less dangerous. Average responses are well covered by replying to the general question regarding the dangerous work on the farm. Apparently the tractor is seen as very dangerous by almost half of the respondents; the risks are classified by the level of danger as follows:
Roll over with a tractor on site, brake failure, to roll back, freewheel axis to fall under the wheels of the tractor or trailer, tractor attachments.

On the question of comparing farm work with other jobs in the industry, 14% of respondents replied that farm work can be compared with work in the iron and steel industry; 14% work in a chemical factory, 16% work in a closed warehouse and 56% to work in the open repository. Although the comparison is almost impossible, the risk parameters are properly assessed.

On the question of how a heavy load can be determined without detriment to health, we get answers of concern. Many of them (more than half) believe that they can raise heavy loads (>30 kg).

Table-1
Frequency responses of the allowable cargo weight lifting by hand

kg	10	15	20	25	30	35	40	45	50
frequency	5	2	4	16	18	11	17	3	17

Noise: The farmers in Slovenia, particularly the ones from smaller farms, own much older tractors and machines which usually exceed permitted noise levels. Most farm machines produce high noise levels and these levels cannot be significantly reduced (chain saw, circular saw, silage machines, etc.). It would be expected that a farmer would protect himself against the noise like the factory workers. The frequent exposure to noise is significantly lower compared to eight-hour work in a factory, but the farmer should be aware of threats that emerge at his work. The responses related to dangers of high noise levels show that respondents know enough about the noise and its dangers. On the question which machine noise harms humans the most they declared: chainsaw (77), tractor (48), lawn

mower (45), combine harvester for silage (23), combine harvester (15), grinder (10), circular saw (8) and other (17).

This corresponds well enough to answer the following questions about the hazards of high noise levels of motor saws and tractor.

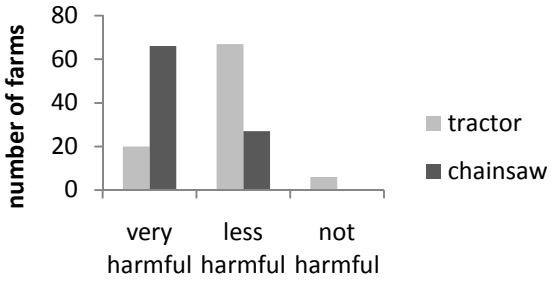

Figure-4
Harmfulness of noise

Use of personal protection equipment (PPE): Generally, it is believed that farmers do not use personal protection resources. The survey shows that although they know great deal about it, they usually act differently. In questions where proper use of personal protection equipment had to be selected, in most cases the farmers answered correctly. Generally they do not usually use it. On the question which protective gloves they are supposed to use for work in the forest, 70% of the respondents chose the correct gloves and 30% selected the improper answer. The function of a facial shield is also not clear:

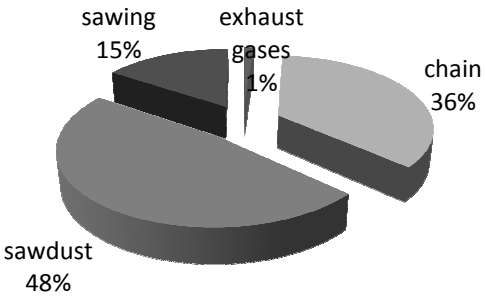

Figure-5
The reason for wearing face shield when using power saws

Several questions were related to frequency of use of personal protection equipment or at least what the farmers use to replace it.

A better overview is enabled if individual values are considered. The farmers usually use safety glasses when overflowing sprays or at least they are aware that the glasses should be used. Less important is the consideration of special clothing for spraying or working with artificial fertilizers as less important. If questioned whether they use ear plugs when sawing, there would certainly be more negative responses.

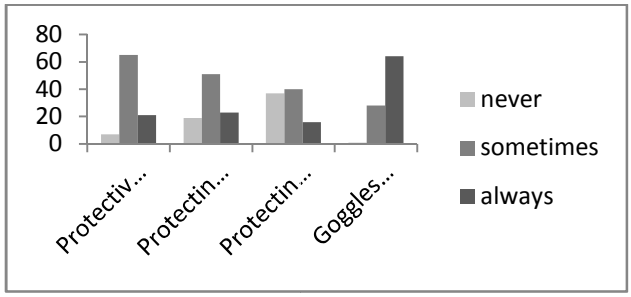

Figure-6
The frequency of using personal protective equipment

Accidents: We also asked ourselves whether the accidents at work occur. Respondents replied that on 11 farms major incidents and on 50 farms small (one or more) incidents occurred. Of course the time was not limited, but it nevertheless shows that accidents on farms are not a rare phenomenon. We also asked what a larger and what a smaller-sized disaster means to farmers. This assessment was left to respondents to determine. Most respondents were also aware of incidents at work with livestock. Most of them think that the hazard of working with livestock is high. Of course, they know less about how to protect themselves against these dangers and a minority actually knows how to protect itself. The survey also included the question regarding the number of casualties in tractor accidents compared to the traffic accidents:

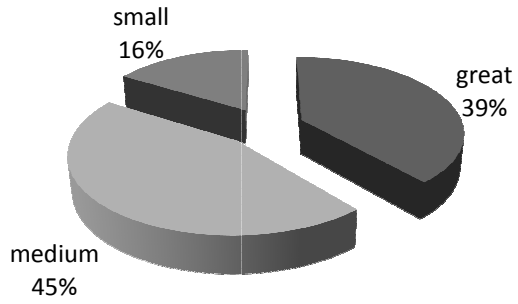

Figure-7
Opinion on the number of accidents by tractor compare to traffic accidents

Education: The development of an effective safety culture is essential to promote safe operations[5]. Most farmers acknowledged that they know very little about safety work on farms. The diagram illustrates the state of knowledge and confirms previous answers in the survey.

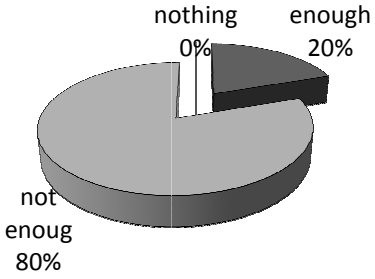

Figure-8
How many farmers know about safety work on the farm?

Table-2
A sample covariance matrix of 12 indicators

	spray	**PPE livestock**	**PPE spray**	**PPE fertilizers.**	**waste oil**	**tractor**	**live-stock**	**Chain saw**	**farm**	**area**	**number of people**	**equipment**
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.20											
2	-0.02	0.32										
3	-0.08	-0.03	0.24									
4	-0.08	-0.07	0.17	0.28								
5	-0.04	-0.13	0.09	0.08	0.43							
6	0.04	0.11	-0.06	-0.06	-0.07	0.25						
7	0.07	0.02	-0.14	-0.10	-0.08	0.05	0.26					
8	0.03	0.06	-0.03	-0.01	-0.01	0.09	0.00	0.23				
9	0.02	0.07	-0.06	-0.07	0.01	0.10	0.10	0.04	0.22			
10	1.56	1.52	0.14	1.28	-1.12	-0.39	1.13	0.42	2.24	196.87		
11	0.08	-0.05	0.11	0.15	-0.23	-0.06	-0.02	-0.10	0.04	5.51	1.49	
12	0.13	0.06	-0.06	0.08	-0.22	0.06	0.25	0.11	0.45	18.97	1.21	4.30

(Personal protection equipment = PPE)

Most of them want to self-educate but they do not know how to do that. This is evident from the answers on the questions regarding the reading of the instructions of the new machine. 20% of respondents read the instructions carefully; the rest (80%) only superficially. Therefore the distribution of brochures on safety at work would likely have a minimal effect.

Relationship between knowledge, behavior and size of farm: By using structural equation modeling[6, 7] it allows us to search for correlations between latent variables, visible only through indicators. We selected three latent variables connected with 12 indicators by factor analysis. Five indicators of safe behavior and conduct in management of agriculture were chosen: the choice of sprays (spray), use of personal protective equipment when working with livestock (PPE livestock), and use of personal protective equipment when spraying (PPE spray), use of personal protective equipment when working with artificial fertilizers (PPE fertilizers) and management of waste oils (waste oil). The above mentioned indicators of safe conduct are by no means the only ones, but have the strongest influence on the variable, which provides secure handling.

The next group of indicators shows the level of knowledge in the field of safety. Can farmers recognize the real sources of danger, have they been properly informed of the risks they are exposed to at work. These questions were assessed with the following indicators: risk assessment when working with tractor (tractor), risk assessment when working with livestock (livestock), risk assessment when working with a chain saw (chain saw), a general risk assessment work on the farm (farm).

We were interested how the size of farm influences the safe behavior and knowledge. Of course, we measured not only the size of the area of the farm (area) but also the number of people on the farm (number) and farm equipment with machines (equipment).

We selected a sample size of 94 farms. The sample and the twelve above mentioned indicators give a sample covariance matrix:

Lisrel record of certification program for calculating the factor analysis and fit the model covariance matrix[8]. As a result we got covariance between latent variables behavior, knowledge and size of farm.

Results and Discussion

Assuming that the latent variables are standardized normally distributed. Covariance between the latent variables is also the correlation factors between these variables.

(Since the variance of all variables are equal to 1).

We have a correlation matrix, or matrix $\boldsymbol{\Phi}$.

The knowledge and behavior are linked with correlation 0.68. Among them, the link is not linear, but significantly related.

Table-3
A correlation matrix between latent variables

	Behavior	**Knowledge**	**Size of farm**
Behavior	1.00		
Knowledge	0.68	1.00	
Size of farm	0.05	0.48	1.00

Knowledge: latent variable was defined as a variable that measures the individual risk assessment. The higher the value the lower the assessed risk. Behavior evaluates the performance of the respondent. The higher the value the less safe conduct there is. It would be expected that the variables correlate. At greater risk there should be a safer conduct. Such a relation results in the graph above the line. Reality shows that the variables are not correlated, which means that the conduct is not associated with an awareness of the hazard and risks.

Even worse result is obtained in connection with the size of a farm. Behavior is not related to the size of farms. Whatever the area, the number of people on the farm, the number of machines on the farm, the safe behavior is exactly the same. It would be expected that on the larger farms at least the attitude to safe work practices would be higher. However, even these variables are not correlated; therefore the relationship between the size of the farm, hazard identification and risk is low. Safe treatment or level of safety culture is not growing in proportion to the increase in knowledge about safety. Even more, the experience with accidents does not raise the safety culture[9].

Conclusion

The method introduced new elements in risk analysis and risk assessment. It identifies the relationship between variables. Of course this is only the first step of structural equation models. There exists a whole range of calculating options, which would be useful in determining the risks as variables in a complex system that depends on a large number of indicators. An example from agriculture alone may not be the best example of the application method of structural equation modeling, but despite of working with a small sample it very quickly shows where the problem of safety in agriculture lies. In subsequent studies we will try to look for connections between variables that accompany the risk and safety at work in the company. Using known methods of risk assessment we will try to identify the indicators which show the variables that determine the safety and risk.

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