11th INTERNATIONAL SCIENTIFIC CONFERENCE RURAL DEVELOPMENT 2023
BIOECONOMY FOR THE GREEN DEAL
26-28th September, 2023, Vytautas Magnus University Agriculture Academy, Lithuania

VYTAUTAS MAGNUS UNIVERSITY AGRICULTURE ACADEMY

Proceedings of the 11th International Scientific Conference Rural Development 2023

Edited by assoc. prof. dr. Judita Černiauskienė

ISSN 1822-3230 (Print)
ISSN 2345-0916 (Online)

Article DOI: http://doi.org/10.15544/RD.2023.031

THE IMPACT OF SAFETY COMMUNICATION ON MACHINERY INJURIES AMONG FARMERS

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This study examined agricultural machine accidents in Finland. In Finland, the relative share of the number of machine accidents of all accidents in agriculture has grown. In addition, agricultural machinery causes more than half of farmers' deaths at work. Most of the machine accidents occur when using field machinery. The two main objectives of the study were 1) to reduce farmers' machine accidents and their costs by publishing machine safety information cards in a magazine for farmers, and 2) to evaluate the impact of this safety information on the occurrence of machine accidents by following up accident statistics. In 2017, ten information cards on agricultural machinery safety were published in the Koneviesti farm machinery magazine. The topics of the information cards were the most dangerous farm machinery and how to avoid accidents with these: tractors, seeding and tilling machines, automatic functions in field machinery, trailers, ATVs, combines, front loaders, machinery used in livestock production, personal protective equipment, and machine maintenance work. One year after the intervention, the statistics of accidents caused by these machines were analysed, from ten years before to one year after the intervention. A statistically significant decrease in accident development after the intervention was observed among Koneviesti's farmer subscribers. By contrast, no corresponding decrease in accident development was observed among other farmers who were not subscribers to the Koneviesti magazine. The study produced practical training material on agricultural machinery safety.

Keywords: *farm safety, agriculture machine injury accidents, safety communication*

INTRODUCTION

This study produced agricultural machinery safety information cards for farmers and tested their impact on agriculture machinery injuries. The share of machinery injuries in the agricultural sector has increased in recent years (Leppälä et. al., 2023a). Over the past ten years, the number of farmers' injuries has fallen from around 5,000 per year to around 4,000 per year, but the number of machinery accidents in agriculture has remained unchanged. Farmers have had around 1,000 machine accidents per year over the past ten years. In terms of machine accidents, the accident incidence rate has been clearly rising over the past two decades. In 2019, a total of 4076 accidents at work occurred in agriculture, while the number of self-employed farmers in Finland was 55241. Relative to the number of farmers, slightly over seven out of one hundred farmers had accidents at work (Leppälä et al., 2023a; Mela, 2020). Around every fourth accident in agriculture has been caused by machinery. Machinery is also responsible for more than half of fatal accidents at work in agriculture. In absolute numbers, the highest number of farm machinery accidents related to agricultural work occur in the use of field machinery. Of all machinery, tractor use still has the highest number of accidents (approx. 200-250 accidents per year), but the tractor also has the most operating hours compared to other field machines. In terms of accident costs, accidents related to agricultural work were highest those caused by motor vehicles and cars. Among field machinery, the biggest accident costs were caused by the use of potato and beet lifting machines, loaders and slurry manure, fertilisers and seeders. The average compensation for tractor accidents was EUR 3866, but the dispersion is large among work phases, most machine accidents occurred in machine maintenance work (32 per cent). (Leppälä et al., 2023a; Mela, 2020).

Agricultural machinery increasingly includes systems powered by automation. Automation in agricultural machinery is often seen as a factor improving safety, but the safety, accident cases and usability of automation systems should also be monitored (Leppälä et al., 2016). Although agricultural machinery accident statistics are dominated by field machinery, approximately 40% of agricultural accidents have occurred in livestock production tasks in recent years (Mela, 2020). A large proportion of accidents are related to animal behaviour and animal care tasks, but as the technology used in livestock production increases, the safety of machinery used in livestock production should also be studied and improved. The transmission of safety information has been mentioned on several occasions as an important factor in safety management (Leppälä, 2023b; Leppälä 2016; Roughton and Mercurio, 2002; Reason, 1997). However, DeRoo & Rautiainen (2000) investigated the effectiveness of different intervention methods and found that the impact of agricultural safety communication or training studies could not so far be reliably measured or demonstrated.

Accidents caused by agricultural machinery are, on average, slightly more serious than other causes of accidents in agriculture. Serious damage is referred to when the accident results in sick leave lasting more than one month. The farm injury statistics in Finland by the Farmers' Social Insurance Institution (Mela) register over 3 days absense in work and the injuries are diagnosed by a licensed physician. Mela statistics collects information about farmer occupational injury (MATA) statistics, municipal and interleaving statistics, time series and statistical images. Mela provides also numerical and euro amount information about insurance, occupational pension, waiver, accident or Mela sickness allowance matters. The machinery injury numbers from Mela injury data were collected only for this study and include both fatal or non-fatal accidents on machinery accidents on farms. As a rule, agricultural machinery sold in Finland is safe to use if it is used in accordance with the intended purpose of the machine (Leppälä et al., 2016). It has been found that especially in machine work, the risk of accidents increases in exceptional situations, in a hurry or when working tiredly (Leppälä et al., 2023b).

RESEACH METHODS

The study had two main objectives: 1) to reduce Farmer´s injury (MATA) accidents and their costs on farms through a series of machinery safety communication. 2) use statistics on accidents in agriculture to evaluate the impact of safety communications on farmers' machine accidents. In 2017, the study published a series of 10 information cards on machinery safety in the Koneviesti machinery magazine, after which machine accident statistics were monitored at the same time for a year to see if there would be a difference in the occurrence of accidents among the farmer subscribers of Koneviestilehti compared to a group of farmers who had not subscribed to the Koneviesti magazine (Leppälä et al., 2023; Koneviesti, 2017).

In this study, together with the Natural Resources Institute Finland's working group and Koneviesti's suppliers, condensed safety information cards were created on the risk management methods sections including how to identify the risks and risk sources, how to handle the risks and how to follow the risks. The information cards were published between 27.4.2017 and 30.10.2017 (Figure 1). Information cards were produced on the following types or areas of operational safety: tractors, combine harvesters, trailers, seeding and tillage machines, livestock production machinery, automation of agricultural machinery, loaders, personal protective equipment, off-road vehicles (ATVs), machine maintenance and a general introduction to machinery safety risk management on the farm. The machinery types were chosen by the previous farm machinery injury risk study. With these farm machinery types the number of accidents over ten year (years 2004-2014) were compared with the average sick leave days and absense of work from farm occupational farm injury statistics provided by Mela (Figure 1) (Leppälä et al., 2016).

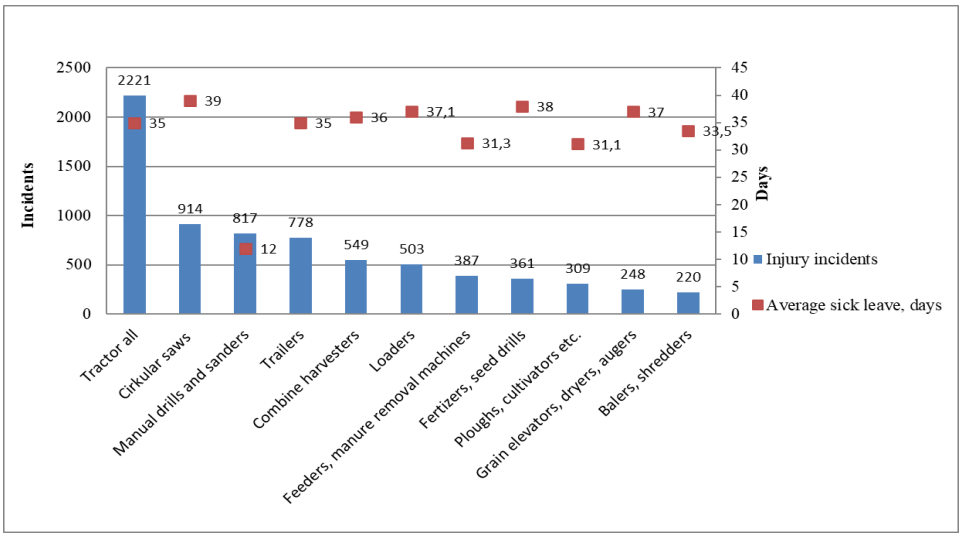

Figure 1. Number of injuries per machinery type and average sick leave among farmers in Finland 2004-2014 (Leppälä et al., 2016).

The ATV's were chosen as there was a growing trend in ATV accidents after year 2007 on farms. However, all the ATV accidents were not present in farmers occupational injury statistics as many ATV accident happen on free time

or happen for farm worker (Leppälä and Tuure, 2018). Also automation systems has been increasing on farms and there has happen some fatal or very serious accidents for example with automated balers (Ronkainen and Leppälä, 2017; Özyürekoğlu et al. 2007). The content of the information cards was the same type of risk management structure in all the information cards on the most common causes and prevention factors of machine safety risks. The information cards also included examples of accidents in the use of agricultural machinery (Leppälä et al., 2023a).

In the target group of farmers who subscribe to Koneviesti (intervention group, approximately 21000 farms) in relation to other farmers who are not subscribers to Koneviesti (control group, approximately 36000 farms). The intervention group was identified from Mela's statistics based on the subscriber register provided by Koneviesti. This identification of injured persons and Koneviesti subscribers was done by Mela to ensure anonymous process. The comparison was made by machine type one by one and all machinery together, 10 years before the intervention and at least one year after the intervention (30.4.2018–31.10.2018) (Leppälä et al. 2023; Koneviesti, 2017). The statistical significance of the changes was tested with the chi-square test. In this method, four-field tables of the injury frequencies of both research groups are created both before and after the intervention. The test is repeated for each machine group separately (Rautiainen et al., 2005). In this paper we present only the all machinery impact collected in figure 2.

RESEARCH RESULTS AND DISCUSSION

The themes of the safety information card series included a general introduction to machinery safety in agriculture, safety in tractor use, seeding and tilling machines, automation in machinery, trailers, ATV use, combine harvesters, loader use, personal protective equipment, machinery work on a livestock farm, and machine maintenance and repair work. Each information card consisted of two pages, which meant that it could be printed on basically one double-sided A4 paper. The series of safety information cards for agricultural machinery was launched in the Koneviesti magazine on 29.4.2017 with a tractor safety information card and a general article on safety culture in the use of agricultural machinery. For example, after the Koneviesti safety information card intervention, tractor accidents in the following year decreased by 17% from the previous year among farmers who subscribed to Koneviesti, while tractor accidents decreased by 7% for other farmers. In principle, the decrease in accidents is in line with the general downward trend in tractor accidents, but the percentage decrease in accidents was greater than in the previous five years. Figure 2 shows the combined ratios of farm machinery accidents per 1000 farmers after the intervention of the information card series and 10 years before the intervention. In relative terms, accidents among those ordering Koneviesti decreased most in accidents involving the use of trailers and loaders, while no corresponding decrease occurred among other farmers or accidents had even risen among other farmers. This was the case, for example, in loader and ATV accidents.

After the publication of the series of safety information cards for agricultural machinery, the compensation paid for machine accidents in agriculture between 27.10.–26.10. for the years 2009–2018 was revised (Figure 2). In addition, the compensation costs of machine accidents decreased for Koneviesti subscribers and other farmers in the year following the publication of the Koneviesti information card series. However, the decrease among subscribers accident costs was relatively greater.

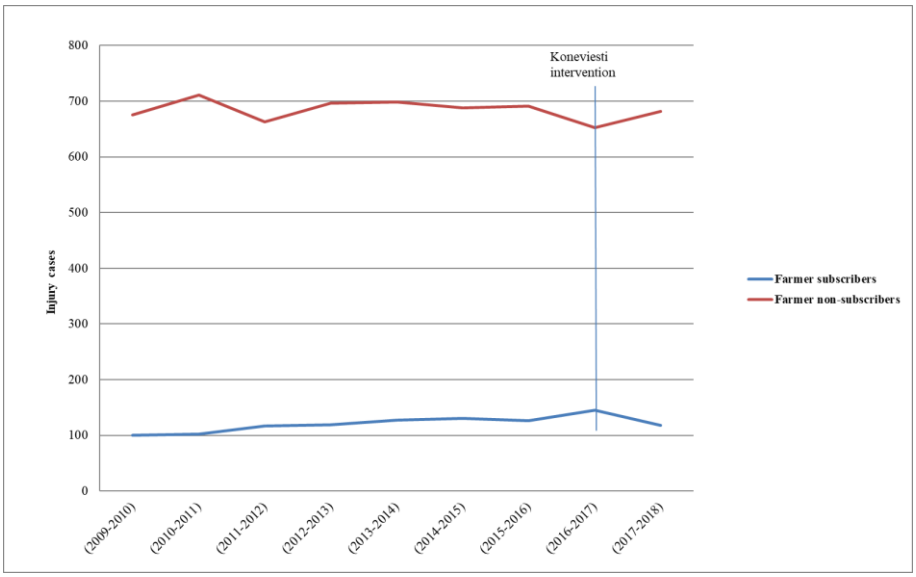

Figure 2. Machinery injuries among Koneviesti farmer subscribers and non-subscribers in 2009 to 2018.

Scientific significance was examined by means of a odds ratio analysis of all the causes of machine accidents that were the subject of the safety card articles as a whole. In this sample, the odds ratio resulted in a statistically significant reduction of 0.78-fold in machine accidents among machine message subscribers (Or = 0.04; CL 0.61-0.99) in relation to non-subscriber machine accidents with a coefficient ratio of 1. In light of this result, it appears that there has been a statistically significant reduction in machine accidents among Koneviesti subscribers relative to non-subscribers' machine accidents. However, variations in the number of subscribers and non-subscribers create a factor of uncertainty. Within

one year, the variation in the number of subscribers is in the range of 5–10%. But the numbers of Koneviesti farmer subscriber (21000) and non-subscriber (36000) groups were very well comparable between the years 2017 and 2018. In odds ratio analysis it is usually estimated that if the sample size is large, the better the estimates reflect the population (Nemes et al. 2009). Thus, the reduction of farm machinery total accident numbers among Koneviesti farmer subscribers can be seen relevant after the Koneviesti magazine machinery safety risk intervention.

CONCLUSIONS

The development of farm machinery injury accidents has varied over the years before, but the statistically significant decrease in accident development after the intervention was observed among Koneviesti's farmer subscribers. On the other hand, no corresponding decrease in accident development was observed among the Koneviesti magazine non-subscriber farmers. It can be argued that the series of articles concerning Koneviesti's safety information cards has had an effect on reducing machine accidents among Koneviesti's readers. However, it should be noted that the annual variation of groups and accidents causes uncertainty. It is very rare that it has been possible to measure this kind of communication and information effect of magazine articles or education in general in concrete terms and achieve an accident reduction effect. In order to enable farmers to become more familiar with the safety aspects of agricultural machinery, more usable advising or training tools should be produced.

Acknowledgements. This study was funded by Finnish farmers social insurance institute (Mela) and it was carried out by Natural Resources Institute Finland (Luke). The whole study report has been published in Finnish language.

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