

Farm health and safety adoption through engineering and behaviour change

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Abstract. The agriculture sector is one of the most hazardous occupations worldwide. The EU farming population is predominantly self-employed, who are largely outside the scope of EU occupational safety and health (OSH) legislation. Utilising effective communications approaches to transmit clear messages is a possible way of motivating farmer OSH adoption. The Public Health Model (PHM) of accident causation conceptualises an accident as occurring due to multiple interacting physical and human factors while the Social-Ecologic Framework enhances the PHM by defining various levels of the social environment which are influential on persons' OSH actions. A knowledge gap exists in how farmers conceptualise accident causation. The aim of this study is to report findings of a Score Card exercise conducted among Irish farmers ($n = 1,151$) to reveal knowledge on farmers' conceptualisation of accident causation where farmers ranked in order of importance up to five causes of farm accidents. First ranked items related to 'machinery/ vehicles', 'organisational' and 'livestock' as accident causation factors (92%). Overall rankings for up to five ranked causes identified six causes: 'machinery/ vehicles', 'organisational', 'livestock', 'slurry related', 'trips, falls, buildings-related' and 'electrical' (96.5%). The study data indicated that farmers' perceptions of accident causes were inaccurate when compared with objective fatal farm accident data. The study concluded that communicating accurate and contemporary OSH messages to farmers has potential to assist with farm accident prevention. Based on the multiple and interacting risk factors arising in agriculture it is suggested that more elaborate study of farm accident prevention is warranted.

Key words: agriculture, accident, osh, causation, communications, hazard.

INTRODUCTION

Agriculture is one of the most hazardous occupational sectors worldwide (ILO, 2011). Worldwide 170 thousand fatal accidents to agricultural workers occur annually while in the EU up to 170 thousand injury-causing accidents occur in the agricultural sector annually (Merisalu, 2018). The EU farming population is predominantly self-employed with 94% having family workers only and just 3% of farms having solely

non-family workers (Eurostat, 2014). Worldwide, individual farms are both dispersed in the countryside and operate in discrete units and use a wide range and variety of resources including: farm infrastructure and buildings, machinery and equipment; livestock; and products such as chemicals and pesticides, all of which present hazards (Field & Thoromolen, 2006).

As regulatory compliance is difficult to implement among a largely self-employed work sector such as agriculture (Gunningham, 2002), and in-any-event the EU Framework Directive for Occupational Safety and Health (OSH) (EC/89/391) does not cover self-employed workers, utilising effective communications approaches to transmit clear OSH messages is a possible way of motivating OSH improvements in the agriculture sector. Furthermore, the majority of farmers have been found to be positive to farm OSH as an issue (McNamara & Reidy, 1997; Knowles, 2002).

This paper, firstly, provides a brief review of contemporary accident causation theory and then provides the findings of a study of opinions of a large sample of Irish farmers on accident causation. The paper then considers the findings in relation to communication of accident causes to farmers.

Regarding Accident Causation Theory an accident is defined as an event which leads to bodily injury and the Public Health Model (PHM) of accident causation conceptualises an accident as occurring due to multiple interacting physical and human factors (Runyan, 2003). In this model a transfer of energy is the vector which causes injury and where a time dimension leads to all factors occurring in the same time and place (Fig. 1). Regarding accident prevention models, the conceptual work of Haddon (1980) indicates that accidents are prevented by applying multi-faceted approaches including both physical and organisational measures (Runyan, 2003). This author proposed that the social-ecologic framework as described by Bronfenbrenner (1979), enhances the PHM model of accident prevention as it defines various levels of the social environment in concentric nested roles of intrapersonal and interpersonal factors as well as institutional and cultural elements which are influential on persons related to accident prevention.

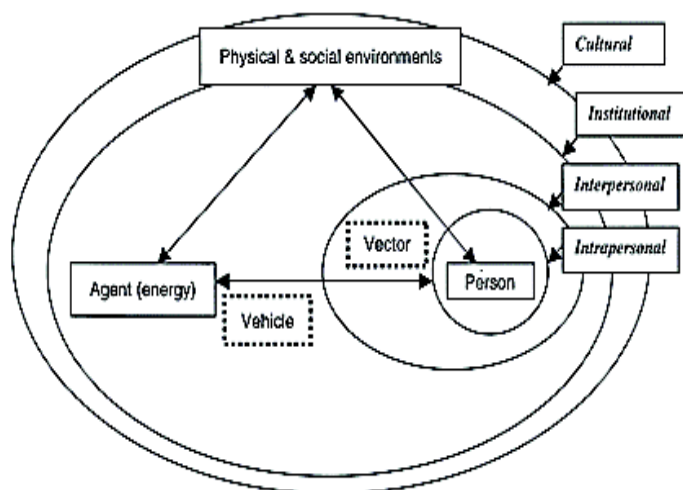


Figure 1. Integration of the Public Health Model and Social-ecologic Framework. Source: Runyan (2003).

A further injury prevention framework proposed by Gielen & Sleet (2003), suggests that a combination of behavioural, work environmental *and* policy approaches are required to gain injury prevention (Fig. 2).

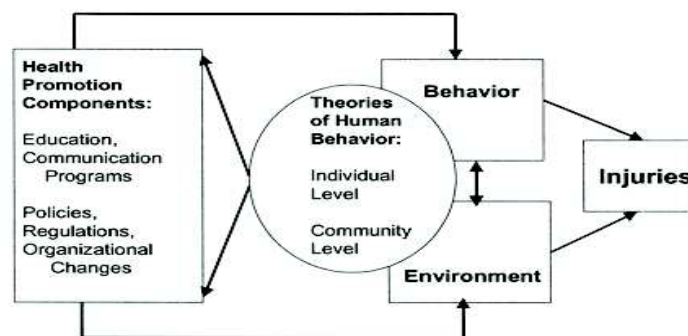


Figure 2. Framework for Promotion of Injury Prevention: Source: Gielen & Sleet, 2003.

Legal preventative approaches emphasise a hierarchical approach which gives preference to physical hazard elimination firstly and then organisational approaches such as work procedures, operator training and personal protective equipment (NIOSH, 2019). This approach is based on the premise that physical controls are collective and remove or reduce hazards while organisational approaches require individual human implementation and accordingly are less reliable and less effective.

The aim of this study is firstly to describe the findings of a Score Card exercise conducted among Irish farmers aimed at revealing knowledge on farmers' conceptualisation of accident causation where farmers ranked in order of importance up to five causes of farm accidents. The findings of the study are then considered in relation to scientific literature on accident causation and prevention.

MATERIALS AND METHODS

In Ireland, the enactment of the Safety, Health and Welfare at Work Act 2005 provided a new approach to improving the safety, health and welfare record among farmers in Ireland. This legislation permits the vast majority of farms, where three or less persons are employed, to complete and implement a Risk Assessment Document (RAD) prepared under a statutory Code of Practice (COP) as an alternative to preparing a written Safety Statement (SS) required by previous 1989 legislation. Following the enactment of the 2005 Act, the Irish Health and Safety Authority (H.S.A.) and Teagasc, the Irish Agriculture and Food Development Authority, commenced a Prevention Initiative (PI) to develop the statutory COP and RAD. The PI also researched the utility of extension approaches on a pilot basis, including document circulation and provision of training and follow-up advice provision to assist farmers to comply with the statutory requirements. Research on implementation of the PI has been published (McNamara et al., 2017). To implement the PI a pilot RAD was produced which included an analysis of fatal farm accidents for the decade up to year 2005. Subsequently a statutory COP and RAD were published in 2006 and these were revised and updated in 2016 and are available on the H.S.A website (H.S.A., 2019).

As part of the Prevention Initiative (PI) half-day training (circa 3.5 hours) on RAD completion and implementation by farmers was provided at circa 40 courses. At the commencement of these training courses the participants were asked to individually rank their opinion of the causes of farm accidents on a Ranking Card (Fig. 3). The objective of the exercise was two-fold: firstly to provide a means to facilitate discussion among participants on farm accident causation early during the training and secondly to provide a possible source of data on farmers' perceptions of farm accident causation before the influence of RAD training occurred as this data had the potential to reveal information on farmers' understanding of farm accident causation. This paper reports on the findings of the second objective and data is provided in Table 1.

Figure 3. Sample of completed Ranking Card.

Table 1. Ranking of Causes of Farm Accidents in Order of Importance

Ranking Order	1 st		2 nd		3 rd		4 th		5 th		Total	
Accident Causes	Score	%	Score		Score		Score		Score		Score	%
Machinery/vehicles	3,165	55	1,091		485		262		80		5,083	31.6
Organisational	1,554	27	819		582		337		138		3,430	21.3
Livestock	576	10	1,364		679		262		80		2,964	18.4
Slurry related	230	4	773		614		200		305		2,122	13.2
Trips, Falls, Buildings related	115	2	227		420		281		124		1,167	7.2
Electrical	58	1	136		194		262		116		766	4.8
Children	12	1	23		97		56		15		203	1.3
Chemicals	0	0	46		65		0		6		117	0.7
Other	0	0	45		97		56		44		242	1.5
Total	5,710	100	-		-		-		-		16,094	100

In total, 1,151 completed Ranking Cards were returned by farmer participants in training. In total, 5,029 accident causes were identified on ranking cards, with 1,151, 1,137, 1,077, 937 and 727 causes listed from 1st to 5th ranking. As accidents may have multiple causes the term 'cause' is used subjectively in this paper reflecting farmers rankings. To analyse the data, 1st ranked accident causes were allocated a weighting of 5, and sequentially each rank was allocated a lower weighting with 5th ranked allocated a weighting of 1. Thus the Score for each ranking and the Total were calculated for each cause by multiplying the number of reported causes by the weighting. The percentage of the total score for 1st and Total causes was then calculated. Farmer responses to the 'Score Card' exercise limit the extent of data analysis in this study and only data that was unambiguous is presented.

RESULTS AND DISCUSSION

The results for the farm accident ranking exercise provided in Table 1 indicate that 92% of 1st Ranked scores related to 'machinery/ vehicles' (55%), 'organisational' (27%) and 'livestock' (10%). In contrast, among Total scores, six scores contributed to over ninety per cent (96.5%) of the total with 'slurry related', 'trips, falls, buildings related' and 'electrical' being the additional 'causes'. First ranked scores are taken to indicate what is most prominent in farmers minds related to accident causation while the total score provides a more broadly-based ranking with more causes included. Notably, 'children' as associated with farm accident occurrence was lowly ranked at 1% of 1st ranked causes while the issue of 'older' farmers having a farm accident received no ranking whatsoever.

Within the 'machinery/vehicles' category, accidents associated with 'Power Take Off (PTO) / power shafts' accounted for 56% of first ranked and 46.9% of all ranked accident causes. Within the 'organisational' category, 'carelessness/ rushing' accounted for 84.1% of first ranked and 65.5% of all ranked causes. For livestock, 'bull-related' causes accounted for 41.6% of first ranked and 46% of all causes in this category.

The findings of this research indicate that participants attributed farm accidents to a number of physical causes and work organization issues. This attribution is in broad accord with general theory on accident causation which indicates that accidents have multiple causes (Haddon, 1980; Laflamme, 1990). However, the data presented in Table 1 indicates that participants' perceptions of accident causation were not in line with the actual causes of fatal farm accidents as compiled for the pilot RAD. This is in accord with the findings of other studies on farm accident causes (Sandall & Reeve, 2000; Knowles, 2002; Murphy, 2003; Durey & Lower, 2004; Australian Safety and Compensation Council, 2006). For instance, data from the pilot RAD indicated that 32% of fatal farm accidents in the 'vehicle and machinery category' were entanglements in PTO/ power drives while Score Card entries attributed almost 47% of accidents to this cause. Furthermore, the pilot RAD indicated that 20% and 38% of accidents respectively were associated with children and older farmers (over 65 years old), while in the score card ranking exercise, children were stated as associated with accidents in 1% of 1st rankings of accident causes and older farmers were not ranked.

The data from this research supports the assertions in the literature (Sandman et al., 1987; Conroy, 1994; Wilde, 1994; Hodne et al., 1999) which suggest that accurate communication of objective accident risk to a target population is an imperative requirement to promote accident reduction.

Further, review of fatal farm accident trends in the RAD documents published in 2006 and 2016 indicates that farm accident causation may change over time. For instance, comparison of fatal accidents in the RAD documents in 2006 and 2016 in respect of machinery PTO entanglement as a percentage of all machinery, declined from 32% to 11%; while for livestock fatalities, cow attacks increased from 16% to 50% of the total related to these causes (H.S.A., 2006; H.S.A., 2016). Thus, on-going injury surveillance is warranted to inform communication strategies related to farm accidents.

As accident causation theory indicates that most accidents have multifactoral causes with both physical and organisational factors, more elaborate study of farm accident causation and prevention is warranted. Holden (2009), for instance, considered that changes in safety are likely to be achieved 'through changes that address not only

people but also the many system components with which people interact'. Kim et al. (2018) further proposed that in designing programmes for farmers related to OSH prevention items should reflect use of a range of safety systems. Analytical approaches such as Fault Tree Analysis may be applied to farm accidents to gain both a broader and deeper understanding of farm accident causation (Kingman & Field, 2005). Further, Rogers (2003) noted that the discipline of Extension has the potential to make progress with a range of farm management issues, including OSH, over time using diffusion adoption approaches.

CONCLUSIONS

Overall this paper indicates that farmer perception of accident causation was broadly based. However, their perceptions of accident causation were inaccurate when compared with objective fatal farm accident data. Thus the study suggests that communicating accurate and contemporary OSH messages to farmers based on objective data is likely to be a crucial requirement to make progress with accident prevention in agriculture.

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