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Health and Safety Adoption from Use of a Risk Assessment Document on Irish Farms

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ABSTRACT

Objectives: This article describes levels of implementation of occupational health and safety (OHS) controls on a sample of Irish farms following completion of a risk assessment document (RAD) made available as part of a statutory code of practice (COP) for the agriculture sector. The article describes the legislation mandating the COP and the operation of a prevention initiative (PI) among key stakeholders to develop and promote farmer use of the COP and RAD. Methods: RADs were collected for farmers (N = 475) and the number and type of OHS controls listed for action were tabulated. A farm audit of OHS standards and of implementation of controls listed for action in the RAD was undertaken among a randomly selected sample of farms (N = 94) where the RAD was completed. Results: The study data indicates that farmers used the RAD to a limited extent, and that their focus in its use was on identifying physical rather than organizational controls. An association was found between farmers who actively implemented controls and positive OHS standards. Farm OHS standards were also associated with farmer attitude to OHS, farm enterprise, farmer age category, and work time needed to operate the farm. Conclusions: Overall, the study data suggests that standards of farm management are a crucial determinant of OHS standards. The study data also indicates that having knowledge of required OHS controls does not ensure implementation. Development of social learning in groups is considered as a significant means of increasing OHS farm adoption.

KEYWORDS

Adoption; management; OHS; risk assessment

Introduction

Internationally, the agriculture sector has an inferior safety record compared to other work sectors,[1] while research and knowledge on approaches to assist farmers to effectively manage occupational health and safety (OHS) through education and training and extension approaches is limited.[2] Devising, implementing, and evaluating such approaches have been the objective of a multi-agency initiative in Ireland based on recently introduced safety, health and welfare at work (SHWW) legislation.[3] This article reports on farmers' adoption of OHS standards and practices based on this initiative.

Regulatory theory indicates that public interest is the major justification for regulation.[4] In Ireland, a Commission of Inquiry on Safety Health and Welfare at Work recommended that "all at work, including farmers, be included under OHS legislation."[5] The Commission based its recommendation on the opinion that improving the OHS of the agriculture sector is in the interest of both individual farmers and the public. The Commission's recommendations were accepted by the Irish Government, which led to the enactment of the 1989[6] and subsequently the 2005 SHWW Acts. Thus, all workplaces in Ireland including farms are subject to SHWW legislation. This article describes an on-going legislative initiative that commenced following the 2005 Act to assist Irish farmers to achieve OHS legal compliance by completing a Risk Assessment Document (RAD) associated with a statutory Code of Practice.

It has been proposed that for successful regulation, programming should establish a synergy between persuasion and punishment.[4] They elaborated on regulatory strategies by outlining a pyramidal approach, which from the base consecutively has the following layers: self-regulation, enforced self-regulation, and command regulation with both discretionary and mandatory punishment. These authors consider that

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programming for successful regulation should be based broadly on the allocation of resources in proportion to space allocated for each strategy in the regulatory pyramid. This broadly is the approach of 'Robens-style' OHS legislation enacted in numerous countries.[7] This legislative approach involves implementation of systematic management of OHS at work including allocation of duties to all parties, consultation related to OHS, and implementation of risk assessment, hazard control and regular auditing. Thus, this approach to legislation moved from adopting prescriptive standards to systematic standards which are devised by each enterprise.

A comprehensive review of OHS regulation in the agriculture sector has been undertaken in Australia with a view to determining the optimal policy mix to gain OHS improvement in the sector.[8] This author considered that for success, OHS information must be disseminated to farmers by trusted sources in a face-to-face fashion. The OHS information must be sector-specific, user-friendly, emphasize practical solutions and its delivery must be effectively coordinated. He advocated developing and using Codes of Practice as he considered that small enterprises require much more specific guidance on OHS requirements than larger enterprises where more formal OHS management structures exist. Such codes can provide an effective way to provide practical guidance on how to achieve practical OHS compliance.

Worldwide, individual farms are both dispersed and operate in discrete units throughout the countryside and use a wide range of infrastructure, machinery and equipment, livestock, and products such as pesticides, all of which present hazards.[9] The nature of farming causes considerable challenges in applying SHWW legislation and mounting OHS advisory campaigns. In Ireland in 2006, there were 132,700 farms with average farm size of 31.8 Ha[10] and average family farm income of €16,680 (~$19,000 USD) compared to an average industrial wage of €29,110 (~$33,000 USD).[11] Data from the Irish National Farm Survey for year 2006 indicated that the percentage of farms in each of the principal farm enterprise categories were: specialist dairying (15%), dairying and other (8%); cattle rearing (24%); cattle non rearing (28%), mainly sheep (18%), and tillage (7%).[11] Estimates for the year 2006 indicate that family members supplied 95% of farm work-time, of which the farm holder supplied 66%, while the remaining 5% was supplied by nonfamily workers.[11] Thus, it is evident that Ireland farming is highly variable by enterprise, is small scale, and with low income where labor is mainly supplied by family members.

The background to the Irish Prevention Initiative is now described. Since 1989, all farms in common with all workplaces have been subject to SHWW legislation.[6] The legislative approach imposed the duty on farmers to complete a document described as a "Safety Statement," which required farmers to identify farm workplace hazards, assess risk, specify controls, and confirm their implementation. Following the enactment of this law, document formats were devised to assist farmers to prepare a Safety Statement; however, these required considerable time to complete in a written format, and studies showed limited uptake by farmers nationally.[12,13] In 2005, new SHWW legislation[3] was enacted that permits farms employing three or fewer employees (estimated to encompass circa 95% of farms nationally[11]) to meet the requirement to prepare a Safety Statement by instead completing and implementing an RAD prepared in conjunction with a statutory Code of Practice (COP). Statutory responsibility in Ireland for providing advice and guidance and enforcing statutory SHWW provisions rest with the Health and Safety Authority (HSA). For the agriculture sector, the HSA is advised on implementing the legislative provisions by a statutory advisory committee to its board referred to as the Farm Safety Partnership (FSP), which is representative of both state and farmer organizations with a role in farm OHS. In 2006, the HSA commenced a Prevention Initiative (PI) with Teagasc, the state Agriculture and Food Development Authority responsible for providing research, training, and advisory services to the agriculture and food sectors in Ireland, with the key role of devising the new RAD and COP approach, assisting farmers with its implementation and evaluating the utility of the new legislative approach in gaining OHS adoption among farmers nationally. During 2006 and 2007, the pilot phase of PI was implemented in consultation with the

FSP, which included the following components: development of pilot RAD for evaluation; training of Teagasc staff to deliver RAD training; provision of RAD 3.5 hour training to circa 2,500 farmers in 5 counties and a more extensive 12.5 hour course in 2 counties with circa 100 participants; circulation of RAD to farmers for completion in one county without provision of training; conduct of farm visits (N = 94) to access on-farm implementation of SHWW controls by farmers who completed the RAD and to assess approaches to the implementation of occupational health and safety (OHS) measures by farmers. Articles outlining farmers' and Teagasc advisers' (extension agents) opinions of utility of the RAD and associated 3.5 hour training in assisting farmers to manage farm OHS have previously been published.[14,15] This article reports on the findings related to implementation of controls by farmers following completion of the RAD in association with their overall approaches to farm OHS management. A copy of the RAD for 2016 that was adopted with minor modifications following the pilot phase of the PI is available on the HSA website.[16]

The pilot RAD principally comprised hazard identification sheets for the major work hazard categories (as listed in Table 1) encountered in Irish agriculture. Each sheet was accompanied by an information page giving short textual information associated with the hazard, pictures showing controls, and a pie-chart giving data on accident causes for the hazard based on a 10-year review of farm fatal accidents and causes of ill health. Each sheet was laid out in matrix format with key questions related to hazard control. Columns were provided for farmers to include the particulars of their farm (e.g., vehicles and machine, buildings, out farms, etc.) to allow them to confirm or not if individual controls were in place. The list of questions for each hazard was laid out in the order of the Hierarchy of Controls (found in Schedule 3 of SHWW Act 2005[3]) with physical controls listed first followed by safe work practices. The instruction sheet indicated that following consideration of each question, a farmer should indicate if a control measure was in place and if not, to list it on an Action list page. In contrast to previous Irish approaches with safety statement formats, no means of probabilistic risk assessment was included in the RAD, as the literature[17-19] indicates that humans have difficulty with making risk-related judgements based on probability. The approach adopted used the causes associated with fatal injury and ill-health as the basis of questions raised in the pilot RAD as an alternative to probabilistic risk assessment.

Table 1. Control measures specified by farmers in RADs (No. = 475).

RAD category (by order of %)	No.	%
Machinery	310	22.0
Tractors, farm vehicles, and ATV's	282	19.9
Livestock	206	14.7
Farmyard, buildings, and slurry	180	12.6
Electricity	125	8.8
Health	126	8.8
Chemicals	94	6.8
Workshop, repairs, working with timber	71	5.0
Children and older farmers	20	1.4
Total	1414	100

Methods

Within Irish agriculture, a wide range of farms occurs with varying socio-economic characteristics.[20] To study both RAD and training utility, voluntary collection of RADs took place in areas with farms of a wide variation in farm socio-economic characteristics (e.g., enterprise, scale, level of farm buildings, and machinery) with a total of 475 pilot RADs collected. A sample of 66 farmers was selected to audit from farmers who returned RADs, together with 28 RADs from farmers following participation in a 12.5 hour OHS course, giving a total of 94 farms. The farms for audit were selected randomly but purposefully to give a range by enterprise and scale, based on information in the RAD. Thus, the study applied a random but non-probabilistic approach to gaining a sample of farms to audit regarding RAD completion and implementation and overall farm OHS standards.

All farm audits were voluntary and took place about 6 to 12 months after RAD completion. Audits took place within 24–48 hours of the visit request to ensure no major changes in SHWW took place. Farm audits were undertaken by two persons, both of whom were qualified and experienced in farm OHS. An inspector from the HSA participated in 70% of farms audited on an advisory basis only; however, where issues arose

related to SHWW legal non-compliance, farmers were advised of the situation.

An assessment of elements of management of OHS on each farm was conducted and a score allocated to the various farm elements. Additionally, an overall safety score was then applied based on overall farm OHS standards. This safety score estimated the components and overall level of OHS management of the farm. The score used a 1, 2, 3, 4 scale representing "very satisfactory," "satisfactory," "unsatisfactory," and "very unsatisfactory," respectively. An audit-sheet describing key OSH requirements was developed and used to assist with applying safety scores consistently.

An assessment of implementation of controls was undertaken by examining if the controls listed in the RAD "Action list" page for implementation had in fact been implemented. A positive score (Yes = 1) was allocated when all controls listed which would warrant legal enforcement were in place and for other controls listed involving less hazard if these were implemented or where intention to implement them was explicitly demonstrated (e.g., machine part ordered). In contrast, a negative score (No = 2) was applied when the controls listed on the Action list were not implemented and where intention to implement them was not apparent.

The audit methods used in this study were informed by previous studies[21,22] that considered an auditor's expertise in the field of OHS as an essential component of auditing. It was found that availability of an audit check-sheet (Site Rank System) increased consistency in OHS scoring of farms.[22] These authors also noted that approximately one hour was sufficient to interview a farmer and conduct audits of the key equipment and facilities of the farm visited. Having an even scoring system with no mid-point is considered useful to facilitate auditor "decision making," and it also allows for consolidation of data by reducing scores to a lower number of categories if necessary (e.g., from four to two).[22,23]

In the case of this study, a four point scoring system was used for farm assessment, where scores were equated to the legal position under the SHWW Act (2005) with the highest score (score = 1) representing an **excellent** standard, a score of 2 an **acceptable** standard, a score of 3 represents where an **improvement notice** would be issued, and a score of 4 where **prohibition notice** would be served by a HSA inspector.

Definitions for dependent variables used in the study are described in Table 2 and are in line with those used by the Irish National Farm Survey[24] other than the following two variables: the score for "farmer attitude to OHS" was obtained by scoring a farmer's motivation for practical OHS adoption through audit questioning and observation of farm standards while the "farm work time" score was based on questioning the farmer on the farm work time required.

Regarding statistical testing in this study, SPSS Software package version 18 was used. The T-test for equality of means was used for mean comparisons in Table 2, and bivariate chi-square testing was used for testing for relationships between variables described in Table 4. Levels of significance are indicated as follows: * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$, and the notation 'n.s.' is used to indicate a non-significant finding.

Table 2. Comparison of mean number of controls specified in RAD following half-day training or not by farm enterprise type.

Farm enterprise	Training participation	Mean no. of controls	[a]*P* Value (Significance)
Dairying	Training (n = 143)	4.28	P = 0.002 **
	No training (n = 58)	2.24	
Drystock	Training (n = 153)	2.60	P = 0.06 n.s
	No training (n = 46)	1.84	
Tillage	Training (n = 39)	3.08	P = 0.09 n.s
	No training (n = 36)	2.55	
All	Training (n = 335)	3.32	P = 0.00 ***
	No training (n = 140)	1.95	

[a]T test for equality of means.
* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

Results

As indicated in Table 1, a total of 1,414 control measures were identified for action in 475 pilot RAD documents giving an average of three actions per farm with machinery having the highest frequency (22%), and "children and older farmers" having the lowest (1.4%). Further examination of the controls listed indicated that the majority (92.4%) were "physical" in nature, with 7.6% being "practice" related, which made up 27.4% of pilot RAD questions. Provision of half-day training on RAD completion[14] led to a 40% increase in RAD action measures identified. The dairying enterprise had the highest level of actions identified followed by tillage and drystock (beef cattle or sheep) (Table 2).

Scoring of farm OHS standards and practices based on farm audits is provided in Table 3. A score was allocated only if the issue arose on a farm, for instance the issues of "children" or "older farmer" arose on a farm in 36.2 and 24.5% of cases, respectively, where the score was applied. Overall farm scoring indicated an OHS compliance level of 76.6% of farms which achieved a satisfactory Safety Score. Thirty-three percent received the exemplary highest "1" score, and 43.6% the satisfactory "2" score; while 20.2% and 3.2%, respectively, received the unsatisfactory "3" and "4" scores.

Data for the relationship between farm safety score and farmer/farm variables are provided in Table 4. Of those who implemented the RAD controls, 92.1% had a satisfactory Safety Score, compared to 56.5% who did not implement the controls they specified ($P = 0.000$).

Overall, the level of implementation of RAD controls was 45.3%, which indicates limited implementation of OHS controls by farmers they had identified. Further analysis found that a positive OHS farmer attitude ($P = 0.003$) and increased farm size ($P = 0.026$) were the only variables studied which were positively associated with implementation of controls.

Farm enterprise was significantly associated with Safety Score as follows: dairy farms had a lower score, while tillage farms had a higher satisfactory score relative to drystock ($P = 0.011$). For "farm work time," where farmers ranked their farm as requiring high farm work time, the farms received a lower Safety Score ($P = 0.001$). Farmer age significantly influenced safety score with farmers in the middle age category (45–55 years) having a lower score than younger or older categories ($P = 0.029$).

Among a subgroup of farmers audited ($N = 28$), tutorial assistance had been offered with completion of the RAD. Half of these farmers ($N = 14$) availed of this assistance and half did not, while the two groups were similar in terms of enterprise farmed and scale. Among those who received tutorial assistance, 35.7% had implemented controls compared to 71.4% of

Table 3. Percentage distribution of farms (No. = 94) by safety score for SHWW farm audit.

Farm element scored	No. of farms	% In each category[a]				% Satisfactory[b] (A: 1&2)
		1	2	3	4	
Tractors/vehicles	94	41.4	55.3	2.2	1.1	96.7
Machinery	91	38.4	49.5	8.8	3.3	87.9
Livestock	81	27.2	58.0	13.6	1.2	85.2
Farmyard/buildings	93	40.9	41.8	11.8	5.5	82.8
Electrical	93	32.3	49.5	15.0	3.2	81.8
Workshop	68	23.5	64.8	8.8	2.9	88.2
Chainsaw	61	6.6	78.7	13.1	1.6	85.3
Chemicals	84	25.0	59.5	15.5	0.0	84.5
Health issues	94	24.5	64.9	10.6	0.0	89.4
Protective equipment	90	26.7	56.6	16.7	0.0	83.3
Children	34	17.6	76.5	5.9	0.0	94.1
Older farmer	23	17.4	78.2	4.4	0.0	95.6
Farmer OHS attitude	92	43.5	36.9	16.3	3.3	80.4
Safety score	94	33.0	43.6	20.2	3.2	76.6

[a]Score type: 1 = very satisfactory; 2 = satisfactory; 3 = unsatisfactory; 4 = very unsatisfactory.
[b]Score reclassification: A satisfactory (scores 1 and 2), B unsatisfactory (scores 3 and 4)
SHWW, safety, health and welfare at work; OHS, occupational health and safety.

Table 4. Relationship between farm safety score and farmer/farm variables.

			Farm OHS score (%) [a]		
Dependent variable/description		N	A Satisfactory	B Unsatisfactory	Significance[b]
Farmer attitude to OHS	Satisfactory (*N* = 73)	94	90.4	9.6	*P* = 0.000 ***
	Unsatisfactory (*N* = 21)		14.2	85.8	
Implemented OSH controls	Yes (1) (*N* = 38)	84	92.1	7.9	*P* = 0.000 ***
	No (2) (*N* = 46)		56.5	43.5	
Farm enterprise	Dairying (*N* = 35)	94	60.0	40.0	*P* = 0.011 *
	Drystock (*N* = 36)		72.2	27.8	
	Tillage (*N* = 23)		95.7	4.3	
Farm size. (Hectares)	0–39 (*N* = 19)	94	57.9	42.1	*P* = 0.177 n.s
	40–79 (*N* = 47)		74.5	25.5	
	80 + (*N* = 28)		82.1	17.9	
Farm economic size (ESU)	0–29 (*N* = 30)	94	70.0	30.0	*P* = 0.868 n.s
	30–59 (*N* = 25)		76.0	24.0	
	60+ (*N* = 39)		74.4	25.6	
Labor units	0–0.99 (*N* = 34)	94	73.5	26.5	*P* = 0.734. n.s.
	1–1.99 (*N* = 35)		77.1	22.9	
	2 > (*N* = 25)		68.0	32.0	
Farm worker status	Part-time (*N* = 24)	94	83.3	16.7	*P* = 0.439. n.s
	Full time (Ft) (*N* = 56)		69.6	30.4	
	Ft.& worker(s) (*N* = 14)		71.4	28.6	
Farm work time	High (*N* = 32)	94	53.1	46.9	*P* = 0.001**
	Low (*N* = 62)		83.9	16.1	
Farmer age (years)	<45 (*N* = 40)	94	77.5	22.5	*P* = 0.029*
	45–55 (*N* = 30)		56.7	43.3	
	55> (*N* = 24)		87.5	12.5	
No. of farm vehicles	1–2 (*N* = 45)	88	73.3	26.7	*P* = 0.908. n.s.
	3+ (*N* = 43)		74.4	25.6	
No. powered machines	0–4 (*N* = 37)	89	75.7	24.3	*P*= 0.636. n.s
	5+ (*N* = 52)		71.2	28.8	

OHS, occupational health and safety.
* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

those who had not received tutorial assistance, which was close to statistical significance ($p = 0.058$). Overall these data suggest that a high proportion of farmers who were challenged to implement on-farm OHS controls also sought assistance with RAD completion. This suggests that the limitations of these farmers have several dimensions including the capacity or confidence to complete the RAD and to implement OHS controls at farm level.

Discussion

The study found that Irish farmers perceive farm risks as principally physical in nature (Table 1), which co-relates with other studies. For instance, data for controls specified in the RAD are somewhat similar to findings of an earlier Irish study[12] where farmers were questioned on concerns about safety on their farms in a National Farm Survey of Safety and Health on Irish Farms. Farmers reported concerns related to farm vehicles and machinery (38.1%), electricity (12.0%), slurry related (9.0%), livestock related (9.2%), children on the farm (7.6%), and other concerns (23.3%). It is notable that "children on the farm" are proportionately higher in these data than in the RAD controls specified data (1.4% children/older) (Table 1), but otherwise similarities occurred related to farm vehicles and machinery (41.9%), electricity (8.8%), and livestock (14.7%). A recent Australian study[25] found that farmers predominantly perceived that farm risks were physical, with 60% being in this category, and among these, 38% were machinery related. Among perceived risks recorded in the Australian study, 3.5% related to children and older farmers made up the total, which is similar to the current study in terms of RAD controls specified. The Australian study indicates that the perceived risks identified by farmers are broadly similar to the RAD and the previous Irish study.

A further example is the issue of farmer "health," which obtained 8.8% of RAD controls

specified. However, an Irish study on mortality in the working population[26] indicates that farmers have considerably higher health related mortality than other occupational groups. The current study and comparisons with various studies related to farmers OHS risks indicate in particular that farmers have a high ongoing concern related to vehicle/machinery use, while areas such as child and older farmer safety and health, for example, receive limited concern. The finding that Irish farmers perceive farm risks as principally "physical" in nature is an important finding related to OHS promotion through extension in Ireland and suggests that further and nuanced extension approaches are needed to widen farmers perspectives related to OHS adoption.

Data in Table 3 provide an estimate of OHS adoption among the random sample of farms audited (N = 94) that had completed the RAD. The study data indicate a higher level of noncompliance compared to the findings from official HSA inspections for 2006,[27] where either a legally binding "prohibition" or "improvement" notice was served on 15.3%, and a written advice letter to a further 22.4% of farms inspected. Improvement and prohibition notice issue corresponds to scores of 3 and 4, respectively, as used in the on-farm scoring in this study, while issuing an advice letter corresponds to OHS issues associated with score 2, where improvement is advised but where a statutory breach of SHWW Act was not identified. A subsequent study as part of the PI indicated that farmers who completed the RAD were both larger in scale and more likely to be extension service clients, which could account for the higher OHS adoption rate in this study.[28]

Among individual farm elements scored during the farm audits undertaken as part of the study, tractors/vehicles had the highest scores of 96.7%, while farmyards and buildings and electrical standards had the lowest scores of 82.8% and 81.8%, respectively. In Ireland, considerable on-going investment in farm vehicles has been reported,[11] while the fitting of ROPS has been a legal requirement since the 1970s, which influenced the high tractors/vehicles score. However, it has been concluded in designing and implementing tractor/machinery injury prevention strategies that human factors, machinery and equipment standards/maintenance, and system factors all need to be considered.[29] Farm buildings and electrical installations on Irish farms have been erected and installed over many years, particularly since the 1960s when modernization of agriculture accelerated rapidly. While significant on-going investment in farm buildings is taking place, this is for new structures.[11] Thus, Irish farms have a mix of both new and old buildings and electrical installations which leads to varying OHS standards. Currently, the Irish government's Department of Agriculture, Food and the Marine (DAFM) has a grant scheme available (Targeted Agricultural Modernization Scheme—TAMS)[30] that provides funding for a wide range of OHS related farm buildings and infrastructure to assist with improvement of this issue. This scheme also requires applicants to have completed a RAD half-day training course within the previous 5 years.

The findings from the study related to farm OHS standards as measured through "Safety Score" and farm and farmer variables (Table 4) suggest that both a farmer's attitude to OHS and their capacity to implement OHS controls on an on-going basis are associated with achievement of satisfactory OHS standards. Prevention of the range of possible farm injuries requires the on-going implementation of a suitable range of both technical and behavioral solutions,[31] which suggests that the on-going OSH managerial input of the farmer is essential. Moreover, recent research in Canada[32] indicates that injury reduction is achieved when the majority of steps in the Hierarchy of Controls are applied at farm level, implying that both physical and organizational control implementation is needed to reduce injury. Thus, the current study suggests that positively influencing farmers' to adopt measures is a crucial requirement of successful extension programs in OHS. The study findings suggest that use of a RAD is helpful to those with the management capacity to implement controls but is of limited utility where this capacity was not present. This finding is in broad accord with adoption of innovations theory,[33] which suggests that within a population, there are innovators, early adopters, late adopters, and laggards in relation to adoption of particular practices.

The study data (Table 4) indicate that having knowledge *per se* does not necessarily lead to OHS adoption, as 55% of farmers did not implement the controls they identified as missing on their farms and specified for rectification on the RAD Action list. Of farmers who did not implement controls, 43.5% had an unsatisfactory Safety Score compared to 7.9% who did implement the controls. The implication of this finding is that extension OHS programs need to go beyond transmitting knowledge and need to apply strategies that encourage and ultimately motivate achievement of farmer adoption of good OHS practice. One possible approach for consideration is inclusion of OHS as a topic for farmer discussion group programs, as these have been shown to be efficient and effective means of farm technology and practice adoption in Ireland due to their practical on-farm interactive peer discussion and facilitated format.[34–36] In relation to OHS adoption, studies across a range of disciplines reported gains in risk reduction using participatory approaches with small groups.[37–42] In Ireland, the current DAFM Knowledge Transfer Programme[43] incentivizes farmer participation in discussion groups, and OHS is included as a mandatory component of the scheme. Knowledge Transfer Facilitators (Teagasc Advisers or private Consultants) are required to receive training to engage in farm OHS facilitation.

Regarding farm enterprise, dairy farming had the lowest percentage (60%) of satisfactory Safety Score compared to drystock (72.2%) and tillage (95.7%) farms. The finding for dairying may be explained by the fact that this enterprise was reported to have the highest labor input[11] compared to other livestock enterprises. Regarding tillage farming in Ireland, there has been a trend toward concentration of production on fewer farms that use labor efficient mechanization systems[20], consequently allowing more time and attention for OHS management.

The study also found that farmers in the mid-career category (45–55 years old) had the lowest Safety Score. This may be accounted for by the fact that this period of a farmers farming career may be at its busiest and most active.

Regarding farms on which there was a reported "high work time" requirement, these had a lower satisfactory Safety Score (53.1%) compared to farms requiring low work time (83.9%). Studies in Ireland have indicated that level of use of work time is associated with both farm technology and practice adoption,[44,45] which is a management attribute. Thus, this study finding supports the findings of other studies[46,47] that found farmers' capacity for OHS management was associated with their overall management capacity.

Conclusion

The principal study findings are summarized in Figure 1. The study data suggest that the RAD has utility in translating legal requirements into practical OHS knowledge for farmers; however, limited adoption arose from its use. This is particularly the case among farmers who are challenged

Principle Study Findings

- The study found that Irish farmers perceive farm risks as principally physical in nature.
- Of those who implemented RAD controls, 92.1% had a satisfactory Safety Score compared to 56.5% who did not implement the controls they specified.
- A positive OHS farmer attitude ($P = 0.003$) and increased farm size ($P = 0.026$) were the only variables studied which were positively associated with implementation of controls.
- Farmer age significantly influenced safety score with farmers in the middle age category (45 – 55 years) having a lower score than younger or older categories ($P = 0.029$).
- A high proportion of farmers who were challenged to implement on-farm OHS controls also sought assistance with RAD completion, suggesting that the limitations of these farmers have several dimensions including the capacity or confidence to complete the RAD and to implement OHS controls at farm level.
- The current study suggests that positively influencing farmers to adopt measures is a crucial requirement of extension programs in OHS . Study findings suggest that use of a RAD is helpful to those with the management capacity to implement controls but is of limited utility where this capacity is lacking.
- Having knowledge *per se* does not necessarily lead to OHS adoption, as 55% of fa rmers did not implement the controls they identified as missing on their farms.

Figure 1. Principal study findings.

to adopt OHS controls. The possibility of the use of social learning through discussion groups is suggested as an extension approach to increase OHS adoption associated with RAD use. The study data also suggest that to improve farm OHS, extension should adopt a broadly based approach to improve farmer managerial capabilities.

Based on the study, it is concluded that the coordinated approach to farm OHS improvement in place in Ireland described is in accord with the Socio-Ecological Model approach advocated in the literature.[48] This model defines various levels of the social environment such as at an intrapersonal, interpersonal, institutional, and cultural level that could be influential in injury and ill health reduction.

While the study obtained considerable new knowledge on farm OHS adoption based on use of the RAD, it has several limitations. Firstly the sample size (N = 94) of farms audited was limited due to available resources and, as a consequence, use of predictive statistical methods such as a multiple regression model could not be applied to this study data. The knowledge gained from this study could, however, provide insights for future studies on farm OHS adoption with larger farm audit sample numbers. Secondly, use of validated instruments to measure variables such as farmer "attitude" and "management capacity" related to OHS among larger samples could facilitate valid comparison among adoption studies in this field.

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