An Examination of the Status of Health and Safety on Irish Farms

A thesis submitted to

the National University of Ireland, Dublin for the Degree of Doctor of Philosophy

by

Anne Finnegan (BAgrSc.)

Under the supervision of Professor J. Phelan

College of Life Sciences

School of Biology and Environmental Science
UCD Agriculture and Food Science Centre,
University College Dublin, Belfield, Dublin 4.

February 2007

Table of Contents

	Page Number
Table of Contents	ii
List of Tables	vii
List of Figures	ix
List of photos	x
Glossary of terms	xi
Declaration	xii
Acknowledgements	xiii
Thesis Abstract	
CHAPTER 1 SETTING THE CONTEXT	
1.1 Introduction	1
1.2 Background to the Study Issue	1
1.2.1 Farming in Ireland	1
1.2.2 Farm Health and Safety	3
1.3 The Study Issue	5
1.3.1 Study Objectives	5
1.4 Study methodology	5
1.5 Utility of the Study	6
CHAPTER 2 LITERATURE REVIEW	
2.1 Defining the terminology	7
2.1.1 Accident defined	7
2.1.2 Injury defined	8
2.1.3 Hazard and risk	10
2.2 Models of accidents and injury	10
2.3 Irish health and safety legislation	15
2.3.1 The Health and Safety Authority	16
2.3.2 Inspectorate	17
2.3.3 Safety Statement	19
2.4 Safety management	20
2.4.1 The safety management process	20
2.4.2 Approaches to health and safety management	23

2.5 Safety management in farming 25

CHAPER 3 LITERATURE REVIEW

3.1 Mortality and morbidity in farming 28

3.2 Ill health problems associated with farming 29

3.2.1 Extent of farm ill health 30

3.3 Characteristics of farming which impact on health and safety 31

3.3.1 Age profile of those exposed to farming hazards 32

3.3.2 Mechanisation 33

3.3.3 Working hours and seasonality of farm work 34

3.3.4 Part-time farming 35

3.3.5 Isolation 36

3.3.6 Stress 36

3.4 Injury characteristics 38

3.4.1 Agent of injury 38

3.4.2 Age of victim 39

3.4.3 Sex 40

3.4.4 Who was injured 41

3.4.5 Time of year 41

3.4.6 Location 42

3.5 Factors associated with injury risk on farm 42

3.5.1 Farm size 42

3.5.2 System of farming 43

3.5.3 Work load characteristics 43

3.5.4 Other factors 44

3.6 Attitudes to health and safety 47

3.7 Attitudes and safety 47

3.7.1 Attitude change 49

3.8 Safety behaviour 50

3.9 Farmer safety behaviour 53

3.10 Injury control 54

3.10.1 The Three-E Method 55

3.10.2 The Human Factors Engineering Method (HFE) 55

3.10.3 The Public Health Approach 56

3.11 Interventions 57

3.12 Conceptual Framework 61

CHAPTER 4 THE SURVEY OF HEALTH AND SAFETY ON IRISH FARMS

4.1 Objective 64

4.2 Methodology 65

4.2.1 National Farm Survey 67

4.2.2 Definitions 68

4.2.3 Statistical Analysis 68

4.3 Results 69

4.3.1 Incidence of injury 69

4.3.2 Environmental characteristics of injury 70

4.3.3 Person characteristics of injury 87

4.3.4 Attitudes and activities toward health and safety on the farm 95

4.3.5 Environment factors 100

4.4 Discussion 106

CHAPTER 5 THE REALITY OF HEALTH AND SAFETY ON IRISH FARMS: CASE STUDIES FROM THREE RISK GROUPS.

5.1 Introduction 114

5.2 Objectives 115

5.3 Methodology 115

5.3.1 Farm Injury Risk Index 116

5.3.2 Farm selection 117

5.3.3 Data collection 118

5.3.4 Case study analysis 119

5.4 Results 119

5.4.1 High Risk Category: Case study 1 119

5.4.2 High Risk Category: Case study 2 129

5.4.3 High Risk Category: Case study 3 136

5.4.4 Medium Risk Category: Case study 4 145

5.4.5 Medium Risk Category: Case study 5 150

5.4.6 Medium Risk Category: Case study 6 156

5.4.7 Small Risk Category: Case study 7 163
5.4.8 Small Risk Category: Case study 8 169
5.4.9 Low Risk Category: Case study 9 173
5.5 Discussion **177**
5.5.1 Person factors 177
5.5.2 Physical working environment of the farm 183
5.5.3 Farm technology 187
5.5.4 Factors having an indirect influence on farm safety 192
5.5.5 Conclusion 193

CHAPTER 6 A MODEL OF HEALTH AND SAFETY IN FARMING: THE FARM SAFETY TRICHOTOMY
6.1 Introduction 195
6.2 Evolution of the model 199
6.3 Model components 200
6.3.1 Person 200
6.3.2 Environment 202
6.3.3 Technology 206
6.3.4 Stress 207
6.4 Model Interaction 208
6.5 Moderating the interactions within the safety trichotomy 209
6.6 Conclusion 210

CHAPTER 7 DISCUSSION AND CONCLUSION
7.1 Introduction 212
7.2 Purpose of the study 212
7.3 Summary of methodology 212
7.4 Main findings of the research 213
7.4.1 Person 213
7.4.2 Environment 216
7.4.3 Technology 218
7.5 Implications of the research 219
7.5.1 Returning to the approaches 219

7.5.2 Managing the dynamics which result in unsafe conditions on farms 220
7.5.3 Recording data to improve farm safety 222
7.6 Final Remarks 223

REFERENCES 224
APPENDICES

LIST OF TABLES

		Page No.
Table 1.1	Fatal accidents by sector 1996-2005	4
Table 4.1	Frequency of injuries according to system of farming	71
Table 4.2	Relationship between injury occurrence and farming system	72
Table 4.3	Relationship between injury occurrence and farming system	73
Table 4.4	Distribution of injuries per farming system according to season	74
Table 4.5	Relationship between accident occurrence and UAA	75
Table 4.6	Distribution of seasonal injuries categorised according to injury type	77
Table 4.7	Distribution of accident type according to the season in which they occurred	78
Table 4.8	Distribution of time of injury according to system of farming	80
Table 4.9	Distribution of injuries per farming system according to accident location	82
Table 4.10	Distribution of injuries per accident location according to farming system	83
Table 4.11	Distribution of types of accidents	84
Table 4.12	Distribution of accident types according to system of farming	86
Table 4.13	Distribution of age of injured person at the time of injury	87
Table 4.14	Distribution of medical outcome of farm work related injuries	88
Table 4.15	Distribution of responses to part of the body injured	90
Table 4.16	Distribution of the principal injuries	91
Table 4.17	Distribution of injuries according to the activity underway	92
Table 4.18	Type of animal involved in injury	93
Table 4.19	Specific cause of animal injuries	93
Table 4.20	Distribution of injuries according to hospital stay	94
Table 4.21	Distribution of injuries according to lost workdays	94
Table 4.22	Association between accident occurrence and the classification of safety on the farm	96

Table 4.23	Distribution of attitudes to safety on the farm	97
Table 4.24	Awareness of and compliance with health and safety legislation	98
Table 4.25	Distribution of responses to barriers to working safely	100
Table 4.26	Distribution of responses provided for specific safety changes	101
Table 4.28	Safety while working with agricultural chemicals	102
Table 4.29	Suggestion to improve farm safety on own farm	104
Table 4.30	Main safety issue causing concern on the farm	105
Table 5.1	Injury farms according to risk category	117
Table 5.2	Summary of case study critical findings	176

LIST OF FIGURES

Page No.

Figure 1.1	The Age Structure of Irish farmers	3
Figure 2.1	A wider perspective on safety research	9
Figure 2.2	The Epidemiological Triangle	12
Figure 2.3	The West Jutland Study of Farm Accidents – Model of Farm Accidents	15
Figure 2.4	Key Elements of Successful Health and Safety Management	22
Figure 2.5	Level of safety ambition in safety work	24
Figure 2.6	Stages in Farm Planning and Control	27
Figure 3.1	Person and environment characteristics	46
Figure 3.2	Person and environment characteristics impacting on health and safety on farms	61
Figure 3.3	Conceptual framework for the study of health and safety on Irish farms	62
Figure 4.1	Estimated number of farm work related injuries per year	69
Figure 4.2	Average number of farm accidents per five-year period	70
Figure 4.3	Type of Farm Work Related Ill Health Problems Sustained on Irish Farms	89
Figure 4.4	Distribution of perceptions of safety in farming	96
Figure 4.5	Sources of Information Sought on Health and Safety	99
Figure 6.1	Factors identified as having an influence on farm health and safety	197
Figure 6.2	Farm Safety Trichotomy	198

LIST OF PHOTOS

Page No.

Photo 5.1	Main farm yard	122
Photo 5.2	Locked chemical store with warning sign	124
Photo 5.3	View across the yard to the dairy and old cattle crush	137
Photo 5.4	Machinery shed and cattle shed with cattle crush to the left	140
Photo 5.5	Cattle crush and yard in front of dairy accidents	147
Photo 5.6	Steps to the loft in the old yard	152
Photo 5.7	Cattle crush	154
Photo 5.8	Restraining gate for suckler cows	162
Photo 5.9	Upper Yard '*A place for everything and everything in its place*'	165
Photo 6.10	Photo 5.10 New shed with pen and crush	166
Photo 6.11	Photo 5.11 Farm Yard	174

GLOSSARY OF TERMS

CSO	Central Statistics Office
HFE	Human Factors Engineering
HSA	Health and Safety Authority
HSE	Health and Safety Executive
NCASH	National Coalition for Agricultural Safety and Health
NFS	National Farm Survey
NHS	National Health Service
NSC	National Safety Council
PTO	Power Take Off
ROI	Republic of Ireland
ROPS	Roll Over Protective Structure
SHSIF	Survey of Health and Safety on Irish Farms
SPSS	Statistical Package for Social Science
UAA	Utilisable Agricultural Area
WHO	World Health Organisation

DECLARATION

I declare that this thesis has not been previously submitted as an exercise for a degree at the National University of Ireland, or any other University, and I further declare that the work embodied in it is my own.

Anne Finnegan

ACKNOWLEDGEMENTS

This thesis would never have been possible without the help, support and encouragement of so many people. I am grateful to have been afforded the opportunity to undertake this study through the Teagasc Walsh Fellowship Programme. The Health and Safety Authority funding of The Survey of Health and Safety on Irish Farms is sincerely appreciated. Thanks to the ASA and AIB for providing me with the opportunity to study abroad through the Travel Bursary. Thanks also to FBD insurance for providing funding to enable me to examine farm safety interventions in Denmark.

I want to express my deep and sincere gratitude to my supervisor Prof Jim Phelan. Jim’s knowledge, common sense and constant encouragement ensured that this thesis arrived at this point. Jim ensured that this thesis was kept firmly grounded while at the same time allowing me space to progress the study. Thank you Jim. I acknowledge and appreciate the guidance and support throughout this study of Frank Laffey and John McNamara.

Thanks to all in the former Agribusiness, Extension and Rural Development Department for your help, support and friendliness. A particular word of thanks must go to Dermot Ruane who has mentored me since my Undergraduate days and has always been so giving of his time. Thanks Dermot.

Thanks to all the farmers who participated in the survey and to the nine case study farmers who willingly gave their time and who welcomed me warmly onto their farms.

Thanks to all my colleagues of recent times in AIB for supporting me and being interested in my PhD. To that group formally know as ‘Women on the Verge of PhD’- Anne Marie, Ailish, Julie, Monica and Lily, thanks for all the help, support, laughs and friendship over the years.

To all my friends for your wonderful friendship and support , I thank you all.

And finally my family, thank you for all the support and encouragement throughout my studies. Catherine, Brid and Maura – thanks so much for so much!!! Auntie Marie, thank you for your encouragement in everything I do- you have inspired me greatly.

My parents who offered support, encouragement and love in everything I have done – no thanks will ever be enough. I love you both dearly.

THESIS ABSTRACT

In the context of the number of people employed, farming in Ireland accounts for a disproportionate level of workplace fatalities. However, there remains an insufficient understanding of the status of health and safety of Irish farms. In the competitive and challenging farm landscape, health and safety is in real danger of being further over shadowed by other farm business issues. This study provides a comprehensive understanding of the current status of health and safety on Irish farms from which a farm health and safety strategy can be developed. This study is unique to previous Irish farm health and safety research, previous research has largely examined the incidence of accident and injury on Irish farms. The current study examines the current status of health and safety on Irish farms.

The research establishes that there is a dynamic relationship between person, environment and technology in farming which is fundamental to health and safety on the farm. The findings of the research suggest that farm injuries in Ireland are increasing. There is a significant disconnect between farmers reported concern regarding farm safety and their actual farm safety behaviour. Evidence from the research suggests that those farmers who are effective farm managers will bring this to bear on their management of farm health and safety. Size and system of farming have a significant association with injury occurrence. Not all hazards present on farms are perceived as hazards by the farmer, this has implications for farmers conducting risk assessments of their own farms. Frequently, farm technology poses risk of injury a result of the interaction protocol determined by those employed on the farm. Stress has a significant impact on the dynamics that exist between people, technology and the farm environment.

The study seeks to provide an understanding of the terminology and theoretical models relevant to the study of farm health and safety. The interaction of person in environment and technology components is fundamental to occupational health and safety. Specific person and environment characteristics of farming have an impact on farm health and safety. This study examines the person and environment dynamic which impact on health and safety on Irish farms. The research involved two studies, a quantitative study which examines the current health and safety situation on Irish farms. A qualitative study sought to examine the interaction between farmer characteristics, the farm environment and farm technology.

The farm safety trichotomy comprehensively describes the farm level components which interact on a daily basis on Irish farms and provide the potential for farm injury. The safety trichotomy provides the context for analysing, interpreting, manipulating and improving health and safety on farms.

CHAPTER 1
SETTING THE CONTEXT

1.1 Introduction

The purpose of this study is to examine the reality of health and safety on Irish farms and thus provide an understanding of the issues involved in health and safety at farm level. This insight will guide and assist those involved in the development of farm safety intervention programs.

Primary Agriculture in the Republic of Ireland in 2005 accounted for 5.7% of total employment. Yet the sector accounts for an average of thirty per cent of workplace fatalities (Farm Safety Action Group, 2003). The Health and Safety Authority (HSA) regard the Irish farm as one of the most dangerous workplaces in the country (Beegan, 2002).

In order to design programmes aimed at reducing accident levels on farms and eliminating fatal accidents, it is vital to understand how farmers think, feel and act toward safety on the farm. This study aims to identify the current health and safety status of Irish farms.

1.2 Background to the study issue

In order to establish the background to the study issue, it is necessary to set both the agricultural and health and safety context in which Irish farmers operate. In addition, it is necessary to discuss the current structure of Irish farming and the changes which are occurring therein. It is also important to examine the health and safety record of farms in Ireland and that of other sectors in the Irish economy.

1.2.1 Farming in Ireland

As other sectors in the Irish economy have grown strongly over the past 10 years, the output from primary agriculture has remained relatively static. However, agriculture is nonetheless a more significant sector to the Irish economy than it is in most other EU countries. Significant consolidation has occurred in Irish farming. The number of farms declined by 17% between 1991 and 2000 while the average farm size increased by 21% (Crowley *et al*., 2002). While there has been a 30% decrease in the number of farms with less than 30 hectares during the period 1991-2002, there has been a 10% increase in the number of farms with greater than 30 hectares in the same time frame (Agri Vision 2015 Committee, 2004).

In line with the consolidation of the number of farms, the farm labour force declined by 17.5% between 1991 and 2000 (Crowley *et al*., 2002). This was facilitated by the opportunities which arose off farm as other sectors of the economy were experiencing rapid growth. Farmer numbers in Ireland declined by an annual average of 3% between 1975 and 1990, however, the average rate of decline has reduced to 2% between 1990 and the present time.

Those remaining in the farming population are increasingly undertaking farming as a part-time activity. Over half of farm households have an off farm income with either the holder or the spouse working outside of the farm (Phelan *et al.,* 2002). Approximately 42% of Irish farmers are estimated to be farming part-time (Agri Vision 2015 Committee, 2004). In addition, the breakdown of total household income on the farm has changed significantly since the early 1970's. The contribution of farming to total household income has decreased, while that of other direct income has increased. At the time of Irelands accession to the EU farm income constituted 70% of the total household income with 19% accounted for by other direct income. By 2000, however, the proportion of total household income apportioned to farming had reduced to 41% while other direct income accounted for 48% of total household income (Household Budget Survey, 1973/2000).

The age profile of Irish farmers is mainly positive with 13% of farmers under the age of 35, which is well above the EU average of 8% (Agri Vision 2015 Committee, 2004). However, there continues to remain a substantial proportion of farmers over the age of 65. While this is well below the EU average of 29%, significant variation in age profile of farmers exists in the EU, with Italy having the highest proportion of farmers over 65 years.

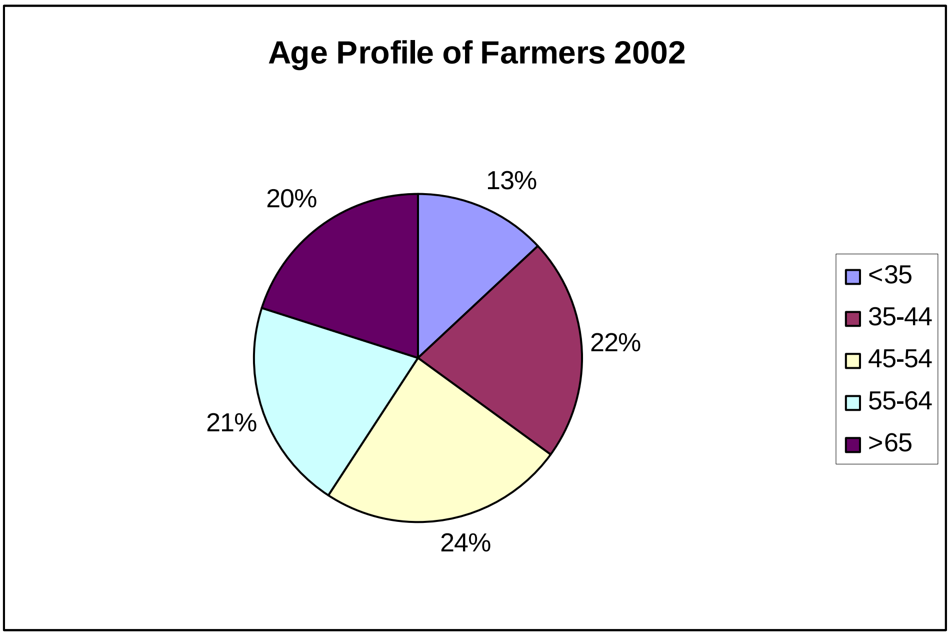


Figure 1.1: The Age Structure of Irish Farmers

Source: CSO, 2002

Thus contemporary farming in Ireland is one in which fewer people are working on fewer farms, although the scale of those farms is increasing. The opportunities in the Irish economy have attracted labour away from farming and into other sectors of the economy. Farming is increasingly becoming a part-time activity and the contribution made by farming to the farm household has decreased significantly. While the proportion of young farmers in Ireland is higher than the EU average, there remains a high proportion of Irish farmers over 65 years old.

1.2.2 Farm Health and Safety

While farming in Ireland accounts for on average 6% of the workforce, HSA statistics illustrates that farming accounts for on average one third of workplace fatalities in Ireland. In the past decade, Irish agriculture performed worse, in safety terms, than most other sectors in the Irish economy (Table 1). In total, 179 people have lost their lives on Irish farms over the period 1995 to 2005.

Table 1.1: Fatal Accidents by Sector 1996-2005

Sector	Number of fatal accidents									
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Agriculture and Forestry	12	15	26	23	16	24	13	20	13	17
Construction	12	15	22	18	18	18	21	17	15	23
Manufacturing	4	2	4	8	9	3	7	6	3	7
Fishing	8	5	6	2	7	2	3	0	3	2
Other	23	11	12	18	19	17	17	22	18	21
Total	**59**	**48**	**70**	**69**	**69**	**64**	**61**	**67**	**49**	**70**

Source: HSA, 2006

While accurate data exist for workplace fatalities in Irish farming, there remains significant under-reporting of non-fatal farm accidents. Fatalities are the tip of the injury pyramid. For every fatal accident that occurs on farms, many more non-fatal accidents occur resulting in injuries of varying severity. The vast majority of these accidents are not reported to the HSA and thus it is difficult to gain an understanding of the extent of the accident problem in Irish farming. '*Statistics on sources of ill-health relating to farming, particularly farm accidents, are scanty in Ireland'* (Doyle and Conroy, 1989, p.38). Several studies have examined the incidence of farming accidents in Ireland. Doyle (1988) found that on systematic examination of hospital and general practitioner records, it was estimated that roughly 3000 farm accident cases are seen in Irish accident and emergency departments annually and at least 2,500 in general practice. A survey of farmers by McNamara and Reidy, 1992 found that between 1987 and 1991, an average of 5,000 accidents occurred annually on Irish farms. This figure decreased to 2,000 for the five-year period 1992-1996 (McNamara and Reidy, 1997). Doyle (1988) reported that for every fatal farm accident that occurs, there are 100 non-fatal injuries, 28 of which will require hospital admission. McNamara and Reidy, 1997 estimated that including those persons providing on-farm services and non-working family members, up to 600,000 persons are exposed annually in one way or another to the hazards of farming.

The statistics portray an image of a sector which has a significant health and safety problem. It is also a sector in the Irish economy in which very little research in health and safety has been undertaken.

1.3 Study issue

The agriculture sector in Ireland is rapidly changing. It is a sector, which is currently facing many new challenges. The changing profile of Irish farming, as outlined in section 1.3, is placing increased challenges and pressures on those engaged in farming. Going forward improvements in the average productivity of Irish farms are required to maintain competitiveness (Agri Vision 2015 Committee, 2004). In this changing farm environment, health and safety is in danger of being over shadowed by other challenging issues. There is a need for effective intervention at farm level in order to improve farm health and safety and in so doing reduce farm injuries and farm fatalities. However, to proceed, accurate information is required in order to guide strategic planning in this area. '*In order to be able to plan preventative measures, we therefore need more knowledge about the risk-group, the attitudes towards safety and interest in participating in this work*' (Jansson and Eriksson, 1990, P.139)

1.3.1 Study objectives

In an attempt to address the study issue as set out above, the following research objectives have been identified:

1. To complete a review of occupational health and safety literature;
2. To determine the extent of injury and farm related ill health on Irish farms;
3. To determine the health and safety attitudes and practices on Irish farms;
4. To gain an understanding of the dynamics which are involved in creating unsafe working conditions on Irish farms and thus providing options for intervention.

1.4 Study methodology

A comprehensive review of health and safety literature was undertaken to provide an understanding of the study of health and safety and health and safety in farming. The primary research component of this thesis involved two studies using mixed methodology. Initially, a survey of health and safety on Irish farms was undertaken in order to quantify the accident level on Irish farms and gain an understanding of the circumstances in which farm accidents occur and the outcomes that result. A detailed questionnaire was compiled and the survey was administered through the National

Farm Survey (Appendix 1). The survey yielded 1127 completed questionnaires. In order to gain an insight into the reality of health and safety on Irish farms a qualitative approach employing case study methodology was pursued. This study examined the day to day reality of health and safety on nine farms.

1.5 Utility of the study

Developing an understanding of the health and safety landscape within Irish farming is potentially of interest to many people. Extension educators and those involved in farm injury intervention can use this information as a solid basis for the development of farm level interventions. The results may aid prioritising farmer groups and issues for intervention programs. The study provides statistics that are not captured by the Health and Safety Authority in accident reporting and thus will provide policy makers with a more accurate picture of the current injury levels in the industry. It will also allow for comparisons to be made and assessments of progress to date. The revision of the Irish occupational health and safety legislation in 2005, discussed in chapter 2, allows for industry codes of practice to be developed. This study may help to guide those engaged in developing such codes. It may also provide the medical profession with a better understanding of the context in which farm work related injuries in Ireland arise.

CHAPTER 2
LITERATURE REVIEW

The purpose of this chapter is to examine health and safety as it applies to the workplace. It aims to provide an understanding of the terminology, theoretical models and structures employed in the understanding of workplace health and safety. This chapter discusses both macro and micro level determinants of health and safety in the workplace and how these relate to agriculture.

2.1 Defining the terminology

In discussing health and safety, several language ambiguities become apparent which contribute to a lack of understanding of the issue. In particular the casual use of the words injury and accident can cause particular problems from a health and safety perspective. The argument has been put forward since the late 1980s, within public health circles, that the term accident be banned in favour of injury, which is perceived to be more scientific. The basis for this argument is that the word accident has a connotation of something unpreventable, like an act of God. Further use of this word would strengthen beliefs in supernatural explanations and thus prevent people taking preventative measures (Andersson, 1999). While luck, chance and acts of God are no longer used as explanations in the cause of disease, they remain culturally accepted explanations of accidents (Cooper and Germain, 1974). The following is a short discussion of the terminology surrounding occupational injury.

2.1.1 Accident defined

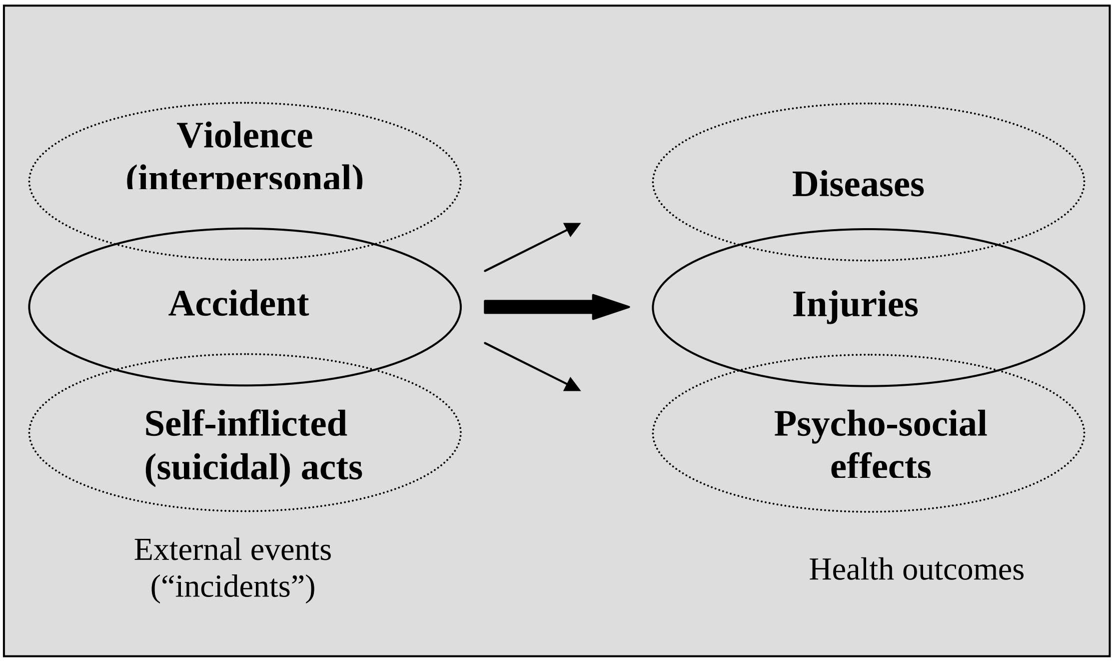
Many accident definitions exist, from very complex concepts to the more straightforward. One of the earliest definitions of an accident was put forward by Heinrich, who defined an accident as an event in which the contact or exposure of a person with an object, substance, another person or conditions causes personal injury or suggests the probability of such injury (Heinrich, 1941). Similarly the World Health Organisation define an accident as an event that results or could result in an injury (WHO, 1989). Both definitions indicate the distinction between accident and injury, accident being the event and injury being the outcome. However, Saari (1986) describes an accident as a process of parallel and consecutive events leading to a harmful consequence. This loose definition allows much scope in terms of accident consequences. However, Strasser *et al.*, 1981, extend the concept of an accident by including outcomes other than injury in the definition and add another dimension to the accident definition, which is that accidents are unplanned. '*An accident may be thought of as an unplanned act or event resulting in injury or death to persons or damage to property'* (Strasser et al., 1981, p.4).

This definition suggests an absence of acts or events resulting in injury, death or damage in the planned environment while a presence of such acts in the unplanned environment. Harms-Ringdahl (1993, p.1) proposes a simplistic accident definition *'an accident is an undesired event that causes damage or injury'*. In addition he uses the same definition for an incident however, he includes the word 'might', that is might cause damage or injury.

2.1.2 Injury defined

The most widely referenced definition of injury is that proposed by Baker *et al.*, 1984, which defined injury as a bodily lesion which results from acute exposure to amounts of energy (mechanical, thermal, electrical, chemical or radiant) that exceed the threshold of physiological tolerance. In some cases the injury results from an insufficiency of a vital element (e.g. drowning, strangulation, freezing). This definition by the very nature of the language included, '*resulting from*'**,** indicates that injury itself is an effect. Andersson (1999) details that those arguing in favour of the use of the term injury believe it consists of two main categories, intentional and unintentional. However, Andersson proposes that medically an injury is an injury irrespective of intention – '*Intentionality is not to be determined at the level of health outcome, but at the level of causal mechanism. Correspondingly, if we look at the health outcomes from the level of harmful events, such as accidents, it becomes clear that injury is not the only health effect to take into account, when assessing health consequences of events such as accidents' (p.17).*

Consequently the scope of safety research needs to be widened to include broader types of effects and causal mechanisms, unintentional as well as intentional (Figure 2.1). It is important to recognise that injury causation can be intentional (violence of self-inflicted acts) or unintentional (accidents). Similarly accident outcomes are wider than injury and encompass both disease and psychosocial effects. The manifestation of these effects occur according to different timescales, injury is an immediate effect and thus research can determine incidence rates with some degree of ease. However, disease and psychosocial effects may take longer to manifest and incidence may not be as straightforward to detect.



(Andersson, 1999)

Figure 2.1: A wider perspective on safety research

However, while the Baker *et al*. definition is that which is used by the World Health Organisation (WHO), the following has been written on injury. *'Injuries have traditionally been regarded as random, unavoidable 'accidents'. Within the last few decades, however, a better understanding of the nature of injuries has changed these old attitudes, and today both unintentional and intentional injuries are viewed as largely preventable events. As a result of this shift in perception, injuries and their health implications have demanded the attention of decision-makers worldwide and injury policy has been firmly placed in the public health arena. Furthermore, the growing acceptance of injuries as a preventable public health problem over the past decade or so has led to the development of preventative strategies and, consequently, a decrease in the human death toll due to injuries in some countries'* (WHO, 2002).

This study assumes the position that the terms injury and accident refer to clearly different phenomena. Farm accidents are understood to be undesired events, which result in harmful consequences. Farm injury is an effect. It is as Andersson, 1999 illustrates a health outcome of an external event such as an accident.

2.1.3 Hazard and risk

A similar explanation of the terms hazard and risk is required. Similar to accident and injury, confusion between the two terms frequently occurs. Murphy (1992, p.15) uses the definition of hazard listed by the American Society of Safety Engineers, which is *'a condition or changing set of circumstances that presents a potential for injury, illness, or property damage'*. Similarly Dunne (2000, p.9) defines a hazard as *'a situation with the potential to give rise to injury to persons, damage to property or damage to the environment – or a combination of these'*. However, Harms-Ringdahl, (1993) states that a hazard denotes a likely source or cause of an accident. While the word risk can be used in a variety of contexts, Dunne (2000) provides a comprehensive definition: '*Technically, risk concerns the likelihood of the danger potential of a specific hazard becoming an actuality and the degree of injury and/or damage likely to result from that event'* (Dunne, 2000, p.9). Harms-Ringdahl (1993) provides a much simpler definition which is that risk is the possibility of an undesired outcome. According to Lees (1980), as referred by Harms-Ringdahl (1993), risk is defined as the probability of loss occurring.

In the context of the current study, farm hazards are viewed as conditions that provide the potential for injury or damage. Based on the above discussion farm injury risk, however, is seen to relate to the likelihood of that injury or damage actually occurring. Farm injury risk is dependent on the existence or otherwise of hazards in the farm environment.

2.2 Models of accidents and injury

Those proposing to ban the use of the word accident were predominantly concerned with the perception that accidents are chance occurrences which cannot be prevented. However, accidents do not happen by chance alone. They arise from circumstances in the workplace which are created by mans interaction with technology; attitudes, beliefs and motivations of all employees and managers and the policies and practices of the organisation. When two or more or these elements are present they provide the conditions for the occurrence of an accident (Dunne, 2000).

While Dunne refers specifically to occupational accidents, Andersson (1999) proposes a more holistic accident concept. According to Andersson the word causation is central to the accident concept as all accidents include a time dimension. He defines causation as something that comes before in time, which influences the outcome of a subsequent variable. The accident is generally seen as sudden and unexpected leading ('downstream') to harmful consequences. Considering this, the genesis of an accident can be explained as a series of causal and mutually interrelated mechanisms ('upstream'), which can be explained at various distances in time and at various social and societal levels. Similarly, Strasser *et al.*, 1981 include a time dimension in their perspective on why accidents occur. They view an accident as *'a complex sequence of events representing a break down in the proper interrelationship of man and his environment. For man, an accident is a manifestation of his inability to adjust to given conditions or circumstances within the environment. An accident may also indicate a weakness in the design of the environment that permits the occurrence of such an event'* (Strasser *et al.*, 1981, P.23).

Dunne (2000) believes that most occupational accidents arise *'in the context of particular personal and interpersonal, technological and organisational situations in the workplace'* (P.1). In addition she presents four issues that have been identified as critical in creating the conditions from which occupational accidents result:

- Inadequate staff training;
- The acceptance of dangerous work practices by managers;
- The failure of equipment designers to understand the way people process information;
- The psychological pressure on employees and managers to cut corners for economic and/or political reasons.

Dunne feels that in time, the unsafe management practices, employees or organisation policy that goes unchecked combine with a system disturbance and inevitably result in an accident. However, Cooper and Germain (1974) proposed that a lack of ability, lack of knowledge and lack of proper attitudes are the reasons for mistakes and accidents. In contrast to most other theories, Cooper and Germain place the burden of the accident problem on shortcomings in ability, knowledge and attitudes of the individual and do not examine the complex interaction that occurs between individuals and their environments.

Several models have been put forward over the years from a range of disciplines, which aim to explain why accidents and injuries occur. All of these models include the time dimension discussed by Andersson (1999), while some include social and societal level analysis. The models can be divided into three main types 1) linear stage models, 2) Surveillance models and 3) Systems-oriented models. The linear models view accident causation mechanisms as a linear flow of time-ordered stages or events. Heinrich, with an industrial background was the first to present accident causation visually. He developed the 'Domino' model which is seen as five dominos in a row representing *the environment* which exerts an influence on *human activities* which give rise to *hazards* which in turn result in *accidents* which lead to *injury*. In addition to portraying the accident sequence, Heinrich's model also provided options for prevention at various stages (Heinrich, 1941 & Andersson, 1999). At the same time the public health field applied the epidemiological model to accident and injury situations. This model had been developed from the perspective of infectious diseases. The model illustrates the interaction between Host (human), Agent (hazard) and Environment (Figure 2.2).

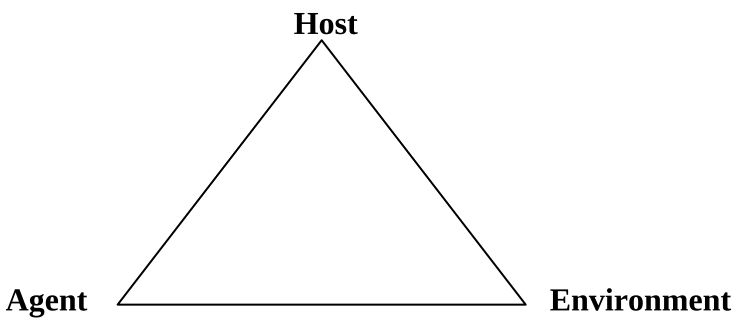


Figure 2.2: The Epidemiological triangle

Haddon, however, went further and developed a model for epidemiological research on accidents and injuries which cross-tabulated the host, agent and environment against time. The time dimension was broken down into pre-event, event and post event. The resulting model is known as the Haddon matrix. Haddon viewed the model as an aid to identifying preventative measures rather than for understanding the exact causes of accidents and injuries. Further research held that the agent is in fact energy. This resulted in the addition of a fourth category, that of “vector” which is defined as the carrier of the agent factor. In addition, environment can be split into both physical environment and social environment (Haddon, 1980, Andersson, 1999, Murphy, 1992). Thus the Haddon matrix provides a holistic view of the accident scenario and options for prevention are easily identified.

Surveillance models are being developed to *‘support the development of preventative-oriented classifications, and to act as mental maps for data recording and analysis’* (Andersson, 1999, p.21). These models reflect a multivariate approach to collecting, compiling and feed-back of information which results from in-dept analysis of accident scenarios. These models portray the “triggering event” e.g. slip, “the contact event” e.g. cut and often “intermediate events” e.g. fall. The Swedish ISA model was the earliest prevention-oriented computerised system on injuries.

Systems-oriented models examine *‘mutual and complex interactions in virtually all types of applications from technology and biology, to economy, psychology and sociology’* (Andersson, 1999, p22). Surry’s model examined man-environment interactions from a behavioural and systems-oriented view in an attempt to understand why these interactions result in accidents. One of the criticisms of this model is that it is biased towards the behaviour of the individual. Because many accidents occur in disturbed situations that require corrective action, it is necessary to analyse these deviations as opposed to focusing on why the situation was not managed properly (Andersson, 1999). Other systems models were developed based on the theory of homeostasis or equilibrium. When a system is in balance it is found to be running according to how it was designed, however, disturbances result in a loss of balance within the system. Benner’s model described how and why systems change into an unstable manner. Similarly the deviation model was founded on the belief that accidents are the result of deviations from the intended process. Therefore a preventative approach of searching for deviations is suggested. Wilde however, held that the deviation model depended on the perceived norm in identifying deviations, that is to say how much risk we are willing to accept. His widely debated 'Risk Homeostasis Theory' says that as people accept a certain amount of risk, providing safer environments is of little benefit if the level of risk acceptance of individuals is not adjusted (Andersson, 1999).

In order to develop a model for preventing farm accidents Glasscock *et al.,* (1997) constructed a model of farm accidents (Figure 2.3). The model assumes that risk situations arise as a function of both person and environmental factors. Examples of person factors are knowledge, attitudes and perceptions. Environmental factors are farm characteristics (size and type), the safety standard of farm machines and whether or not children live on the farm. The model assumes that farmers have a major influence on their own working environment and therefore two types of behaviour are proposed. Behaviour A supposes that farmers can improve safety standards on their farm via safety checks, maintenance and planning. Behaviour B supposes that in risk situations farmers can behave in a safe manner like everyone else. They can use personal protective equipment and not engage in risky behaviour. The model hypothesises that stress can affect both types of behaviour by reducing the quality of maintenance activity or by increasing risk taking behaviour. The authors also propose that a persons previous accident record will influence attitudes or behaviour, for example long term risk taking which does not result in accidents will increase the tendency to take risks.

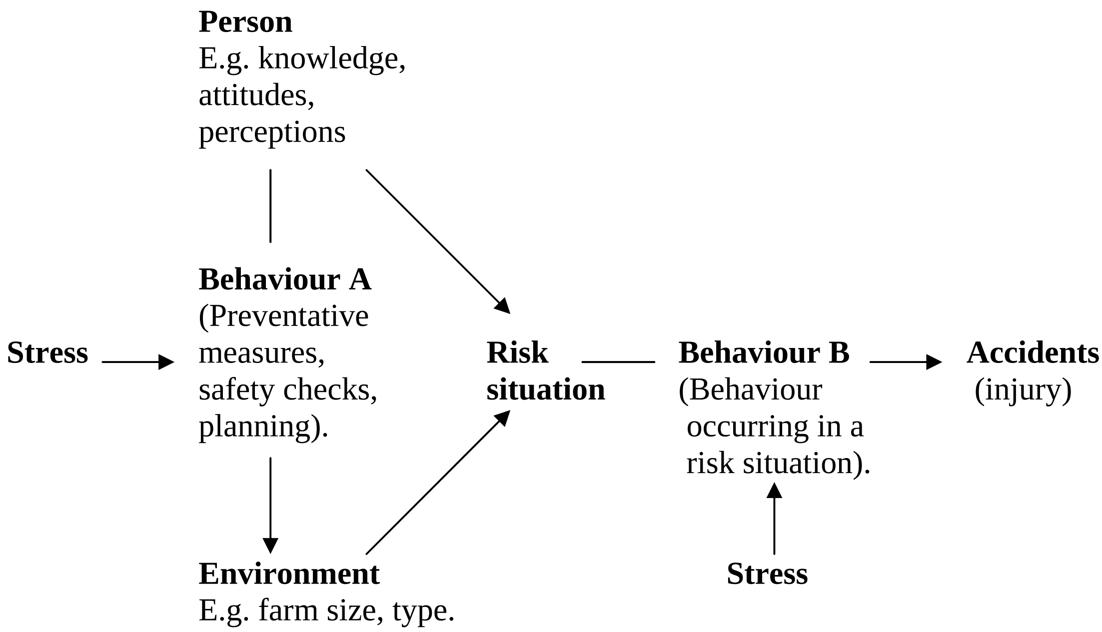


Figure 2.3: The West Jutland Study of Farm Accidents–Model of farm accidents

The fundamental essence of all of the above models is that they provide a means to examine the elements, which comprise an accident event. Each model seeks to identify the causal mechanisms, which result in accident occurrence and thus provide opportunities for intervention. An examination of the interactions within a particular system is fundamental to this process.

2.3 Irish health and safety legislation

Legislation acts as a macro-level determinant of safety, in essence it is a form of intervention and that, which is most widely used. In farming, legislation has been very successfully used in many countries to make tractor roll over protective structures (ROPS) compulsory.

The current legislation governing safety, health and welfare at work was enacted into the Irish statute book in September 2005. This body of legislation represents a modernisation of Irish occupational Health and Safety Legislation. Its predecessor, The Safety, Health and Welfare at Work Act 1989 applied occupational health and safety legislation to all Irish workplaces for the first time. This legislation can be traced back to the recommendations of the Barrington Commission, which reported in

1983. This report highlighted the weaknesses in the Irish occupational health and safety system (Garavan, 1997). Prior to the enactment of the 1989 legislation, there were twenty statutes, which had a bearing on safety and health at work. These were supplemented by approximately two hundred regulations. Ten government departments in addition to local government and state-sponsored bodies played a role under this body of legislation. Unlike previous health and safety legislation in Ireland, the 1989 Act included both the self-employed as well as employers. This was a significant advance for agricultural health and safety in Ireland as it was the first time farmers were covered by health and safety legislation.

The new act has provided inspectors with a system of on-the-spot fines, which were not previously available to them. In addition, there are provisions, which allow testing for intoxicants in particular circumstances within particular sectors. Under the legislation, managers and directors have a significant responsibility to protect the health and safety of all present in the workplace. In addition to providing the body of occupational health and safety legislation the 1989 Act also provided for the establishment of the Irish Health and Safety Authority (HSA) and this remains under the new legislation. It also allows for inspectors to be put in place to enforce the statutory provisions. Under the 1989 Act all employers and self-employed persons were required to compile a Safety Statement, which would specify the manner in which the safety, health and welfare of people would be secured at work. However, the Safety, Health and Welfare at Work Act (2005), which repalled the previous legislation, is framework in nature, in that it focuses on the broad general duties and the organisational and structural arrangements required to achieve better workplace health and safety.

2.3.1 The Health and Safety Authority (HSA)

The Health and Safety Authority has responsibility for the administration and enforcement of Irish health and safety legislation. The authority monitors compliance with legislation and also has an enforcement arm. The HSA is also charged with providing information and advice to employers, employees and the self-employed on workplace health and safety.

The main functions of the HSA as set out in the legislation are as follows:

- To arrange the enforcement of all relevant health and safety statuates;
- To promote, encourage and foster the prevention of accidents and injury to health at work in accordance with the 2005 Act;
- To promote, foster, encourage and provide education and training in the safety, health and welfare of people at work;
- To encourage and foster activities and measures which are directed towards the promotion of safety, health and welfare of persons at work;
- To monitor, evaluate and make recommendations to the Minister regarding implementation of and compliance with the relevant statutes and occupational health and safety best practice;
- To promote, encourage and foster co-operation with persons representing employers and employees regarding the prevention of risks to safety in accordance with the relevant statuates;
- To make arrangements as it considers appropriate for providing information and advice on matters related to safety, health and welfare at work;
- To make such arrangements as it considers appropriate to undertake, to promote, to sponsor, to evaluate and to publish the results of research, surveys and studies relating to hazards and risks to the safety and health of persons at work or arising from work activities;

(Safety, Health and Welfare at Work Act, 2005)

2.3.2 Inspectorate

The inspection arm of the Health and Safety Authority is the direct instrument of intervention. The primary function of the inspectorate is to ensure that workplaces comply with the provisions of the legislation (Garavan, 1997). Inspection concentrates on assessing the management of health and safety in the workplace and also examines the safety statement.

The HSA inspectors have specific powers, which allow for them:

- To enter, inspect and search any work place;
- To employ the services of the Garda Siochana if they feel they will be obstructed in their duty;

- To carry out inspections or investigations in accordance with the relevant statutory provisions;
- To examine, copy, remove and retain any documents or records (including electronic) required for investigation purposes;
- To require persons with information relevant to the inquiry to answer reasonable questions relating to the investigation;
- To direct that workplaces remain undisturbed for the examination purposes;
- To remove articles or substances from the workplace or to sample the atmosphere.
- To have articles or substances which have caused or are likely to cause danger to be dismantled or subjected to any process or test;
- To take measurements, photographs or recordings necessary for the examination;
- To direct that a safety statement be amended;

(Safety, Health and Welfare at Work Act, 2005)

Inspectors have certain options available to them under the 2005 Act which were previously available under and the 1993 regulations, which allow them to take action in three ways. The strategy is one of graduated enforcement:

- **Improvement Direction and Plan**

When an inspector finds that workplace activities involve risk or are likely to involve risk to the health and safety of people they can serve an Improvement Direction. This requests those managing the workplace to provide an Improvement Plan within a specified time outlining the remedial action to be taken.

- **Improvement Notice**

When inspectors find a workplace breaches any of the statutory provisions they may issue an Improvement Notice which will: specify the provisions in question; state reasons for their opinion; where relevant state that a workplace has failed to comply with an Improvement Direction.

- **Prohibition Notice**

Where an inspector feels that the activities in a workplace involve or are likely to involve a risk of serious personal injury to persons at work a prohibition notice can be served which prohibits the carrying on of activities in the notice (Garavan, 1997).

2.3.3 Safety Statement

Section 20 of the Safety, Health and Welfare at Work Act (2005) provides the requirement for all employers and self-employed to formulate a Safety Statement and to bring the safety statement to the attention of employees or others at the place of work that may be affected by the Safety Statement. The Safety Statement is a programme in writing which is based on identifying the hazards and assessing the risks to safety and health at the place of work to which the statement relates. The act states that the Safety Statement specifies the arrangements made and the resources provided for safeguarding the safety, health and welfare of persons at work. It should also detail the co-operation required by employees with regard to safety, health and welfare and where relevant the names of those responsible for the tasks as set out in the statement. The safety statement is informed by risk assessment, which involves identifying and assessing the hazards in the workplace. Where a safety statement is seen to be inadequate by an inspector they may direct that it be revised within a specified time (Safety, Health And Welfare At Work Act, 2005).

Ironic as it may be the safety statement itself may act as a safety hazard. Once the safety statement has been prepared it can often be shelved and not referred to again. Completing a safety statement can lull people into a false sense of security, a sense that compiling it is enough to create a safe working environment (Dunne, 2000). According to Dunne *'it is essential that, once drawn up, a safety statement becomes a real benchmark for the work practices of the organisation'* (Dunne, 2000, P.12). In order to do this the safety statement should be reviewed regularly to include new hazards that have been introduced into the workplace. The 2005 legislation has lifted the requirement for farmers or small businesses, with three or less employees, to prepare a safety statement. Instead, a sector specific code of practice will be devised for these groups.

2.4 Safety management

Achieving a high level of safety is a goal of companies (Harms-Ringdahl, 1993). For those that have the liberty to determine the way in which they work, some degree of control exists over the risks they face, however, for many more it does not. *'Safety management is essentially concerned with the effective use of safety measures in the pursuit of specified safety goals'* (Garavan, 1997, P.476). The basic premise of this statement is that in order to manage safety, goals must be set. Safety management is defined as *'the decision making procedure that applies in relation to accidents and other types of undesired events'* (Harms-Ringdahl, 1993, p.190).

According to Garavan (1997) an organisations safety policy should be integrated into all management activities and therefore viewed and managed as any strategy fundamental to the success of the business. Many of the features of successful health and safety management are the same as good management practices advocated by those striving for business success (Byrne, 1995). As a result successful organisations generally excel in health and safety as the skills and expertise that make the business itself a success are also employed in health and safety management. Organisations that achieve high health and safety standards are structured and function in a way that puts health and safety policies into effective practice. This is aided by the establishment of a positive safety culture, which assures involvement and participation at all levels (Lindsay, 1992). *'The visible and active leadership of directors and senior managers develops and maintains a culture consistently supportive of health and safety management. They aim not simply to avoid accidents, but to motivate and empower people to work safely'* (Lindsay, 1992, p.390).

2.4.1 The safety management process

The safety management process is not dissimilar to other functions of the organisation and is very much dependent on the safety culture within the organisation. *'To manage safety and health is to take a proactive stance toward the elimination, prevention, and control of risks. Managing is resolving the conflicts between ever-present risk and the equally ever-present desire for safety and health'* (Murphy, 1992, p.104).

The degree of importance placed on a safe and healthy work environment impacts greatly on the management response to workplace safety. The safety management activity within a business encompasses four areas:

- The management of health and safety operations;
- The measurement of health and safety performance;
- The motivation of managers to improve standards of health and safety performance;
- The design of effective organisational structures and cultures which contribute to effective safety performance (Garavan, 1997).

The Health and Safety Executive (HSE), 2001 examine the process in more detail highlighting the key elements of successful health and safety management (Figure 2.4). This model identifies three principles elements of successful health and safety management; policy development, organisational development (putting together structures which allow for successful health and safety management) and developing techniques of planning, measuring and reviewing the safety management process. This model relies on control and information links to function effectively. Auditing is central to the information collection and feedback. However, while auditing is an essential element of successful health and safety management systems, it alone is not sufficient management of health and safety issues (Lindsay, 1992,). *'Auditing has value only in so far as it forms part of an overall health and safety management system, is attuned to that system and is systematically and imaginatively, applied'* (Lindsay, 1992, p.389). Many organisations rely too heavily on auditing to manage workplace safety. However, auditing provides the medium through which the effectiveness of other components can be measured and reviewed and thus should not be relied on to the exclusion of other components (Lindsay, 1992). In order to successfully manage workplace health and safety, each organisation must have a clear health and safety policy and organisational structure, such as that outlined in figure 2.4, for implementing this policy, In the case of farming, these structures may be much less complex than in other businesses yet each step will be essential and no one step, such as auditing, will be more important than the others.

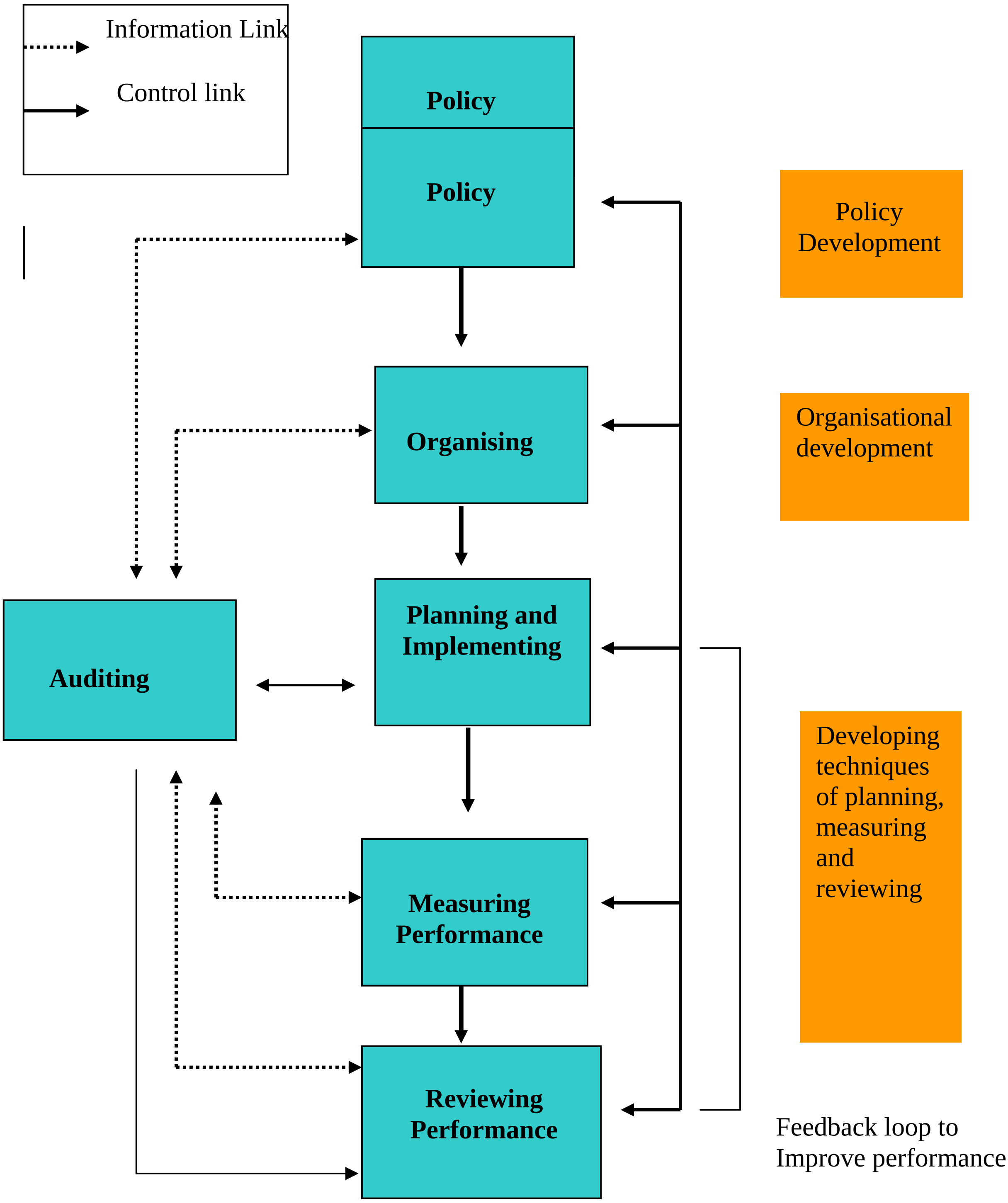


Figure 2.4: Key elements of successful health and safety management

The health and safety policy once developed must be implemented according to a plan and subsequently will require evaluation. '*The best health and safety policies are concerned not only with preventing injury and ill health as required by minimum standards set in health and safety legislation but also with positive health promotion going well beyond the minimum which gives practical expression to the belief that people are a key resource*' (Lindsay, 1992, p.389). The specific policy adopted by the organisation will determine the management approach employed toward health and safety.

2.4.2 Approaches to health and safety management

Garavan (1997) examines the four main approaches to health and safety management that have prevailed in the literature; The Legalistic approach, Socio-Humanitarian approach, The Financial-Economic approach and The Human Factor approach. While the legalistic approach is largely based on the principle of investing the minimum effort into health and safety management in order to comply with the law, the human factor approach requires a major investment and commitment by both management and employees. This approach considers the system as a whole as opposed to considering the safety of personnel or the cost of safety.

1) The Legalistic Approach. In this approach the organisation simply aims to comply with their legislative duties.

2) Socio-Humanitarian Approach. This approach works on the principle that personnel are integral to the success of the business and therefore should not be exposed to danger at work.

3) The Financial-Economic Approach. This approach holds that all accidents and incidents cost money. Therefore the motivation is to bring about an improvement in health and safety performance in order to reduce safety related costs.

4) The Human Factor Approach relies upon identifying the organisational characteristics that influence safety behaviour. Garavan (1997) outlines the importance of five factors in this approach; importance of a safety culture or climate, the need for policies and systems to control risk, a commitment to improving health and safety performance, an active interest by management in health and safety issues and the creation of an environment where safe behaviour is encouraged. The human factor approach is a holistic approach to health and safety management, which requires a management process such as that outlined in figure 2.4. The safety approach adopted by an organisation is also a factor of safety ambition. What exactly do management want to achieve in safety terms in this work environment. Safety ambition can vary considerably; Harms-Ringdahl (1993) uses a stairway to illustrate the different levels that exist.

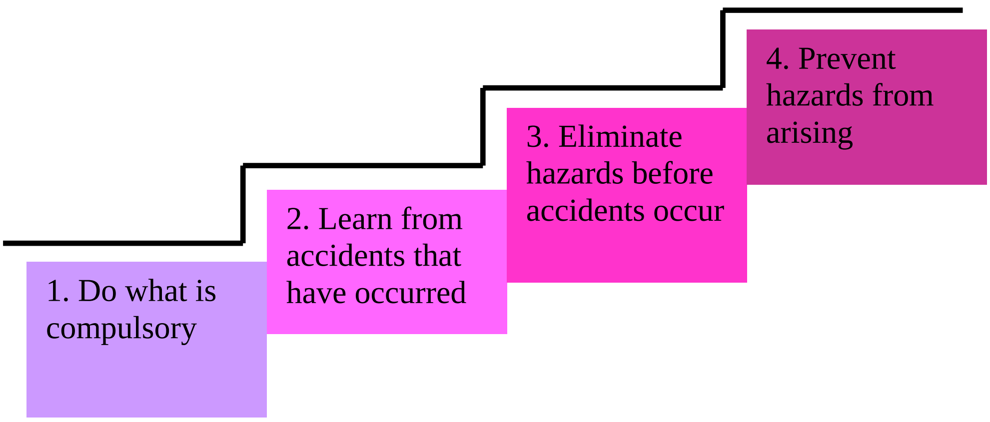


Figure 2.5: Level of safety ambition in safety work (Harms-Ringdahl, 1993)

Those at the very bottom of the stairway do only what is compulsory, they take the legalistic approach. While some learn from accident situations, others aim to eliminate hazards before they result in an accident. Those who are most ambitious will try to prevent hazards from arising in the first instance; those employing a human factors approach will be working at this level of motivation (Figure 2.5).

Two types of safety management strategies exist; proactive and reactive which are examined by Garavan (1997) and again these strategies are a function of the safety management policy. While proactive strategies are concerned with prevention of accidents and incidents, reactive strategies are post-accident strategies and should never be uniquely relied upon. Proactive strategies are an integral part of safety management, however, reactive strategies may also be required in the event of an accident occurring. Proactive strategies can be broken into both safe-place strategies and safe-person strategies. Safe-place strategies aim to reduce the physical danger present in the workplace, while safe-person strategies rely on employees adhering to health and safety standards and practices of the organisation. Both strategies aim to reduce accident occurrence by confronting elements identified as fundamental in accident causation; human activities and the environment (section 2.2). Neither strategy can be successfully employed without the other.

The safety management process is two dimensional, involving both management of personal and the working environment. The overall safety culture dictates the organisation policy which in turn determines the type of approach taken to managing health and safety on the farm.

2.5 Safety management in farming

Giles and Stansfield, 1990, p.7 define management as *'a comprehensive activity, involving the combination and co-ordination of human, physical and financial resources, in a way which produces a commodity or a service which is both wanted and can be offered at a price which will be paid, while making the working environment favourable for those involved'.* Human resources are identified as being an integral element of all businesses and the farm business is no different. Giles and Stansfield, 1990 believe that acceptable and agreeable working conditions could be as important in the long-term survival of that business as the profit itself. Agriculture is a scientific field, which requires an educational background reinforced by practical experience. It requires knowledge of agronomy, economic projection and fiscal management, personnel management, and government regulatory policy (Elkind, 1993).

Agriculture differs to other sectors of the economy in that the farmer must be competent in diverse areas. In other sectors, different people are responsible for the different functions of management. In industry there are separate management and labour functions but in agriculture the farmer does both (Berry, 1971). According to Murphy, 1992, no evidence can be found that supports the belief that farmers have the organisational, social or political support for engaging in thorough and continuous health and safety management adequate for dealing with the scale and difficulty of the problem. Therefore, while safety management is the responsibility of the farmer, the literature suggests that those skills required for health and safety management at farm level may not be present on all farms. A comparison between the elements included in successful health and safety management (HSE, 2001) and the stages in farm planning and control as outlined by Bernard and Nix, 1979, P.15 (Figure 2.6), illustrate that both management processes are similar. While the steps are not identical, both schemes include fundamental functions of management such as auditing, planning and implementing, control or measuring performance and reviewing or evaluating. Bernard and Nix outline a seven stage planning and control process which involves both policy development and developing techniques of planning, measuring and reviewing. Organisational development is understandably not part of the Bernard and Nix farm management model. Similar to the HSE model the stages in farm planning and control involve control and information feedback. Based on a review of both models it is apparent that health and safety management is not vastly different from the management function of planning and control as it applies to farms. Hence, as Byrne, 1995 has suggested, it is reasonable to assume that those farmers that have skills and expertise in management and thus manage successful farm businesses will also effectively manage health and safety on their farms. Managing health and safety provides a structure for prioritising health and safety endeavours. Safety management allows farmers to examine the nature, consequences and costs associated with risks and make informed decisions on which risks to address (Murphy, 1992).

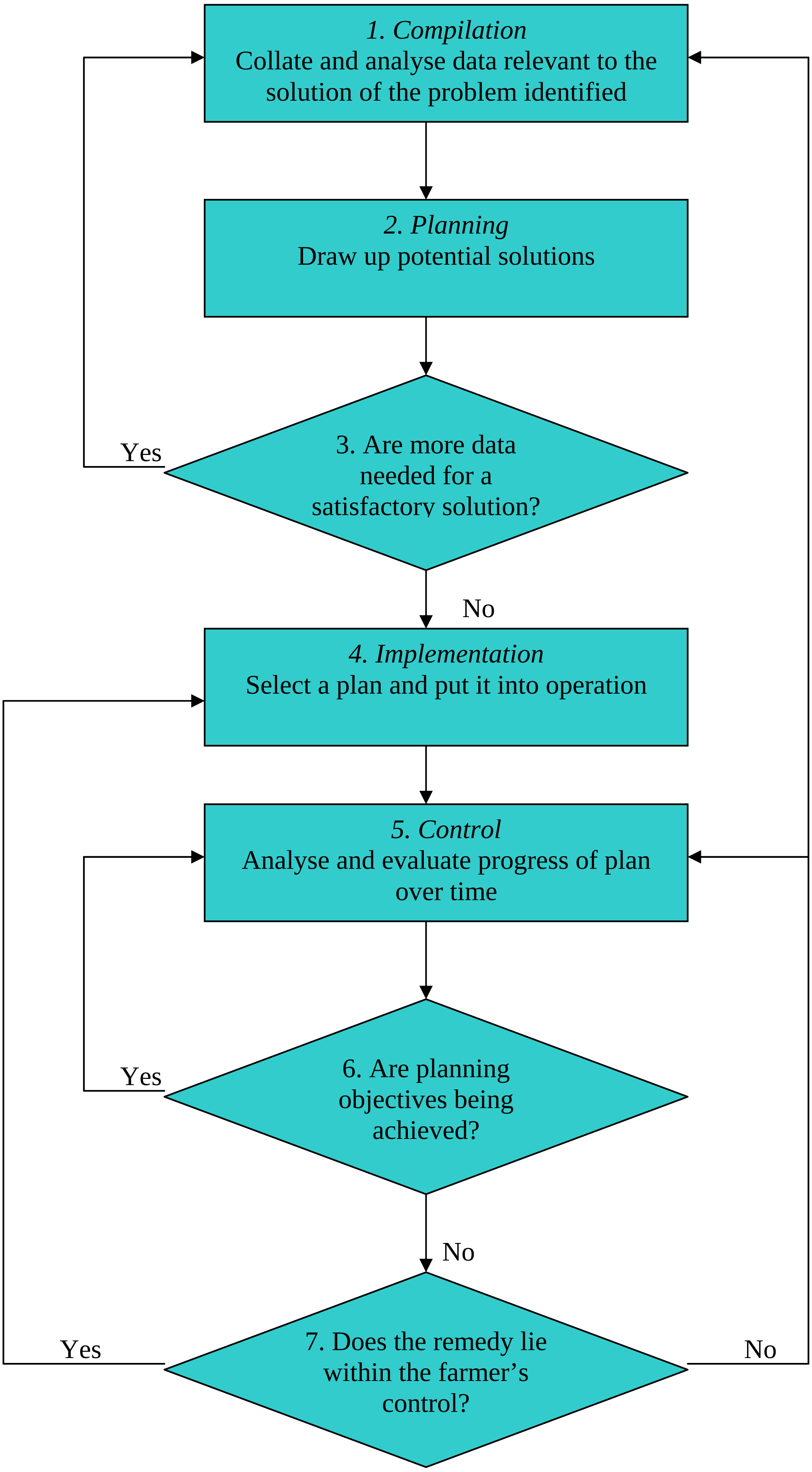


Figure 2.6: Stages in farm planning and control (Barnard & Nix, 1979, p.15)

CHAPTER 3
LITERATURE REVIEW

In contrast to the industrial accident setting where health and safety requirements are pre-determined due to established work routines and a stable environment, agricultural work involves a small work force, a high level of self reliance and multi activity orientation (Knapp, 1966). As far back as the 1930's, farming has been recognised as having significant health and safety issues, which were not adequately addressed. Power, 1939 as referred to by May, 1990 identified farming as the occupation in which most accidents occurred and in which the least accident prevention effort had been made. The farm population is unique in many ways and consequently poses problems for those concerned with injury prevention (Aherin & Murphy, 1992).

3.1 Mortality and morbidity in farming

Agriculture is reported to be one of the most hazardous industries in America. While fatality statistics are widely available, data on non-fatal injuries is not well documented. In terms of occupational fatality surveillance, the agriculture industry is the least sufficiently dealt with (Myers, 1990). Rautiainen & Reynolds, 2002 reported that during the 1990s the fatality rate in farming was approximately 22/100,000 workers. According to McCurdy and Carroll the data regarding the number of people at risk from farm work related injury and the numbers of persons suffering injury are totally inadequate. An analysis of agricultural fatalities between 1980 and 1985 shows that agricultural production has a fatality rate more than three times that for all industries combined. While the agricultural services fatality rate is higher than that of all industries, it is not nearly as large as the rate for production agriculture (Myers, 1990). The National Safety Council have estimated that in the USA approximately 780 occupational fatalities occurred in agriculture in 1998, which is a rate of 22.1/100,000. The rate of non-fatal injuries however, was estimated at 140,000 in 1998 (McCurdy and Carroll, 2000). Myres and Hard, 1995, cite three data sources which estimate fatality rates in agriculture ranging from 17 to 42 deaths per 100,000 workers which puts agriculture in the four most hazardous industries in America.

However, problems do exist in definitively quantifying the extent of injuries in America.

The agricultural injury problem in the USA is difficult to enumerate due to the issues posed by hired farm workers. This population are transient by nature and are very often marginalised for social, economic and linguistic reasons. As a result, many hired workers go unaccounted for in agricultural labour statistics (McCurdy, 1995 as cited by McCurdy and Carroll, 2000). While numerator data pertaining to agricultural injuries and fatalities can be calculated using various sources, a particular problem exists in establishing accurate denominator data. In addition, there is a significant lack of data relating to farm workers under the age of 16 years (Myers, 1990). The issues surrounding numerator data are not relevant in the Irish context, although, establishing denominator data is more challenging for the reasons discussed in section 3.3.1 below. Similar to America, agriculture in Finland has been described as one of the most hazardous industries with a fatality rate of 6.5/100,000 workers (Rautiainen, 2002). Sweden also reports a high level of fatal accidents in agriculture, 11.6/100,000 workers per year (Thelin, 2002). Research indicates that workers in one Swedish municipality found that farmers displayed the highest work-related injury level. Agricultural injury in Australia represents a significant health, social and economic issue. It is the fifth most dangerous occupation in Australia with a fatality rate of 19.5/100,000 employed compared to 5.5/100,000 for all employees (Mather and Lower, 2001).

3.2 Ill health problems associated with farming

> *'Farmers make very little issues of their health problems individually or collectively. They are stoic and independent, accepting that there are certain risks associated with their occupation. Work comes first; illness and injury are just part of farm life.'* (Donham *et al*., 1982, P. 513)

Farming is often considered a healthy lifestyle, those engaged in it are often envied for their healthy and outdoors way of life (Gerrard, 1998). Many people think farmers and farm workers spend their time working in healthy conditions outdoors and therefore enjoy a healthy lifestyle (Walsh, 2000). However, according to

Donham *et al*. (1982) the health status of the people engaged in farming is poorer than would be commonly believed. Compared to other populations this group of workers have excess rates of chronic illness, excess disability from respiratory conditions and the highest death rate from occupationally related accidents. Hazards in the farmers working environment extend beyond the risk of accidents. There are many hazards in the farm environment that are capable of producing chronic health problems. In order for improvement to occur in the health status of farmers and farm workers, it is necessary to recognise their unique health problems. Farmers collectively make little issue of their health problems as they accept that there are risks associated with their occupation (Walsh, 2000). A study by Gerrard (1998) revealed that farmers in England perceived their industry as one which poses serious risks to their health. Walsh (2000) asserted that the economic problems facing farmers exacerbated the serious health problems already in existence. Yet they are largely not recognised by the majority of health professionals and policy makers from urban backgrounds. Consequently the health needs of the UK farming community are not being met by the National Health Service (NHS). There is a need for health care workers to understand the nature of farming in order to provide an effective service to farmers.

3.2.1 Extent of farmer ill-health

McNamara and Reidy, 1997, reported that in a study of health and safety in Ireland three quarters of those who reported disability said the disability was attributed to farm related ill health. Eight out of ten of the cases were related to respiratory problems. All of those who reported an ill health problem, felt the problem was persistent. A similar study by McNamara and Reidy in 1992 also found a high occurrence of respiratory problems among those who reported ill health problems. Back problems and allergies also constituted a large proportion of the ill health problems. Health problems associated with agriculture vary significantly, with specific health problems being related to specific agricultural practices. As agriculture changes and becomes more mechanised, the associated ill health problems also change. It is therefore important for those involved in health promotion to be aware of the changing health problems associated with farming. Donham *et al*., 1982, list twenty-five infectious diseases common to animal and man, which are significant to farmers. Many of these diseases are difficult to diagnose and therefore there is very little data available on the incidence of these diseases (Donham *et al*., 1982).

However, it is thought that they are more common than is generally recognised. Gerrard (1998) recognised that farmers health can be endangered through contact with animals due to exposure to the hazards of zoonoses, i.e. diseases caused by infective agents common to animal and man such as leptospirosis, ringworm and orf.

It is generally accepted that similar to many industrial environments, the farm environment is contaminated with many pollutants that may cause chronic lung problems. Owing to the fact that all farmers are exposed to these pollutants, the most severely affected are generally 'self selected', that is, they do not take the necessary precautionary measures. Another common respiratory problem among farmers is farmers lung. Similar to the infectious diseases common to man and animal, it is difficult to get a picture of how wide spread these problems are among the farming community. According to Gerrard, 1998, farmers exposure to air borne hazards may produce acute, sub-acute and chronic health problems. Agricultural pesticides have received much more publicity than any other agricultural hazards, in the United States. However, the majority of hospitalisation records in relation to pesticide poisoning are related to accidental ingestion and suicide attempts. These chemicals are the cause of many skin irritations among farmers (Donham *et al.*, 1982). Gerrard, 1998, felt that exposure to agricultural chemicals has greatly increased in the United Kingdom which has lead to possible health risks from acute and chronic poisoning.

3.3 Characteristics of farming which impact on health and safety

Farming has many unique factors which from a safety point of view, place those involved in the sector in a unique position compared to those in other sectors (McNamara and Reidy, 1997). While agriculture thinks and acts like industry, health and safety problems are not comparable. Even as industrial thinking is applied to the production aspects of agriculture, there is an obvious disparity between an effective health and safety program in a manufacturing facility and one that applies to the unique requirements of agriculture (Berry, 1971). The inherently dangerous characteristics of farming are widely acknowledged by farm health and safety professionals. '*When the conditions of work are intrinsically dangerous or when they encourage the worker to get through it quickly, or with increased comfort at the expense of safety, or when his/her task is intricate or so demanding that his/her* *capability to perform it suffers, that the greatest risk occurs. The very nature of farm work makes these occurrences commonplace'.* (Lloyd, 1983, p190).

In contrast to other industries farming has many characteristics which prove challenging to the management of health and safety. Doyle and Conroy (1989) compared the industrial working environment where working hours are limited and the worker is supervised to that of the farm where farmers work long hours to complete tasks alone. In addition, deteriorating economic conditions increase the probability that farmers will cut corners with regard to health and safety in order to save money (Walsh, 2000). Accordingly, this 'make do and mend' approach results in increased risk of both injury and farm work-related ill health. While individually these characteristics have a definite impact on farm accidents, there is a synergistic effect of these factors on agricultural injury prevention (Murphy, 1992). '*Collectively, these factors have a huge negative impact in changing the status quo of safety and health beliefs and practices on the farm, and pose obstacles for professionals engaged in agricultural safety and health research, education and intervention*' (Murphy, 1992, p27). In addition to the impact of the unique characteristics of farming on injury causation, Donham (1982) proposes that they may also have an impact post accidents, which consequently affects the medical outcome.

3.3.1 Age profile of those exposed to farming hazards

Farming provides a unique problem in that people of all ages are at risk on farms. The nature and location of farm enterprises is such that in general the farm and the family home are one and the same. It is not unusual to find three generations of one family present on a farm with women, children and the elderly including those that are non-workers exposed to the hazards of the farm (Berry, 1971; Simpson, 1984; Purschwitz & Field, 1990; McNamara and Reidy, 1997). In contrast to other industries, children constitute a significant proportion of the agricultural workforce and are thus exposed to the hazards of farming at an early age (Rivara, 1985). Children often become involved in situations on the farm that they cannot control. These situations require knowledge, strength and skills that children lack *(*Schelp, 1992). Economic hardship and poor access to childcare often results in children being required to act as additional labour on the farm or being supervised in an environment where farm work is being carried out (Aherin *et al*., 1992). Consequently, toddler injuries on farms may be related to increased curiosity and activity before they have developed mature decision-making and caution (Cogbill *et al*., 1985a). Minimum estimates by Rivara, 1985 indicate that more than 25,000 children and adolescents are injured on farms, in the United States each year, of which almost 300 die. The majority of children fatally injured on farms died before they reached a hospital, however, not all of these injuries can be attributed to farm work.

The aged farm population are also subject to the hazards of farming. Because there is no standard retirement age for farmers many remain working past the ages of 65 and 70 (Purchwitz and Field, 1990). In Ireland a large number of older farmers remain despite the incentives that have been provided to encourage land transfer. Farmers over 65 years old control nearly 20% of farm land (Department of Agriculture, Food & Rural Development, 2000). Elderly people over 65 years old have been found to be the least conscious of accident hazards (Janson and Erikson, 1990). Similar to child farm labour, it is proposed that aged workers continue to work on farms due to labour shortage and economic necessity (Aherin *et al*., 1992). Degeneration in sensory, information processing and muscoskeletal capabilities may contribute to the increased levels of risk among aged workers (Small, 1987 as cited in Aherin *et al*., 1992). Older people may have physical problems that mean they do not have the same degree of agility, which in turn increases their accident risk (Thelin, 2002). Older farmers very often use older machinery and tractors and neglect to use protective devices. Slower reflexes and carelessness have been associated with injuries and deaths among the aged farm population (Hansen, 1986 as cited in Gill Coury *et al*., 1999).

3.3.2 Mechanisation

Modern agriculture is heavily dependent on mechanisation. There has been an increasing trend in farming towards larger scale enterprises and the use of large capacity machinery, which often needs to work long hours in order to be economic. This has led to an increase in the level of specialisation needed in some farming activities and often results in exposure to hazardous jobs for long periods of time (Lloyd, 1983). The modernisation of farming and in particular the mechanisation has left farmers and farm workers exposed to greater risks than those faced by workers in other industries (Monk *et al.*, 1986). Because many farm machines are very expensive they are replaced very infrequently and therefore this affects the safety of these machines. The average life span of tractors in Wisconsin was found to be 20 years and many were built before the development of some safety features (Cogbill *et al.*, 1985b). Similarly, the average age of tractors in England that were involved in fatal farm accidents between 1992 and 1997 were found to be 19 years old. This may also be true for farm machinery in Ireland, particularly in specific farm systems and sizes. In response to the mechanisation of agriculture, agricultural engineering has provided many hazard reduction possibilities. However, often these are rendered useless once they reach the workplace as they are often removed. No standards are applied when farmers sell machinery between one another (Aherin *et al.*, 1992). Therefore while agricultural engineering may produce safer farm machinery, there is no guarantee that once sold to the farming community that these safety innovations will be maintained, used or in effect valued. In many cases, smaller sized farm units that are operated by a fulltime farmer often have a very limited budget and consequentially their machinery and equipment is usually older, less well maintained and therefore hazardous (Murphy, 1992).

Not only has agriculture become increasingly mechanised, the declining labour force combined with an increase in the speed and sophistication of many operations has resulted in farmers and farm workers being left alone and perhaps unsupervised for long periods of time. Additionally, while technological advances have reduced the physical burden on man, the machine operator has more decisions to make and functions to perform in order to use the machine (Kepner *et al.* 1972 as cited in Murphy, 1981). This demand may result in mistakes being made which can lead to accidents. Ultimately, farm machinery present many hazards on the farm. New machinery in themselves provide new hazards for the farming community in addition to those posed by older, poorly maintained machinery.

3.3.3 Working hours and seasonality of farm work

Due to the nature of farm activities farmers tend to work long hours and at certain times of the year bear more pressure than others. Farmers often have to work long hours under severe time constraints (DeRoo, 2000) and are often subjected to shortage of time when completing tasks due to the weather (Pickett *et al*., 1995; Gill Coury *et al*., 1999). In other industries the work routine is usually regular with limited hours of work and training is provided for specialised work. However, in farming, the farmer is usually self-taught and has very irregular work patterns (Doyle, 1988). The farmer has no limit to his daily or weekly work regime compared to his industrial counterpart who works a forty-hour week and in addition holidays are unusual for the farmer (Berry, 1971). Farmers may accept long, irregular hours and short holidays too readily; however, this is associated with ‘living over the shop’ (Giles and Stansfield, 1990). Many farmers work at least twelve hours per week more than their employees, with great seasonal variation (Lloyd, 1983). According to Leahy, 2003, the average labour input per farm per day on Irish suckler farms was 9.90 hours per day. However, this was seen to increase to as high as 11.45 hours per day at times of heightened activity. In reality, many farmers are pushing themselves beyond their limitations. The commitment required by farmers in terms of length of working day, lack of adequate holiday leave and irregularity of work results in an insecure working environment in which the farmer does not know what to expect from his day.

3.3.4 Part-time farming

For some farmers the working day is more defined as they are also engaged in employment outside of the farm. In Ireland the uptake of off-farm employment has been increasing over the past decade. In 1998, 30% of Irish farm operators were engaged in off-farm employment (Phelan & Frawley, 2000). Although this change has been positive in terms of farm income it may have an adverse affect on farm safety. The economics of farming have forced many family farms to decide between increasing the scale of the farm and production or engaging in off-farm employment in addition to farming part-time. Both scenarios may have adverse effects on health and safety on the farm. According to Murphy (1992) multiple job holding has important implications for production agriculture safety and health. It results in the farmer having less time to devote to farming and given the nature of farming this often means hurrying to complete work. This in turn increases the risk of errors occurring which could result in accidents. Part-time farmers are required to work long hours in the evening and at weekends (Rautiainen & Reynolds, 2002). Multiple job holding leads to less experienced farm workers, which again can lead to a greater risk of injury. If farming is not profitable enough to sustain a full time operator then it will not have the resources to invest in farm health and safety (Murphy, 1992).

3.3.5 Isolation

In addition to working long hours, perhaps 7 days a week, farmers often work alone. Unlike in industry where the worker is supervised, the farmer works alone, often continuously until the job is finished (Doyle and Conroy, 1989).

As farmers work alone, if an accident occurs the victim may not be discovered until hours after the accident. In addition, the location of the accident may not be easily accessible to emergency rescue vehicles and may indeed be isolated from medical assistance (Donham *et al*., 1982; Cogbill *et al*., 1985b, Simpson, 1984). As farm accidents occur in rural areas, response and transport times can be long. For farmers working alone, an accident could go undiscovered for several hours if the farmer is trapped or unconscious. This serves to intensify the traumatic effect of a serious accident (Cogbill *et al*., 1985b; Pickett *et al*., 1995). In the case of machinery related injuries, extraction from heavy machinery can be time consuming (Cogbill *et al*., 1985b). This situation can be contrasted with that of workers in industry where there are generally adjacent workers and isolation is rarely an issue (Berry, 1971). The solitary nature of farm work means that in cases where the injured person has been unable to raise the alarm they can go unmissed for some time. This presumably has an impact on the medical outcome of the injury. Where the alarm is raised, geographic isolation can be an issue in responding.

3.3.6 Stress

The National Institute for Occupational Safety and Health ranked farming as one of the ten most stressful occupations in the USA (Elkind, 1994). Walker and Walker, 1987 found that the body of literature on farm stress indicated that farming is significantly less idyllic than is frequently portrayed. While farmers were found to share some stressors that were common to all occupational groups, they also experienced stressors that are specific to farming. In addition it reflected that farm families exhibited a high incidence of stress-related symptoms. Walker and Walker (1988) found that farm men and women reported symptoms commonly associated with chronic stress. Those engaged in mixed grain and livestock operations, younger farmers and those with off-farm jobs reported significantly higher stress symptoms than non-farmers. According to Thu *et al*., (1990) farmers identified stress as one of their major family health and safety concerns. Walker and Walker (1986, P.427) suggests that *'farmers are experiencing chronically high stress intensified by* *perceptions of lack of control over the major stressors of government policy, weather and market conditions'.* Economic factors including low commodity prices, increasing expenses, high debt load and irregular cash flow, unfavourable weather conditions and government policies and regulations have been identified as the top farm stressors (Walker and Walker, 1987). In addition, other major farm stressors categorised as daily hassles were identified, these included machinery breakdowns, worries about market conditions, deciding when to sell, worries about the weather, heavy work loads, time pressures and unplanned interruptions (Walker *et al.*, 1986). Similarly Weigel (1980) identified stressors that were unique to farming, these included machinery breakdowns, disease outbreak, weather conditions, government regulations and heavy workload. Research from Canada, Washington and the Midwestern United States found farmers experiencing a significant amount of stress, which is specifically related to economic stressors. Farmers' anxiety and worry arises from unstable markets, competition and day-to-day economic concerns. Additionally, they experience work overloads at peak times when labour is scarce and workload is heavy and work underloads while completing boring, repetitive tasks (Aherin *et al*., 1992).

Literature suggests that there is a relationship between farmer stress and safety on farms. The combination of the interactions between farmer-equipment-agricultural environment along with physical stress, economic burden and heavy workloads has introduced a variety of hazards to farmers and the farm family (Ogilvie 1990 as cited in Elkind 1994). Elkind, 1994, found that according to the literature ongoing patterns of stress trigger distractions and these in turn lead to events, which may cause accidents, and threats to health. A focus group of practicing farmers in Washington felt that the primary cause of unsafe and unhealthy behaviour was stress. In addition, it was concluded that stress prevents farmers from taking appropriate safety precautions when they are aware of danger in their work practices. In order to concentrate on injury prevention farmers must learn to recognise the cause of their stress and learn to manage their reaction to these circumstances in an appropriate way. Thu *et al*., (1997) identified stress as a significant risk factor for agricultural injuries. Their study found that those farmers reporting high stress were 1.7 times more likely to sustain a serious injury than those reporting moderate to low stress. Glasscock (1999) found an association between stress related variables and injury occurrence among farmers. Similarly Simpson *et al*., (2004) found a strong association between stress and the incidence of farm injury. However, Glasscock proposes that the stress-accident relationship may be in part related to self-employment rather than simply related to farming. Lewin-Epstein and Yuchtman-Yaar (1991) as cited in Glasscock (1999) found self-employed men had a higher perceived stress than employed men. The author proposes that this may be due to a greater burden of uncertainty, the effects of market fluctuations and the threat of loss of assets. Contrary to this, Rautiainen *et al*., (2004) found that the injury rates did not differ according to stress level. As stress was measured at the same time as injuries, the presence and effect of stress pre-injury is questionable.

3.4 Injury characteristics

Accurate national occupational injury data relating to non-fatal injuries in farming is not readily available from many countries. In many cases the legal workplace health and safety requirements differ between agriculture and other industries and thus this affects reporting requirements. Where farmers are required to report injuries, under-reporting is common. According to Purschwitz and Field (1990) data collection is costly both in time and money due to the physical dispersion of farms. In addition, the variety of people living and working on farms leads to inconsistencies in data. Studies of farming accidents identify many factors which appear significant in the analysis of farm injury data. According to Knapp (1966, P. 503), *'who is injured and by what is of considerable importance in the development of any educational program or recommendation with respect to design changes for injuring devices'*.

3.4.1 Agent of injury

From their review of the Traumatic Injury Surveillance of Farmers, Hard *et al.,* 2002, found that machinery and livestock were the leading causes of farm work related injury in America between 1993 and 1995. In 1988, the National Coalition for Agricultural Safety and Health (NCASH) reported that farm fatalities and injury predominantly result from interactions with machinery, which accounts for over 50% of traumatic farm deaths (Hard *et al.,* 2002). In the American context the tractor has been consistently identified as the predominant causative agent associated with farm fatalities (Purschwitz, 1990). However, for non-fatal accidents, the National Safety

Council's (NSC) 31-state report showed that animals were involved in 16.8% of all injuries and machinery (excluding tractors) accounted for 16.3% of all injuries. Machinery injuries, however, accounted for the majority of permanent injuries where as animals accounted for only 6.3% of permanent injuries. The machine most often involved in farm-work related injury is the tractor (May, 1990). During the period between 1976 to 1989 machinery injuries in Canada accounted for on average 55% of annual farm injuries (Gill Coury *et al*., 1999). Similarly Doyle and Conroy (1989) found machinery and falls to be the most common agents of injury on farms in Ireland. If a league table of farm accidents were developed machinery would comprise the leading single category, accounting for half of fatalities and a quarter of non-fatal accidents (Lloyd, 1983). Lloyd also ranked falls and animals as major agents involved in farm work- related injuries. Evans (1999) found that two thirds of accidents in mid-Wales involved machinery or implements of some kind while animals were involved in one third of accidents. Cogbill *et al*., 1985b and Pickett *et al*., 1995, also found machinery to be the main agent of injury. Gill Coury *et al*., 1999, identified excess of self-confidence and carelessness as causal factors in accidents involving animals.

3.4.2 Age of victim

From the literature reviewed, the majority of victims of farm-work related injury appear to be middle-aged men. Doyle and Conway (1989) found the victims of farm accidents in their study to be mostly young fit middle-aged men, followed by children. Children were found to be particularly vulnerable at peak times on the farm, when their help was required. Evans (1999) found the mean age of those injured to be 39.71 years, however, both children and the elderly were among the injured. Cogbill (1985) reported a similar mean age for those injured while Reiling (1997) found the average age of those sustaining injury to be 43 years, although, it was slightly higher (55 years) for those sustaining fatal injuries. A Canadian study found male farmers between the ages of 31-40 to be at the highest risk of injury in Ontario (Pickett *et al*., 1995). The NCASH report as cited in Hard *et al*., (2002), stated *'Agricultural injuries affect, in substantial numbers, children under the age of 16 and the elderly 65 and older'* (NCASH, 1989, p.19). Purschwitz (1990), in examining results from the NSC's 31-state report found that the age groups 5-14 and 15-24 had the highest rates of farm work injury per million hours of work exposure.

Zhou and Roseman (1994) found that injury risk is inversely related to age, younger farmers are involved in more high-risk activities; lack training and experience and are greater risk takers. Correspondingly, Sprince e*t al.* (*2*003) identified a significant relationship between younger age and farm work-related injuries. They suggest that inexperience related to younger age may indirectly be a significant factor in injury risk. In Sweden, injuries to the over 64 year olds and under 30 year olds were found to be significantly greater than for farmers as a whole (Thelin, 2002). In addition, McCurdy and Carroll (2000) identified several studies showing increased rates of farm work-related injuries among the extreme age groups. The literature suggests that older farmers and farm workers are at highest risk for work-related agricultural fatalities (Hard *et al* 2002; Reiling, 1997; Myers, 1990; Myers *et al*., 1995) however the relationship is not as strong for non-fatal injuries (Reiling, 1997; Myers, 1990). The consensus appears to be that a higher proportion of middle aged men sustain farm work related injuries than all other age groups, however, those in the young age groups and older farmers are at the highest risk of farm work related fatalities.

3.4.3 Sex

According to Diderichsen *et al.*, (1999) in all age groups women are not injured to the same extent as men with the exception of perhaps after retirement. Purchwitz (1992) interpretation of the NSC's 31-state report found that while males were involved in almost 84% of the injuries they constituted approximately 62% of the population, and accounted for about 77% of the hours worked. Cogbill *et al*., (1985b) found in their study of agricultural trauma that similar to other forms of trauma the male female ratio was 4:1. Similarly, Evans (1999), Schelp (1992) and Mather and Lower (2001) found that the majority of those injured on farms were male. According to McCurdy and Carroll (2000) the increased risk for men is most likely related to working longer hours and engagement in more hazardous jobs than women. Traditionally roles within the farm family were quite well defined. Women tended to play the major role in managing the household and children and perhaps took on farm chores such as rearing fowl and tending to young animals. Men on the other hand, took on the vast majority of the farm tasks and in the majority of cases carried out all machinery work and heavy work on the farm. In Ireland, while men's roles have remained the same with regard to farm activities, by and large women's have changed in that they play a lesser role in farm activities and more frequently engaged in work activities off the farm. Consequently women were and even more so are now exposed to less risk in the farm environment.

3.4.4 Who was injured

When reviewing the results of the Traumatic Injury Surveillance of Farmers Hard *et al.*, (2002) found that the majority of farm work injuries occurred to the operator or a family member, followed by hired farm labour. Evans (1999) found the farmer to be the victim in 60% of reported accident cases in his study in the UK. Similarly Doyle and Conroy (1989) found the farmer to be injured in the majority of accidents presented in Irish general practice, however, children accounted for 16% of the cases. Purschwitz (1990) presented a similar picture from his synopsis of the NSC's 31-State report where 73.4% of farm work injuries involved family members who accounted for 70.8% of the population. In addition, Mather and Lower (2001) found employers were injured most frequently (58%) while employees sustained a relatively high level of injury (31%) on farms.

3.4.5 Time of year

Due to the seasonal nature of farm work (Section 3.3.3) one expects the majority of accidents would occur at peak periods in the farming calendar. Cogbill *et al.*, (1985b-) found a clear seasonal variation in injury with the majority of injuries occurring between May and November. Similarly, Jansson (1987) found that the accident rate on the farm was higher at busy periods of the year such as April, July and September. While Evans (1999) found that the majority of farm accidents occur in June. Zhou *et al.*, (1994) found the seasonal pattern of farm injuries to be bimodal, with one peak in spring and a larger peak in September while much fewer injuries occurred in winter. Gill Coury *et al.*, (1999) found that the majority of both injuries and fatalities, in the previous decade, were reported during the harvest season. A study in Ontario reported a seasonal distribution according to the type of accident. While machinery accidents were concentrated in summer and autumn, more animal related injuries and falls occurred during the winter months (Pickett *et al.*, 1995). However, Purschwitz and Field (1990) found that farm accidents varied widely by state for the month of the year in which they occurred. In addition to a seasonal factor farm accidents have been found to occur predominantly in the late morning and early to mid afternoon times (Jansson, 1987, Purschwitz & Field, 1990, Evans, 1999, Rautiainen *et al.*, 2004). There is a clear relationship between periods of peak farm activity and injury occurrence. While different studies have reported different peak times for injury, it may well be that they are closely related to particular systems and thus as Purschwitz and Field found can vary by region depending on the predominant system.

3.4.6 Location

According to Denis (1976), as cited in O'Sullivan (1995), almost 40% of accidents recorded in a survey of farm accidents in Canada occurred in the farmyard. Similarly McNamara and Reidy (1997) found that the majority of farm work-related accidents in their study of Irish farms occurred in the farmyard. However, according to Evans (1999) almost 42% of accidents took place in fields while just over one third took place in farmyards. Similarly most farm injuries in Canada during the period 1976 to 1989 occurred in fields while somewhat fewer were found to have occurred in the farmyard. Zhou *et al*., (1994) found that the majority of injuries occurred in fields or pasture followed by animal facilities and farm buildings. Stallones (1990) found that injuries were more likely to occur in the barn, barnyard or fields. Both Jansson (1987) and Evans (1999) found that somewhat more accidents occurred outdoors than indoors. This may be due to a greater level of activity taking place in the outdoor environment and the impact of environmental conditions, e.g. carrying out activities in inclement weather conditions or working under pressure in good weather to complete tasks before weather conditions deteriorate.

3.5 Factors associated with injury risk on farms

Many studies seek to identify injury risk factors in an attempt to determine what approaches will be most appropriate to reducing or eliminating injuries (Pratt & Hard, 1998). Findings generally confirm the theory on accident causation, in that a series of events create the conditions under which the incident occurs.

3.5.1 Farm size

'Size of farm is clearly an important factor as regards farm accidents in terms of the incidence of accidents generally and serious accidents' (McNamara and Reidy, 1997, P.18). According to Jansson (1987), the size of the farm is a significant factor in the occurrence of accidents. Although farms of more than 50 hectares constituted only

15% of the farms in the study area, they accounted for 39% of all accidents. Zhou and Roseman (1994) found that the greater the farm size and the higher the annual production tended to result in a higher injury risk. They also propose that larger farms have a higher exposure to hazards due to the fact they have higher livestock densities, are more mechanised and are possibly under heavier economic pressure. Rautiainen *et al*., 2004, did not find an association between farm size and injury rate. However, Pickett *et al*., 1995 support the association between injury and farm size based on the results of their population based survey. In addition, they suggest there is a clear association between higher farm income and increasing risk of injury. Larger farms tend to have a higher activity level and also possess a higher level of animals and machinery both of which have been cited above as the predominant agents of injury in farming.

3.5.2 System of farming

Reiling (1997) found that the majority of work related accidents on Norwegian farms occur on farms where more than 75% of their time is spent on animal husbandry. However, this is the predominant system of farming in Norway. Having large livestock on the farm has been significantly associated with farm work-related injury (Sprince *et al., 2003,* Stallones, 1990, Rautiainen, 2004). Zhou and Roseman (1994) found that dairy farms and farms with forestry have the highest risk. McNamara and Reidy (1997) found that over one third of farming accidents in Ireland, over a five year period, occurred on specialist dairy farms while tillage farms were also found to have a high proportion of accidents.

3.5.3 Work load characteristics

Sprince *et al.*, 2003 found an association between work characteristics and farm work-related injury in their study. This is similar to the finding of Zhou and Roseman (1994) who found an association between proportion of time spent farming and farm work-injury risk. Jansson (1987) found that over half of the accident victims they encountered did not have continuous leave (of one week or more) during the year. However, Rautiainen *et al*., 2004 did not find a significant association between farm work hours and injury rate. In addition, part-time farming has been found to have an impact on work-related injury in farming. Zhou and Roseman (1994) found that part-time farmers had an excessive injury risk compared to full-time farmers. Reiling, 1997 found that when injuries were analysed per million working hours, the injury rate was higher on farms with the lowest level of working hours. Part-time farmers, who work under severe pressure both early in the morning and late in the evening on their farms, may explain this. Furthermore, the production systems on small farms may not be as modern as on large farms and the variety of tasks is much greater on small farms than on large farms. A more recent study from Iowa found no significant association between part-time farming and injury rates. However, Sprince *et al.,* 2003 found that working part-time on the farm was protective against farm work-related injury.

3.5.4 Other factors

Pickett *et al.,* (1995) observed a two-fold increase in risk of injury associated with third level education as opposed to a primary level education. Zhou and Roseman (1994) also found an association between higher education level and increased injury risk. According to Sprince *et al.,* (2003) this association may be explained by the possibility that younger farmers are more likely to recall and report accidents. According to Jansson (1987) 24% of those injured on farms in their study had a short work experience in farming (0-5 years). However, Rautiainen *et al*., 2004, did not find education to be an injury risk factor. In addition, farmers who had suffered a prior residual injury were found to have an almost three fold risk of injury, farmers who have been previously injured were more likely to be injured again (Zhou and Roseman, 1994). Alcohol use has been associated with virtually every type of injury, especially those that are severe and fatal (Baker *et al*., 1984; Smith and Kraus, 1988). Farmers in Ireland do not tend to drink at work; rather they drink late at night, at the weekend and when they go to agricultural shows (Doyle and Conway, 1989). Some Irish evidence, however, suggests that a higher proportion of serious accidents occur on farms with larger size households irrespective of whether children were present or not (McNamara and Reidy, 1997)

Figure 3.1 below illustrates both the person and environment characteristics identified from the literature, which play a role in farm health and safety. Person relates to the farmer or the decision maker, should they be different, in the farm business. It is the person who determines the management ethos of the farm. Environment in this context relates to the farm environment in which farm activities take place. The literature identifies characteristics of farming, injury characteristics and factors associated with injury risk, which can be described as either person characteristics or environment characteristics. Person characteristics were found to have been examined and discussed in greater detail in the literature reviewed than were the environment characteristics.

Characteristics of farming

Person

- Age Profile
- Working hours
- Part-time farming
- Isolation
- Stress

Environment

- Mechanisation

Factors associated with injury risk

Person

- Work load characteristics
- Person factors

Environment

- Farm Size
- System

Injury characteristics

Person

- Age
- Sex
- Who injured

Environment

- Agent of Injury
- Time of injury
- Location of injury

Figure 3.1: Person and environment characteristics

3.6 Attitudes to health and safety

Attitudes have been associated with accident occurrence from the genesis of the industrial safety movement. Many people believe that in order to prevent accidents in the workplace, good safety attitudes are necessary (Strasser *et al.,* 1981). Safety educators and researchers have frequently linked attitudes and behaviour and intervention programmes have been frequently based on this relationship. '*Attitudes signify a predisposition to act in a specific way. The advantage that can be gained from a knowledge of attitudes is that it allows for some prediction of behaviour in certain situations'* (Cooper and Germain, p.27, 1974). Fishbein and Ajzen (1975) define attitude as *'a learned pre-disposition to respond in a consistently favourable or unfavourable manner with respect to a given object'* (P.6). The essential difference between both definitions is Fishbein and Ajzen view attitude as learned and actions are considered to be consistently favourable or unfavourable. This basic premise is supported by Strasser *et al.*, (1981) who asserted that attitude formation toward safety starts early in life. These influences shape the causative factors rooted in unsafe behaviour. Therefore if farm safety was not prioritised when a child was growing up on the farm, that child would be less likely to be concerned with safety management when farming in later life.

Fishbein and Ajzen (1975) offered a conceptual framework relating beliefs, attitudes, intentions and behaviours with respect to an object. They proposed that attitude is related to a set of intentions, which in turn relate to specific behaviours. There is not a direct correlation between attitudes and behaviours; i.e. a positive attitude toward an object does not reflect a positive behaviour toward the object. Instead a positive attitude toward performing behaviour (intention) generally provides a high consistency between attitude and behaviour. Thus behaviours towards an object cannot be predicted from knowledge of a person's attitude toward the object.

3.7 Attitudes and safety

Attitude of the person has been proposed as one of the most important causes of accidents. Since attitudes were thought to be involved in controlling human activities, it was accepted that they determined whether people would react safely to particular circumstances (Strasser *et al*., 1981). However, Murphy (1981) disputes this. He found no significant difference in attitude scores of farmers that experienced an accident and those that did not. He asserts that other factors are more directly related to farm accidents than safety attitudes. The pressures exerted by society and the low value placed on safety in the decision making process is likely to cause more risk behaviour and accidents. Similarly, Elkind (1993) found that knowledge about farm safety and health hazards is not necessarily linked to deep-seeded values and attitudes' regarding what is right in farm life. Farm family attitudes may be related to economic well-being of which productivity and costs of preventative safety measures may be factors. If people with good farm safety attitudes sustain farm work related injuries and continue to pursue unsafe activities, a balance between education and environmental modification is perhaps the only way to prevent injuries occurring or to reduce the severity of injuries that do occur (Stallones, 1989).

According to Williams (1970) as referred to by Elkind (1993) attitudes, in terms of farm work, also appear to be influenced by interest in the activity at a given time, understanding of the inherent risk of the job, and pressure from others relative to job output. In addition, a high level of safety consciousness often competes with other issues which may well be stronger, such as lack of holiday relief, time and money. Societal dynamics have also been proposed as having an effect on farmers' safety attitudes. Society in general expects farmers to be tough, independent and rugged individuals. Using safety equipment goes against this perception of the farmer (Jespen, 1976 as cited in Murphy, 1981).

There may also be a cultural effect at play as suggested by Cooper and Germain (1974); people are governed by the influences they were exposed to in their formative years. In addition, according to Murphy, 2003, P.27, '*Culture is reinforced by everyday experiences on the farm. That is, the commonness of the personal experience of interacting with hazards and not being injured, and the earliness at which it starts for many (e.g. in childhood or adolescence), results in an ingrained belief that hazards and injury are as integral to farming as seed and feed'*. When safety is part of a groups norms and the organisation culture, individuals will be less likely to take risks and will be more likely to conform and work safely (Dunne, 2001). Traditionally safety has not been part of farmers' norms and consequently risk taking and lack of safety precautions has been prevalent. Research found that adolescents from northeastern Colorado felt that sustaining injuries was part of growing up on a farm. The study found that adolescents learned most of their safety information from observing parents and other workers on the farm (Darragh *et al*., 1998).

3.7.1 Attitude change

'*As an enduring tendency to react positively or negatively, attitudes are difficult to change or modify*'. (Strasser *et al.,* 1981, p.90) Given that most attitudes are developed over many years, they often involve complex personality traits. Therefore, any attempt to change or modify the attitude is often construed as an attack on the beliefs and behaviour of the individual. Hence, modifying socially unacceptable attitudes is a very complex and challenging task (Strasser *et al.*, 1981). The approaches of specific propaganda campaigns which serve to change attitudes towards risk taking have been ineffective (Cooper and Germain, 1974). Many resources were invested in safety attitude development as the principal means of accident prevention; however, by the early 1980s the success of this method was being questioned. Murphy (1981) proposed a re-examination of the high priority given to safety attitude development as the principal means of accident prevention. Consequently, research looked beyond safety attitudes as a means to prevent accidents. Elkind (1993) proposed that in order to make agriculture safer for the farm families and their employees, it is vital to motivate people to protect themselves from health and safety hazards. Nevertheless, several authors continue to emphasise the need to explore safety attitudes and the psychology of working in order to plan preventative programs. Dunne believes that in order to improve safety at work it is essential to understand how people think, feel and act in relation to hazards and dangerous situations. *'If we don't put effort and time into understanding the personal or human factor in safety, we are missing a very real opportunity to improve safety at work'* (Dunne, 2001, P.35). In order to plan preventative measures it is necessary to know the attitudes towards safety of the at risk group (Jansson and Eriksson, 1990). Wadud *et al.,* (1998) assert that if farmers don't believe that occupational ill health problems are preventable they will not take the necessary precautions to minimise the risks. Therefore understanding the relationship between farmers' beliefs about prevention and their safety practices is important for developing effective prevention programmes. Traditionally, farm health and safety education focussed on the presentation of safety rules and guidelines. However, this method largely ignored the factors that actually influence farmer behaviour. Hence, although the majority of farmers understand the safety messages, they continue to engage in risky behaviours (Cole, 2002). He uses three learning theory perspectives: behaviourism, constructivism and socioculturalism to explore why distribution of knowledge alone is ineffective in developing safe work practices. Cole concludes that replacing risky behaviours with safe behaviours requires a change in attitude. *'Attitudes are changed primarily through our interactions with human models and parables. Furthermore, changing attitudes of the members of a practice community is best approached from within that community'* Cole (2002, P.157).

While the priority given to proper safety attitudes as a means of accident prevention has diminished substantially, there is an increasing emphasis on understanding the broader psychology of workers in order to design systems, which are compatible with the people that use them.

3.8 Safety behaviour

'Unsafe behaviour is a contributing cause of 85% of all accidents. In accident situations where human behaviour is an important factor, it is often possible to modify behaviour in order to decrease the likelihood that the accident will occur, as well as to reduce the probable consequences of the accident' (Strasser *et al.*, 1981, P.82).

Efforts to modify behaviour through attitude change have been found to be too simplistic to solve the farm safety problem (Glasscock, 1997; Elkind, 1993; Murphy, 1981). However, investing time and effort in understanding the human factor in safety is essential in order to improve workplace safety (Dunne, 2001). Human behaviour in terms of accident prevention depends on the attitudes and beliefs that people bring to a given situation. The choice of safe or unsafe actions is always present and therefore people develop attitudes, which in turn determine their responses. Once formed, action and decision making with respect to the object of the attitude are consistent with the attitude. Therefore the existence of attitudes is identified through observing the behaviour of people (Strasser *et al*., 1981). However, attitude is rarely the only determinant of behaviour. Motivation can also have a significant impact on behaviour (Strasser *et al*., 1981; Wadud *et al*., 1998). In addition, other forces such as social and physical conditions can also impact on safety behaviour. The impact and strength of these conditions may be adequate to overcome a safe attitude (Strasser *et al.*, 1981). In addition, Strasser identified two other levels of behavioural control that have an impact on safety, habits and values. While an attitude may possibly result from a single experience, habits are automatic responses to functions in life, which exist without direct involvement of conscious thought. According to Elkind (1993) the mundane repetitiveness of performing certain farm tasks over many years may affect farmers' concentration on the tasks. The habitual nature of some farm tasks result over time in farmers completing tasks almost automatically, without giving them adequate thought or attention. However, further examination by Reis and Elkind (1997) suggests that more experienced farmers may be more accustomed to the injury risk associated with performing risky tasks. In actual fact, they may be more likely to aim to control or avoid certain aspects of tasks, which are risky. Values are seen as enduring principles upon which people build their lives. While safety is not a value, other values have an important impact on safety e.g. family and friends.

In addition initial socialisation into a workplace has a bearing on perceptions, attitudes and commitment to safety as well as safety behaviour. Van Mannen & Schein, 1979, P.211 define socialisation as *'the process by which an individual acquires the social knowledge and skills necessary to assume an organisational role'* (Cited by Mullen, 2004). Safety socialisation involves conversations with colleagues, observing co-worker behaviour and the rewards or punishments relating to certain behaviour. Individuals that experience positive socialisation influences are more likely to have positive safety attitudes and perform work safely (Mullen, 2004). Mullen, 2004 found that socialisation which took place before a person joined an organisation has an effect on their behaviour after they have become socialised into the workplace. In other words, socialisation in one environment has an effect on future work environments. Essentially, people learn from experience and thus people 'learn to take risks'. When a situation arises in which a person has prior experience, this experience will help to determine and focus the response. Over time as experiences are repeated, a readiness to respond to a particular stimulus in a certain way is developed (Strasser *et al*., 1981). In terms of occupational injuries, since unsafe behaviour is very often not followed by a negative outcome, people learn to behave unsafely and to take risks (Dunne, 2001). In other words, risky behaviour which has been pursued to save time for example, is rewarded if injury does not occur. However, Mullen, 2004 argues that very often workers in an organisation pursue unsafe behaviour to avoid negative outcomes, such as harassment from co-workers. While previously it was thought that workers engaged in unsafe behaviour because they did not understand the risks, research now suggests that workers understand the risks associated with their behaviour and continue to engage in unsafe practices (Mullen, 2004).

Since negative consequences so infrequently follow risky behaviour, it is necessary to engineer workplaces so that risky behaviour is not rewarded, that is it does result in negative consequences. In this regard, several principles of learning have been employed in safety management systems. Dunne (2001) discusses the main principles of learning as they apply to safety;

1) **Punishment and negative reinforcement**
   This should follow risk taking in order to ensure that the consequences are meaningful to the person involved. However, punishment is only effective when it is immediate, inescapable and severe (Cole, 2002).
2) **Consistency and consequences**
   Ensuring that consequences of risky behaviour always follow and that they follow immediately.
3) **Imitation effects**
   Respecting the power of safety promotion, superiors should always be safety role models for subordinates.
4) **Discrimination learning and the stimulus control of behaviour**
   Improvement in safety performance can only take place if all members of an organisation are consistent in the implementation of safety regulations.
5) **Positive reinforcement**
   Working safely should be promoted by consistently positively reinforcing safe behaviour. Maintaining constant compliance with safety behaviours requires repeated positive reinforcement (Cole, 2002).
6) **Extinction**

When safe behaviour is no longer being reinforced, a process of unlearning occurs. In effect safe behaviour becomes extinct. To avoid this situation the above principles need to be implemented in order to promote safe working.

These principles are fundamental to the success of health and safety management systems and are widely used. Essentially these principles are based on the premise that *'people learn practices from experience'*. *'The most basic psychological principle of learning is that behaviour is governed by its consequences. We don't get hurt, cut or burnt. We don't fall (even though we may wobble). Nobody comments on our unsafe behaviour. Our risk taking does not have a negative consequence – so we take a chance again the next time'* (Dunne, P.39, 2001). However, the application of these principles in production agriculture is constrained by the fact that the farmer, in general, works alone and is both operator and manager. It is reasonable to assume that nobody does comment on farmers unsafe behaviour. Thus, in the vast majority of cases, farmers only face consequences of their unsafe behaviour when an accident or injury occurs.

3.9 Farmer safety behaviour

Farmer's perceptions of their ability to perform general health behaviours were found to be correlated to their perception of their ability to perform farm health and safety behaviours. Farmers who consider themselves able to perform health behaviours perceive more benefits and fewer barriers to practicing protective farm safety behaviours. In addition, they view themselves as less vulnerable to farm injury and anticipate less severe consequences. Those who place more value on their overall health in turn place more value on practicing proper farm health and safety practices. This suggests that an optimistic bias exists among farmers in which they feel unrealistically optimistic about their invulnerability to harm (Hodne *et al.*, 1999).

Green (1999) identifies factors at three levels, micro, meso and macro that make farmers in general exposed to health and safety risks. At the micro level factors internal to the farmer such as knowledge of hazards and recommended protective actions are translated into beliefs that are specific to each performance of a task. Thus each time a particular work activity is carried out, the farmer intuitively assesses his personal risk and considers the costs involved in using protective measures in relation to their ability to reduce his risk. Based on analysis, he/she decides which, if any, protective actions he/she will engage in. In addition to knowledge, the authors feel beliefs are shaped by close calls, health impairments which are affected by the farmers work and that physical capacity declines with age which in turn increases perceived susceptibility. At the meso, the immediate social and physical environment level, the farmers beliefs are influenced by others beliefs and practices. The presence of children or spouses will heighten the farmers perception of susceptibility. Also the belief that other farmers follow protective practices will reduce the perceived barriers to engaging in those practices. In addition, attributes of the farmers working environment also contribute to the perceived barriers to protective action. For example, the awkwardness and discomfort of certain protective equipment combined with time, financial and workload pressures. As farmers are their own bosses, this may prove an additional barrier to safety. The occupational culture of farming also affects the individual beliefs of farmers. The macro level or the broader environment, which includes policies, markets and societal values has also been found to shape the farmers working environment (Green, 1999). Farmers who were personally concerned about contracting farm work-related ill health problems (i.e. perceived susceptibility), felt that those problems could be avoided (i.e. perceived benefits), and identified fewer barriers to taking preventative action (i.e. perceived barriers) were most likely to take the necessary precautions to reduce their risks (Wadud *et al.*, 1989). Similarly, Murphy (1992) asserted that when people do not believe that they have control over certain behaviours, they are not disposed to voluntarily changing those behaviours. In addition, they will not pay attention to programs aimed at promoting such voluntary behaviour changes. Moreover a high degree of safety consciousness competes with other, frequently stronger, factors such as lack of holiday relief, time and money. In this regard risky but time-saving behaviours are often rewarded as they seldom result in injury (Jansson and Eriksson, 1990).

3.10 Injury control

Traditionally the agricultural industry, farm organisations and farm safety professionals have employed educational methods to address farm safety issues (Murphy, 1992). However, these efforts were seldom evaluated and therefore provided no means to differentiate between effective and ineffective interventions. As a result the effectiveness and applicability of previous education efforts are largely unknown (Aherin *et al.,* 1992). Both the industrial safety and health and public health fields have developed particular approaches to injury prevention, into which, psychological concepts and principles are deeply intertwined (Murphy, 1992). The Industrial Safety and Health approach to accident prevention grew from workplace experiences of workers in specific industries or occupations. The approach relied heavily on economic incentives to reduce accident losses (Aherin, 1992). In recent years, these approaches and research from other health and safety fields is being applied to farm health and safety. In addition behavioural change and persuasion research is an area, which has potential to provide empirical methods for identifying effective injury control intervention systems (Aherin, 1992). Three fundamental schools of thought on injury intervention are discussed below.

3.10.1 The Three-E Method

The Three-E method, otherwise known as the common sense approach was the principal industrial accident prevention strategy until the middle of the last centaury. This method was developed in or around 1961 by the then president of the Kansas Safety Council, Julian H. Harvey (Aherin *et al.*, 1992). This method rests on the premise that accidents can be prevented through the use of three instruments, Engineering, Education and Enforcement. While the method had success in industrial settings, this success was not achieved in agriculture. According to Murphy, 1992 the successful implementation of the Three E method in industrial settings was due to the control present in the workplace. The lack of workplace control in farming results in engineering technologies being disabled or altered by farmers. This method overwhelmingly relies on the control of worker behaviour in order to achieve success. The appropriateness of this intervention approach to farming in Ireland is questionable as the majority of farms are owner operated and thus worker control is absent.

3.10.2 The Human Factors Engineering Method (HFE)

Human Factors Engineering (HFE) is concerned with matching machine operation with the abilities and limitations of human operators. In doing this it acknowledges that humans are often unreliable, unpredictable and poor risk preceptors, therefore this approach does not rely on man to adapt to the product or process in question (Murphy, 1992). It is the application of the broader field of Human Factors. The study of Human Factors focuses on cognitive errors of workers, concentrating on subconscious factors, which result in accidents rather than conscious decision to pursue an unsafe action (Garavan, 1997). Human Factors Engineering is comprised of two fields, engineering and psychology. While engineers are the practitioners in HFE, psychology dominates the research field in HFE (Murphy, 1992). Systems are a central concept in HFE (Sanders and McCormack, 1987). In HFE a system is a logical arrangement of components that interact to perform a certain task in a given environment. HFE is sometimes referred to as the study of operator-machine and operator-environment systems with the main emphasis on the operator-machine system and the environment in which it takes place (Aherin, 1992). The application of Human Factors Engineering, like many industrial safety approaches, relies on control and supervision in the workplace. Thus in occupations where a self-employed person predominantly works alone, such as farming, HFE is generally not a reliable accident control approach.

3.10.3 The Public Health Approach

The Public Health Approach to accident and injury prevention has been developed from a concern for understanding and preventing diseases and for controlling the spread of disease throughout communities. The science of epidemiology is employed in order to understand, prevent and control occupational injury and ill health (Murphy, 1992). Various injury prevention or safety promotion measures are available to those concerned with reducing injury rates. In terms of occupational safety, many methods can be employed depending on the nature of the organisation or sector.

Sweden has long recognised its problem with farm accidents and has strived to prevent the occurrence of accidents through a farmers occupational health program. The Farmers Health Service was established over twenty years ago and benefited from government subsidies and contributions from the Federation of Swedish Farmers (LRF). The Farmers Health Service conducts research and provides occupational health services to farmers and others involved in ‘green areas’ through regional health centres. The service provides farm visits by safety engineers, which is seen as extremely important to advance change in environments and habits and also provides health checkups every second year and distributes information to those affiliated. Through their research activities the Farmers Health Organisation develops information materials, which are available to farmers in pamphlets, at meetings but most effectively during checkups and farm visits. Research findings are also used to lobby manufacturers and dealers of farm machinery in order to improve the work environment. Farmers who are affiliated to the service have fewer accidents and consume less general health care than others. The service has found that to be successful in this type of prevention program it is important to reach farmers through their organisations. Also the availability of technical staff who specialise in helping farmers construct safe workplaces is vital. Where the occupational health structures are not in place to provide this type of service, the Swedish experience suggests that with proper training there is an opportunity for primary health care workers to do so (Höglund, 1999).

3.11 Interventions

There is a significant amount of literature relating to farm safety interventions and as was highlighted earlier very little of this research has been evaluated. However, much of the literature provides research-based guidance on planning interventions. Scharf *et al.,* 1998, on reviewing farm safety interventions, provided a template of intervention protocols. They found four themes that were common among a number of reviewed farm safety interventions, which are discussed below. These are:

1. Active participation of the farmers;
2. Farm economics;
3. Safe-work practices and productivity;
4. Community participation.

Rural health care workers require an understanding of the occupational and environmental roots of farmer health problems, which in turn would enable them to recommend preventative measures (Donham *et al.,* 1982). Similarly, Walsh, 2000 found evidence in the United Kingdom that the National Health Service (NHS) is not meeting the health needs of the farming community. Walsh concurs that health care workers need to understand farming and provide a service that is tailored to farmers.

However, Thu *et al.,* 1990 highlighted the need for farmer input in designing new farm health and safety programs to ensure practicality, applicability and acceptance.

Kidd *et al.,* 1998 found that farmers and farm workers do not recognise the direct and indirect costs associated with work-related injury and consequently are not making safety decisions on an accurate basis. It is proposed that an intervention that visually illustrates the realities of work and highlights both the direct and indirect costs associated with work related injury enables farmers to see that safety is inexpensive and that farm expansion, labour requirements, and commodity choices all have safety implications. Dunne, 2001, asserts that the view of those who have no interest in working more safely is that safety is too costly and bothersome to merit time and money investment. They do not recognise all the costs associated with injury and believe that their insurance will cover any costs they may face.

Jaspersen *et al.,* 1999 detail the pilot Certified Safe Farm program in Nebraska which consisted of on-farm safety assessments and occupational health screening with an education program. This program attracted participant farmers with the incentive of a reduction in their health insurance premiums. The program was based on health and safety programs widely used in other industries. It consisted of voluntary participation in farm health and safety education, occupational health services, and on-farm safety assessment. The results of the program identified important safety problems on the farms while also finding current health problems and risk factors for future health problems. Chapman *et al.*, 2003, conducted and evaluated an intervention among dairy farmers in Wisconsin that coupled safety and profitability. The intervention sought to increase voluntary adoption of three production practices that were safer and more profitable than typical practices: barn lights, bag silos and a mixing site for calf feed. The program availed of print media, public events and resource people to disseminate the information to the farmers. The study found that the farmers appeared to be voluntarily responding to the intervention.

The Theory of Planned Behaviour adds sophistication to farm injury interventions by basing them on the actual beliefs and intentions of the target population. It allows for more specific targeting of interventions to a particular group for specific hazards. The model provides greater information on attitude, subjective norm and perceived control of the target group and the effect of these on a persons' intention to perform a safety behaviour (Petrea, 2001). Dunne, 2001 also puts forward the initiative of actively involving employees when developing safety policies, procedures and practices at work. This method ensures that people are seen as a resource within the organisation. The same could be said for the farming industry; the insights of people at all levels in the industry are relevant to safety and should be drawn on. This will serve to illustrate to farmers that they are a resource in the industry and that safety involves everybody, not just inspectors and safety advisors.

Safety campaigns generally aim to raise awareness about an issue, inform about an issue or to change attitudes and ultimately behaviour regarding an issue (Dunne, 2001). Safety education had its beginnings with the industrial health and safety movement. Originally, there were two aims to safety education. The first was to train people to engage in safety behaviour which affects people in direct and observable ways everyday. An example of this would be putting on a seat belt in a car. The second purpose however, was to act as a basis for devising the engineering / safeguarding and supervision / enforcement strategies. In essence this purpose aimed to aid industry and the general public in understanding all the possible accident prevention options. While the first purpose was common among workers, the second was by its nature the realm of health and safety professionals (Murphy, 1992). Safety education has long since come under criticism from professionals in industry. According to Heinrich (1941) employees may be talked to, read articles and view pictures about safety frequently and still fail to apply the messages within to themselves. In addition, he felt that safety education efforts, which were general in nature and aimed at mass audiences were somewhat limited as they failed to highlight the specifics of how safety applied to individual workers at the exact time they needed it. He believed that controlled work environments that had close relations between supervisors and workers were most favourable to safety education. Farm health and safety education is typically general and is delivered through a mass appeal approach. An example of this is 'always disengage the PTO and turn of the tractor before cleaning out a machine'. This presents good advice to all farmers, thus the mass appeal approach and it is applicable to a variety of situations encountered on a farm, and therefore it is general. However, it does not take account of the reality of situations that exist on farms at the precise time a safety decision must be taken. A variety of factors such as tired workers, cold workers, untrained workers, irritated workers, crops continually blocking the machine due to poor weather or disease and so forth, impact on safety decisions. *'In the face of such realities, routine safety or health instructions have little chance of effecting behaviour'* (Murphy, 1992, P.140). Dunne, 2001 also questions the degree to which educational campaigns influence attitudes and behaviours. Messages may be disregarded because the target group do not think they are relevant to them, they don't believe in the effectiveness of the content, they may have a fatalistic attitude to accidents or they become defensive and simply stop processing the information.

'*We will never, ever engage people in health if we pursue them with fundamentalist answers, regulations, warnings and prohibitions'* (Fugelli, 2003, P.12). Improving the effectiveness of injury prevention or education campaigns increases the likelihood that the message will reach the target group. Campaigns should be targeted rather than broadly based and subsequently the content and issues should be designed with this target group in mind. It is more constructive to provide information on how to work safely rather than issuing warnings about hazards or behaviours. If the content is presented positively and links safety to attractive aspects of the job, it is more effective. In addition, concrete and personal information rather than statistical data will appeal to the audiences' imagination, while focussing on more frequent events will increase the awareness of workplace hazards (Dunne, 2001). Dunne emphasises that as people we are all open to education and we inherently seek a better understanding of our environment.

Little evidence exists to direct the design and implementation of farm safety interventions. The techniques of the fundamental schools of thinking on occupational accident and injury prevention are not all relevant to farming owing to the absence of workplace supervisors. However, research has identified factors, which diminish the effectiveness of interventions. Participation in safety courses has not been shown to reduce injury risk in North American agriculture (Layde *et al*., 1993; Lewis *et al*., 1998). Tools that improve the effectiveness of interventions have been identified by occupational psychology and should be employed in intervention programs.

3.12 Conceptual framework

From the literature review, it is possible to derive a conceptual framework to direct the ensuing research study. In the context of work place health and safety, the complexity of the working environment is fundamental to the study of workplace accidents and subsequent injury. The literature review identified both person and environment characteristics in characteristics of farming, factors associated with injury risk and indeed in injury characteristics. Further, key characteristics of both the person and the environment that impact on health and safety on farms are identified (figure 4.1).

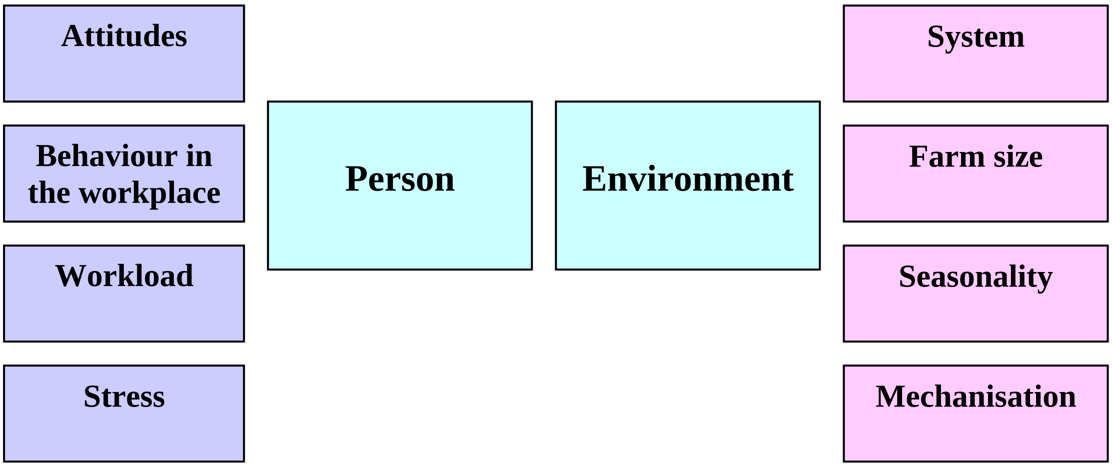


Figure 3.2: Person and environment characteristics impacting on health and safety on farms

The person and the environment are, however, integrated components – each exerting an influence on the other. Strasser *et al.*, 1981, described the interrelationship between man and the working environment. From the literature review, a dichotomous model is proposed which identifies the relationship between the components of health and safety on farms.

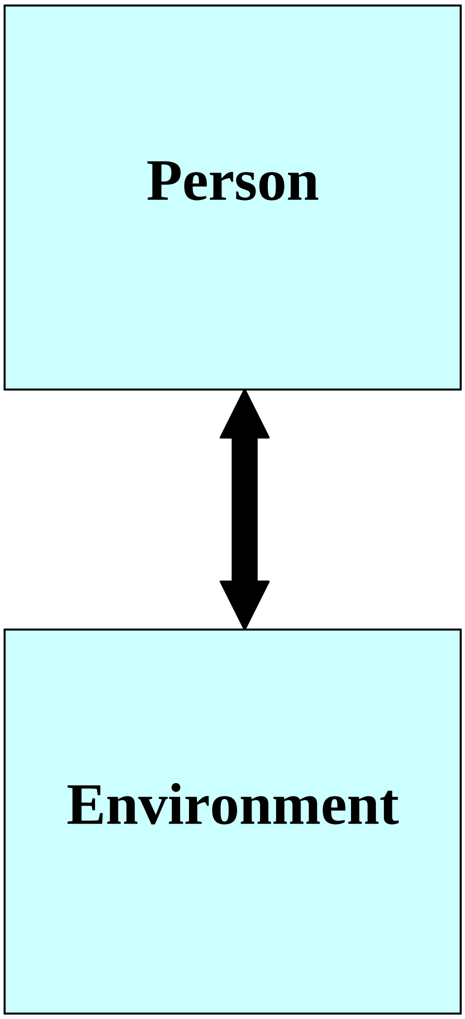


Figure 3.3: Conceptual framework for the study of health and safety on Irish farms.

Figure 3.3 illustrates that the interaction of the person within the working environment is central to health and safety in the workplace. This relationship is fundamental to the genesis of accidents, and the resulting injuries, in the workplace. While an understanding of both the environmental and person components, which ultimately impact positively or negatively on farm health and safety, is necessary, an understanding of the interaction between these components is critical to understanding health and safety on Irish farms.

The literature on farm health and safety places significant emphasis on understanding accident occurrence and injury outcomes. The importance of understanding behaviour and attitudes of farmers to health and safety was carried strongly by the literature. However, it provides limited understanding of risk and risk perception at farm level. In addition, the theory does not explore the impact of injury on the wider farm management and farm operations. Further, the literature tells little of how health and safety is managed on farms or how it is incorporated into day-to-day activities, both in thinking and practice. The literature review did identify and discussed the terminology, theories and models which underpin our understanding of health and safety both in farming and more broadly.

From the literature, it is clear that understanding person and environment factors are fundamental to the study of health and safety on farms. In relation to both, it is necessary to identify the characteristics which impact on farm health and safety. The literature review identified the necessity to record farm injuries in detail in order to design and plan intervention strategies and inform policy makers. In addition, it is now deemed fundamental to identify and explore the factors associated with injury risk on farms. There is a need to examine the place of health and safety in farm management and how this impacts on accident occurrence.

CHAPTER 4

THE SURVEY OF HEALTH AND SAFETY ON IRISH FARMS

One of the specific objectives of this study was to examine the degree to which health and safety impacts on the day-to-day management of farms in Ireland. An examination of the incidence of injuries and farm work related ill-health problems is necessary in order to estimate the extent of the problem and to examine the trends that occur over time. In addition, prevention efforts, to be successful, require accurate data relating to the injured person and the injury itself.

The conceptual framework proposes that the working environment and person factors are fundamental to workplace health and safety. It asserts that the interaction between environmental and person factors is critical in accident occurrence and subsequently injury to persons or property. Hence, The Survey of Health and Safety on Irish Farms has been constructed to provide an understanding of the incidence of injury and the attitudes and activities of farmers to health and safety on the farm. The survey was designed with the person and the environment as keystones.

In addition to examining farm work related injury levels, understanding farmers' perception of health and safety and their behaviour towards occupational hazards and risk is vital in order to create safe work places (Chapter 3). In addition it is necessary to determine the level of understanding farmers have of their legal requirements with regard to health and safety on the farm and the information, training and support requirements of farmers necessary to comply with this legislation.

4.1 Objective

The purpose of this chapter is to examine the current health and safety situation on Irish farms. The under-reporting of occupational injuries in farming to the HSA, results in unreliable statistics. Under reporting constrains opportunities to take appropriate measures and determine priorities (Barancik *et al.*, 1983). While Teagasc have conducted two previous studies which examined the level, cause and consequences of accidents on Irish farms only interim results have been available since the 1997 study. The specific objectives of this chapter are to;

(i) To determine the extent of occupational injuries on Irish farms;

(ii) To determine the extent of farm work related ill-health problems on Irish farms;

(iii) To examine the perceptions of farmers relating to health and safety on their farms;

(iv) To examine the safety related behaviours of farmers;

(v) To identify the needs of farmers in relation to farm health and safety.

4.2 Methodology

To meet one of the major objectives of this study, which was to 'determine the extent of injury and farm related ill health on Irish farms' a quantative study titled 'The survey of Health and Safety on Irish Farms' was undertaken. This exploratory study aimed to fulfil the objectives as set out above and provide a greater understanding of health and safety on Irish farms.

Based on the objectives outlined above a comprehensive questionnaire was developed and was attached to the February 2002 supplement of the National Farm Survey (NFS) (Appendix 1). The design of the questionnaire was based on those used previously by Teagasc in the 'Survey of Health and Safety' 1992 and 1997. Each of these studies took a retrospective approach to determining incidence of injury. Injuries that occurred in the five years prior to the date of recording were sought from participants. In the current study it was deemed necessary to employ the same basic approach and use the same reference time frame to allow for comparisons with the previous studies. Use of a similar questionnaire allowed for the examination of trends across the three survey periods. The Teagasc National Health and Safety Specialist, the Teagasc Safety and Labour Organisation Specialist and a researcher from the Health and Safety Authority were consulted on the design of the questionnaire. The questionnaire was then tested on a number of farmers and a number of minor changes were made. While the questionnaire was quite extensive, it was somewhat restricted in scope as the length was determined by the National Farm Survey. Thus, it was not possible to explore all elements in as much detail as was desired.

The questionnaire consisted of five sections:

a) Accidents on the farm;
b) Physical health of farm workers;
c) Safety Attitudes;
d) Safety behaviours;
e) Preventative actions.

While predominately made up of closed questions, a number of open questions were included in instances where it was deemed important to understand the full range of opinion held by the farming population.

The components of farm health and safety presented in the conceptual framework were fundamental to the design of the questionnaire. The questionnaire sought information relating to both person and environment components and specifically the factors of each which are implicit in farm accidents and the resultant injury.

In designing the survey it was necessary to choose whether to use elements of the questionnaire previously administered by Teagasc or to design an entirely new study grounded in the literature reviewed. The benefit of incorporating elements of the Teagasc questionnaire, which was the strategy adopted, allowed for comparisons to be made across three survey periods. It was necessary to examine whether the study should focus only on farmers that sustained farm work related injuries or whether it should include both injury and non injury farms. The latter scenario was pursued. The former scenario would have employed a surveillance methodology based in either hospital emergency departments or GP surgeries or a combination of both. This type of study would have required significant collaboration with medical professionals. It would have involved training of hospital or surgery recorders and ultimately would have relied on the staff in high pressure and time-poor environments to identify and record information from appropriate cases. This approach would have delivered detailed and accurate information on the accident event, pre-event and post-event. However, it would only have captured the most serious injury events and it would have had a strong medical focus. In addition, the reliance on staff to remember and to have the required time to administer the questionnaires meant that not all cases presented would be included in the study.

From the literature review attitude presented as being significantly associated with farm health and safety. Different measures of attitude were discussed; however, these were not incorporated into the Survey of Health and Safety on Irish Farms. The attitude measurements presented are drawn from the field of psychology and are specific in their design and administration. It was decided that it was beyond the scope of this study to employ attitude measurements as the necessary expertise was outside of the researcher's academic field. In addition, it was deemed important to ground the study, in so far as possible, in agriculture to provide an agricultural perspective on farm health and safety. Thus the survey included questions designed to give and indication of attitude without technically measuring and quantifying attitude.

4.2.1 National Farm Survey (NFS)

The primary function of the NFS is to collect and analyse information relating to farming activities. The objectives of the NFS are to:

a) Determine the financial situation on farms in the Republic of Ireland (ROI) by measuring the level of gross output, costs, income, investment and indebtedness across the spectrum of farming systems and sizes;
b) Measure the current levels of, and variation in, farm performance for use as standards for farm management purposes;
c) Provide a database for agricultural economic and rural development research, and;
d) Provide data to the EU Commission on Irish farm incomes.

(Connolly *et al*., 2003)

A farm accounts book is recorded for each year on a random sample of farms throughout the ROI. Stratified random sampling is used to select the sample. This ensures that all systems of farming are accurately represented. The weighting system is provided by the Central Statistics Office (CSO). Farms are weighted according to size and system. Of the 1167 farms that participated in the NFS in 2001, the supplementary questionnaire was completed for 1119. When CSO weightings were applied, the survey population represented 120,201 farmers nationally. The NFS is administered by a team of trained recorders and recording takes place on individual farms. Prior to the commencement of the survey, a training session was undertaken with the recorders to explain the background to the study and fully explain the questionnaire.

4.2.2 Definitions

For the purpose of this study the following definitions are employed:
Farm work related accident (accident): An event which occurs during the course of farming, excluding road traffic accidents, which has the potential to cause injury to persons or damage to property.

Farm work related injury: is an injury to a person, which has resulted from a farm accident.

Farm work hazard or hazard: is a situation in the farm environment with the potential to give rise to injury to persons, damage to property or the environment.

Farm work risk or risk: Likelihood of a specific farm hazard becoming an actuality and the degree of injury and or damage likely to result.

4.2.3 Statistical analysis

This data were analysed in conjunction with data collected by the NFS in 2002 relating to the farmers personal profile and farm characteristics. Analyses of the data were carried out using SPSS V.10. While data were recorded for 1119 farms, not all sections of questionnaires were fully completed with some questions not answered. For that reason, the number of respondents varies slightly across different sections. As the survey was conducted by a panel of recorders, it is not possible to determine if non-responses are predominately related to the recorder or respondent or indeed if they are a function of both. However, the excellent reliability of the National Farm Survey instrument assures that the data collected is of high quality. Analysis of the data took place at two levels, that of the entire population (n=1119) and the sub population that experienced an injury (n=110).

4.3 Results

This section examine the results of the quantitative analysis. The results are analysed on the basis of person and environment characteristics.

4.3.1 Incidence of injury

A farm work related injury was found to have occurred on 9.8% (n=110) of the sample farms and of these four farms experienced more than one injury. When the weighting was applied to the sample, the results indicated that an estimated 3,002 injuries occurred on Irish farms in the most recent survey year 2001 (Figure 4.1). This represents an injury rate of 21.5/1000 for Irish farmers (based on the actual population of 139,000 farmers). Fewer injuries were reported in each of the four years prior to 2001. Although fewer injuries may have occurred in those years, it is likely that recall errors may account for a significant proportion of this difference. Given that the average number of annual injuries in the five years prior to 1997 was 2,000 (McNamara & Reidy, 1997), it is unlikely that such a significant drop would be seen in 1997.

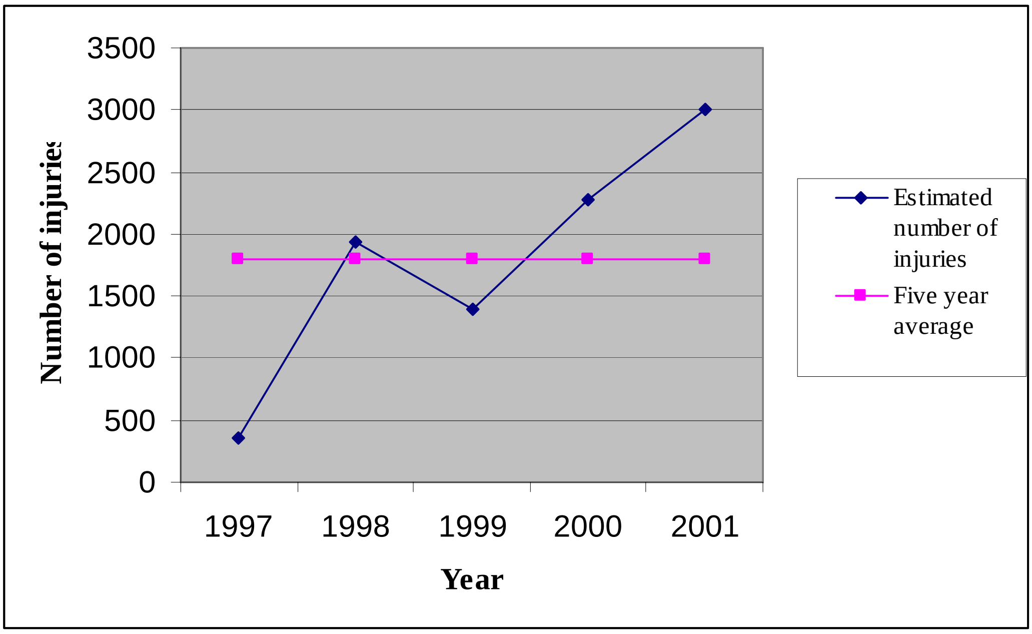


Figure 4.1: Estimated number of farm work related injuries per year

The estimated average number of injuries per year in the five-year period between 1997 and 2001 was 1,792. When compared to two previous five-year averages (McNamara & Reidy, 1992; McNamara & Reidy, 1997) the 2001 data shows some improvement over the 1997 data. However the rate of decline in farm injuries appears to have slowed down (Figure 4.2).

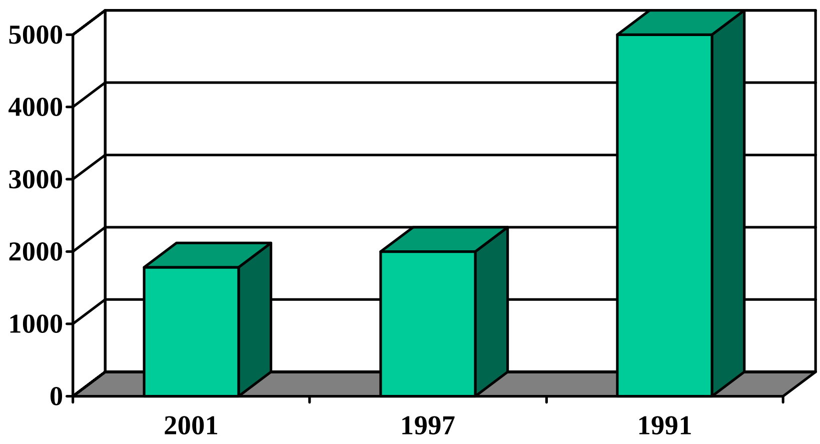


Figure 4.2: Average number of farm accidents per five-year period

The results show that ill health problems, which were attributed to farm work, existed on 11.5% of the farms surveyed; six farms reported having more than one incidence of farm work related ill health problems.

4.3.2 Environment characteristics of injury

4.3.2.1 System of farming

Table 4.1 shows the distribution of farms that reported an injury analysed according to system of farming. The farming systems are classified by the NFS based on enterprise gross margin. Dairy and other represents farms engaged in dairy farming in conjunction with one or more other enterprises. ‘Cattle other’ refers to beef systems other than suckler cow farming. Almost 30% of the reported injuries occurred on dairy farms while this system accounts for 30.8% of the farm population. While accounting for 8% of the entire population of farms, tillage farms accounted for 15.5% of the injuries. The highest proportion of injuries was reported by dairy farmers, followed by dairy and other.

Table 4.1: Frequency of injuries according to system of farming compared to distribution of farms by system

System of farming	Injury farms 1997* (%)	Injury farms 2001 (%) (n=110)	All farms 2001 (n=1119)
Dairy	35	29.1	30.8
Dairy and Other	15.1	20.9	16.5
Mainly Tillage	11.4	15.5	8
Suckler Cows	9.7	14.5	20.1
Cattle Other	13.6	10.9	13.3
Mainly Sheep	15.2	9.1	11.3
Total	100	100	100

***Source: The Survey of Health and Safety on Irish Farms (1997)**

A decrease in the injury level between 1997 and 2001 was reported by dairy farms, sheep farms and 'cattle other'. All other systems experienced an increase in injury with a substantial increase apparent in both suckler cow and dairy and other farming. Thus the findings correspond to those discussed in section 3.5.2 which assert that having large livestock on the farm is significantly associated with farm work related injury.

An examination of the relationship between system of farming and accident occurrence (Table 4.2, Cross Tabulation Analysis) suggests that Irish tillage farms and those categorised as dairy and other experience more injuries than those involved in other production systems. Using the chisq statistic (chisq=13.080, df=5, significance=. 023) this association was found to be significant at the .05 level.

Table 4.2: Relationship between injury occurrence and farming system

Injury Occurrence	System						Total
	Dairy	Dairy & Other	Suckler Cows	Cattle Other	Mainly Sheep	Mainly Tillage	
Yes	32 9.3%	23 12.4%	16 7.1%	12 8.1%	10 7.9%	17 19.1%	110 9.8%
No	313 90.7%	162 87.6%	209 92.9%	137 92.1%	116 92.1%	72 80.9%	1009 90.2%
Total	345 100%	185 100%	225 100%	149 100%	126 100%	89 100%	1119 100%

(Chisq=13.080, df=5, Significance=.023)

When the farming systems were recoded into four main categories, dairying, cattle, sheep and tillage the relationship between system and injury became more significant. The results indicate that Irish tillage farms experience a higher incidence of injury than those engaged in other systems, while those engaged in dairying sustain more injuries that either cattle or sheep farmers. Using the chisq statistic (chisq=11.636, df=3, significance=.009) this association was found to be significant at the .01 level (Table 4.3).

Table 4.3: Relationship between injury occurrence and farming system.

Injury occurrence	Dairying	Cattle	Sheep	Tillage	Total
Yes	55 10.4%	28 7.5%	10 7.9%	17 19.1%	110 9.8%
No	475 89.6%	364 92.5%	116 92.1%	72 80.9%	1009 90.2%
Total	530 100	374 100	126 100	89 100	1119 100

(Chisq=11.636, df=3, significance=.009)

Table 4.4 presents the distribution of injuries for each of the farming systems on a seasonal basis. The majority of injuries on all farms took place in autumn (33%), while 27.5% occurred in summer. Winter saw fewest injuries on all farms, which reflects the lower level of activity on farms compared to other times of the year. Seasonal variation in injury levels occurs when farming systems are analysed. On dairy and sheep farms the highest proportion of injuries occurred during the summer. Autumn appears to be a critical injury time period on suckler cow and dairy and other farms. This is generally 'turn in' period on the majority of cattle farms and cattle would require increased handling before being housed. At this time cattle would experience some level of stress and there would be a higher level of contact between the farmer and animals than in the previous months. Not surprisingly the injury level peaked on tillage farms during the harvest period. The cattle other category saw the highest level of injuries during the spring.

There is seasonal variation in injury levels within each of the Irish farming systems. Similar to the findings of previous research, section 3.4.5, the injury rate was highest in autumn and summer, which are the busiest periods in Irish farming.

Table 4.4: Distribution of injuries per farming system according to season

Season	All Injuries 2001 (%) (n=110)	System					
		Dairying (%)	Dairy & other (%)	Suckler Cows (%)	Cattle Other (%)	Mainly Sheep (%)	Mainly Tillage (%)
Winter	15.6	15.6	21.7	6.3	16.7	2.2	11.8
Spring	23.9	25	26.1	18.8	33.3	11.1	23.5
Summer	27.5	37.5	8.7	25	25	44.4	29.4
Autumn	33	21.9	43.5	50	25	22.2	35.3
Total	100	100	100	100	100	100	100

4.3.2.2 Size of farm (Utilisable Agricultural Area)

When examining the association between Utilisable Agricultural Area (UAA) and injury occurrence, the results show a clear relationship between farm size and injury occurrence (Table 4.5). As farm size increases so to does injury occurrence. Therefore the trend appears to be that those working on large farms experience a higher level of injury. Using the chisq statistic (chisq=7.497, significance=. 024) this association was found to be significant at the .05 level. This corresponds to the evidence from prior research which found the greater the farm size, the higher the injury risk.

Table 4.5: Relationship between accident occurrence and UAA

Accident Occur	***Utilisable Agricultural Area*** **<20ha**	**20-40ha**	**>40ha**	**Total**
Yes	11 7.3%	27 7.2%	72 12.1%	110 9.8%
No	140 92.7%	347 92.8%	522 87.9%	1009 90.2%
Total	151 100%	374 100%	594 100%	1119 100%

(Chisq=7.497, df=2, Significance=. 024)

4.3.2.3 Season and time of day injury occurred

The seasonal breakdown of the injuries according to system of farming has already been explored (Table 4.4). However, further analysis examines the seasonality of injuries according to accident type (Table 4.6) and indicates that certain agents of injuries may be related to seasonal activities and thus result in more injuries during specific seasons. A high proportion of livestock injuries occurred across all seasons, while machinery injuries were found to be highest during summer and autumn. Trips and falls accounted for the highest proportion of injuries during the summer period. Both summer and winter reflected high levels of injuries resulting from accidents with gates and doors.

In addition, table 4.7 shows injury type according to the season in which they occurred. Livestock injuries peaked in autumn with a smaller peak in spring. These are typically intensive periods on livestock farms in Ireland. In addition, there is a greater degree of animal handling at these periods, turn out and turn in, than at other times of the year. Trip and fall injuries peaked during spring and summer and declined towards autumn. Machinery injuries peaked sharply in the autumn. While the majority of other farmyard accidents occurred during the autumn, a significant amount was found to have occurred during the summer. While seasonality undoubtedly has an effect on injury occurrence, the peak periods for injuries in the farming calendar are not consistent across research (3.3.3). This possibly reflects the differences in the type of systems and characteristics of those systems according to country and indeed state in the case of America.

Table 4.6: Distribution of seasonal injuries categorised according to injury type

Injury Type	All Injuries 2001 (%) (n=110)	Season			
		Winter (%)	Spring (%)	Summer (%)	Autumn (%)
Livestock	25.5	29.4	30.8	16.7	27.8
Machinery	20	11.8	15.3	20	25
Trips and Falls	21.8	23.5	26.9	23.3	16.7
Chainsaw/wood	6.4	11.8	7.7	3.3	5.6
Other farmyard	6.4	0	3.8	6.7	11.1
Tools and Implements	3.6	0	3.8	6.7	2.8
Gates and Doors	7.3	11.8	7.7	13.3	0
Other	9.1	11.8	3.8	10	11.1
Total	100	100	100	100	100

Table 4.7: Distribution of accident type according to the season in which they occurred

	Accident Type							
Season	**Livestock (%)**	**Trips & Falls (%)**	**Machinery (%)**	**Chainsaw/Wood (%)**	**Other Farmyard (%)**	**Tools & Implements (%)**	**Gates & Doors (%)**	**Other (%)**
Winter	17.9	16.7	9.5	28.6	0	0	25	20
Spring	28.6	29.2	19	28.6	14.3	25	25	30
Summer	17.9	29.2	28.6	14.3	28.6	50	50	0
Autumn	35.7	25	42.9	28.6	57.1	25	0	60
Total	100	100	100	100	100	100	100	100

Regarding time of day when injuries occurred, the results show that the highest proportion (30%) of all injuries occurred between 9am-12noon, which corresponds, to the findings from elsewhere (section 3.4.5). On both dairy and tillage farms the injury level was found to peak between 9am-12noon. Most injuries on sheep farms and dairy and other farms were sustained between 3-6pm while on both categories of cattle farm the highest proportion of injuries occurred between 12noon-3pm (Appendix 2). Table 4.8 illustrates the time of injury according to system of farming. The majority of injuries in both of the morning categories occurred on dairy farms. This reflects periods of high activity on a daily basis due to milking. In both of the afternoon periods, high proportions of injury took place on dairy and cattle farms.

Table 4.8: Distribution of time of injury according to system of farming

System of Farming	Time of day 6-9am (%) (n=10)	9am-12noon (%) (n=33)	12noon-3pm (%) (n=26)	3-6pm (%) (n=28)	6-9pm (%) (n=8)	9pm-6am (%) (n=5)
Dairying	50	33.3	19.2	21.4	50	20
Dairy & Cattle	20	15.2	26.9	28.6	0	20
Suckler Cows	0	12.1	26.9	7.1	25	20
Cattle Other	10	9.1	15.4	10.7	0	20
Mainly Sheep	0	12.1	0	21.4	0	0
Mainly Tillage	20	18.2	11.5	10.7	25	20
Total	100	100	100	100	100	100

4.3.2.4 Location of accident

Table 4.9 shows the distribution of injuries per farming system according to the accident location. Similar to previous Irish findings (3.4.6), the highest proportion of all accidents took place in the farmyard and this was true in the case of each farming system with the exception of sheep farming where the highest proportion of injuries were sustained in fields. Almost 38% of injuries on suckler farms occurred in the field and a similar proportion of injuries on tillage farms occurred in fields. In both of these systems, a significant level of the farm activity takes place in fields. The highest proportion of injuries that occurred in the farmyard was on dairy farms while just over 23% occurred on dairy and cattle farms (Table 4.10). In addition half of the accidents in farm buildings occurred on dairy farms. Both suckler and tillage farms each accounted for one fifth of injuries that occurred in fields.

As indicated in the literature, the farmyard and the field are the most significant locations for accident occurrence. However, variation in accident type was found according to accident location. The most significant accident types for farmyard injuries were found to be Trips and falls, livestock and machinery respectively (Appendix 3). Livestock accounted for the highest proportion of accidents in fields.

Table 4.9: Distribution of injuries per farming system according to accident location

Accident Location	All Accidents (n=110) (%)	System of Farming					
		Dairying (n=32) (%)	Dairy and Other (n=23) (%)	Suckler Cows (n=16) (%)	Cattle & Other (n=12) (%)	Mainly Sheep (n=10) (%)	Mainly Tillage (n=17) (%)
Farmyard	47.7	46.9	52.2	43.8	66.7	30	43.8
Field	24.8	12.5	21.7	37.5	16.7	40	37.5
Farm Buildings	18.3	31.3	17.4	12.5	0	20	12.5
Public Road	7.3	9.4	8.7	6.3	8.3	10	0
Farm Road	1.8	0	0	0	8.3	0	6.3
Total	100	100	100	100	100	100	100

Table 4.10: Distribution of injuries per accident location according to farming system

	Accident Location				
Farming System	**Farmyard (n=52) (%)**	**Field (n=27) (%)**	**Farm Buildings (n=20) (%)**	**Public Road (n=8) (%)**	**Farm Road (n=2) (%)**
Dairying	28.8	14.8	50	37.5	0
Dairy & Cattle	23.1	18.5	20	25	0
Suckler Cows	13.5	22.2	10	12.5	0
Cattle & Other	15.4	7.4	0	12.5	50
Mainly Sheep	5.8	14.8	10	12.5	0
Mainly Tillage	13.5	22.2	10	0	50
Total	100	100	100	100	100

4.3.2.5 Type of accident

The injuries have been classified according to the type of accident from which they resulted (Table 4.11). Over one quarter of injuries resulted from livestock accidents while 20% resulted from machinery accidents. A further 21.8% of the injuries arose from accidents classified as trips and falls. When compared to the results of the Survey of Health and Safety on Irish Farms (1997) it appears that machinery accidents have decreased while both livestock and other farmyard accidents have increased. In addition accidents categorised as trips and falls have increased since 1997.

Table 4.11: Distribution of types of accidents

Accident Type	All Injuries 2001 (%) (n=110)	All Injuries 1997* (%)
Livestock	25.5	22.9
Machinery	20	34.9
Trips and Falls	21.8	18.1
Chainsaw/wood	6.4	8.6
Other farmyard	6.4	6.8
Tools and Implements	3.6	0
Gates and Doors	7.3	0
Other	9.1	8.7
Total	100	100

*Source: Survey of Health and Safety on Irish Farms, 1997

An examination of the distribution of accident types according to system of farming shows that over one third of all livestock accidents occurred on dairy farms while a further quarter occurred on dairy and other farms (Table 4.12). The highest proportion (36.4%) of machinery accidents took place on mainly tillage farms, which by their nature are machinery intensive. The highest levels of trip and fall accidents occurred on dairy farms followed by dairy and other. The highest proportion of the three predominant accident types, trips and falls, livestock and machinery took place in the farmyard. However, a significant proportion of livestock accidents also occurred in fields (Appendix 4).

Within each category of accident type, the majority of accidents were found to have occurred on farms of greater than forty hectares (Appendix 5).

Table 4.12: Distribution of accident types according to system of farming

	Accident Types							
	Livestock (n=28) (%)	**Machinery (n=22) (%)**	**Trips & Falls (n=24) (%)**	**Chainsaw/wood (n=7) (%)**	**Other farmyard (n=7) (%)**	**Tools & Implements (n=4) (%)**	**Gates & Doors (n=8) (%)**	**Other (n=10) (%)**
Dairying	35.7	9.1	29.2	14.3	42.9	50	25	50
Dairy & Other	25	9.1	20.8	42.9	42.9	25	25	0
Suckler Cows	17.9	13.6	16.7	14.3	0	0	25	10
Cattle & Other	3.6	22.7	8.3	28.6	0	0	12.5	10
Mainly Sheep	10.7	9.1	12.5	0	0	25	0	10
Mainly Tillage	7.1	36.4	12.5	0	14.3	0	12.5	20
Total	100	100	100	100	100	100	100	100

4.3.3 Person characteristics of injury

4.3.3.1 Injured person

In almost three-quarters of the injury cases recorded (74.3%), the farmer was the injured person, while farm labourers accounted for 8.3% of the injuries. In addition 7.3% of the reported injuries were sustained by the farmers' son. The remainder of those injured were family members (Appendix 6). Similarly, the farmer was the affected person in the majority (84%) of reported ill health cases (Appendix 7).

Almost 92% of those injured were male. However, the median age of females injured on farms was ten years older than that of men, forty-two years versus fifty-four years. The age of the injured person was recoded in accordance with the age categories used by the CSO to characterise farm holders. However, in order to reflect injuries sustained by children the first CSO category <35 years was split into <16 years and 17-34 years. According to the HSA a child is a person who is less than 16 years old or the school leaving age which ever is higher. Table 4.13 illustrates the age of those injured in farm work related accidents. Of those injured 27.3% were aged between 17-34, while 18.2% were aged between 45-54. Almost 11% of those injured were over 65 years old while 4.5% were less than 16 years old and thus classified as children. In over 6% of the injury cases the age of the injured person was not disclosed. With the exception of the less than sixteen years old category the farmer accounted for the majority of injuries in all age groups (Appendix 8).

Table 4.13: Distribution of age of injured person at the time of injury

Age category	(n=110) (%)
1-16	4.5
17-34	27.3
35-44	17.3
45-54	18.2
55-64	15.5
>=65	10.9
No Age given	6.4
Total	100

The distribution of injuries per age group according to medical outcome of the injury illustrated a high level of fatality among the under sixteen's while fatality also occurred in the two older age categories. No other significant trends in medical outcome were apparent from the data (Appendix 9).

4.3.3.2 Medical outcome

Over 80% of the farm work related injuries reported required a hospital visit. Almost one third of the reported injuries resulted in medical attention as an outpatient in a hospital while almost 22% required medical treatment in hospital. A further 19% of the injuries required surgery (Table 4.14).

Table 4.14: Distribution of medical outcome of farm work related injuries

Medical Outcome	Frequency (n=110) (%)
Outpatients	32.7
Medical (In hospital)	21.8
Surgery	19.1
GP only	12.7
Observation (In hospital)	4.5
Fatality	4.5
None	4.5
Total	100

Further examination of the medical outcome of injuries according to age of the injured person shows that over one third of those who required surgery were in the 17-34 age categories. Over one third of those that required medical treatment in hospital and 27.8% of those who required outpatient treatment in hospital were also in this category. Although the numbers involved are low, 40% of the fatalities were in the youngest age group while 60% were over 55 years old (Appendix 10). When the outcomes of the ill health cases were examined, chronic back pain accounted for almost 50% of the reported cases. Dust related allergies accounted for 23% and farmers lung for over 12% (Figure 4.3).

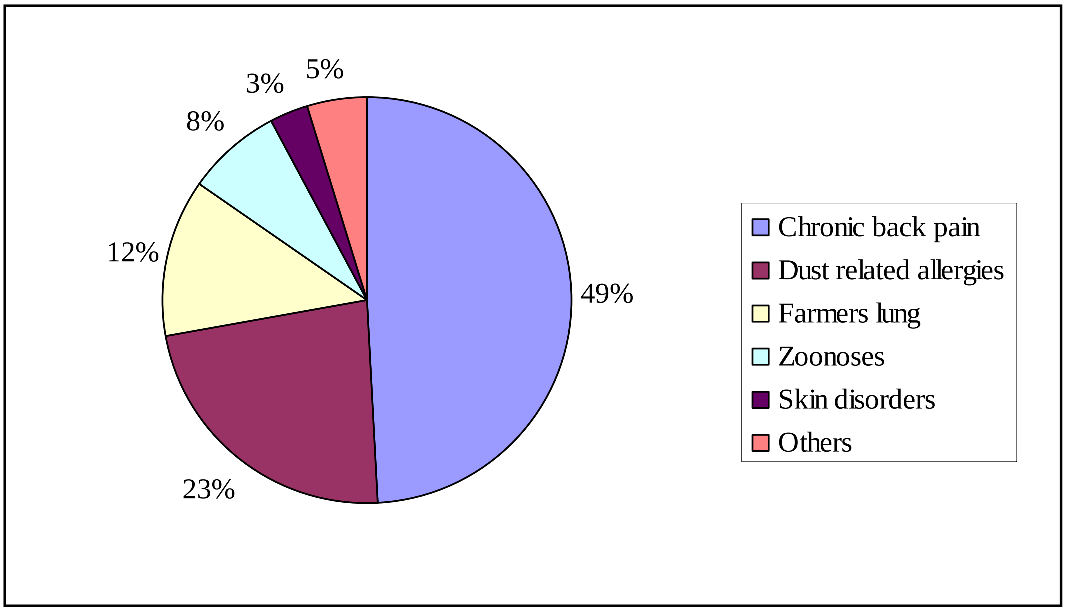


Figure 4.3: Type of farm work related ill health problems sustained on Irish farms

Of those who suffered from a farm related ill health 45.4% ranked the severity as being moderate, 29.2% ranked it as severe while 25.4% ranked it as mild. Over 70% of the respondents reported that their ill health problem was recurrent while almost 30% felt it was persistent. In 77% of the ill health cases the respondent said a measure was taken to eliminate the ill health risk.

When asked what part of the body was injured in the accident 121 responses were given, therefore, some of those involved in an accident sustained more than one injury. The extremities (i.e. legs and arms) accounted for over one quarter of the injuries. In addition, head injuries accounted for over 10% of the injuries sustained (Table 4.15).

Table 4.15: Distribution of responses to part of the body injured

Body part injured	**Frequency (n=121) (%)**
Hand, fingers, lower arm	25.9
Knee, lower leg, ankle	19.8
Shoulder, arm, elbow	14.9
Head (excluding eyes)	10.7
Back, spine	7.4
Eyes	5
Foot	4.1
Chest, ribs	4.1
Hip, thigh, pelvis	3.3
Neck	3.3
Internal	1.7
Total	100

An examination of the distribution of types of accident according to the part of the body injured shows that livestock accidents result principally in leg, arm and head injuries and chest/rib to a lesser extent. These injuries would be consistent with the principal types of accidents which livestock were involved in; kicks, attacks and crushing. The high proportion of head injuries, which resulted from livestock accidents is an alarming result. Machinery accidents result in a high level of hand and lower arm injuries and upper arm and shoulder injuries to a somewhat lesser degree. However, half of the trip and fall accidents were found to result in lower leg injuries (Appendix 11).

Fractures and broken bones accounted for over 30% of the principal injuries resulting from farm work related accidents while over one fifth reported their principal injury to be an open wound (Table 4.16). Fractures and broken bones are predominantly the principal injuries experienced by those involved in livestock accidents. Both fractures and open wounds are significant outcomes from machinery injuries while for trips and falls, fractures and broken bones and sprains are the main injury outcomes (Appendix 12)

Table 4.16: Distribution of principal injuries

Principal Injury	**Frequency (n=104) (%)**
Fracture / Broken Bone	30.8
Open wound	23.1
Bruising / contusion	9.6
Crushing	6.7
Muscle / Ligament	5.8
Other	5.8
Sprains	4.8
Eye damage	4.8
Internal injuries	2.9
Back / Head injuries	2.9
Fatality	1.9
Burns	1
Total	100

4.3.3.3 Injury related activities

It is evident from the results that the farm activities associated with the highest injury level are working with animals and working with machinery. However, one in ten injuries occurred while undertaking farm maintenance (Table 4.17).

Table 4.17: Distribution of injuries according to the activity underway

Activity underway	**Frequency (%) (n=107)**
Working with animals	46.7
Working with machinery	24.3
Farm maintenance	9.3
Tidying and cleaning the farm yard	4.7
Wood/tree cutting	4.7
Handling bales	2.8
Other	7.5
Total	100

Of the injuries that occurred while working with animals, cows accounted for the highest proportion followed by bullocks. Injuries involving bulls accounted for 10% of the animal related injuries, which was less than those accounted for by sheep. The nature and severity of injury associated with bull accidents is widely appreciated by the farming community and has been highlighted by both the media and safety campaigns. However, the results suggest that farmers do not afford other animals the same degree of caution as they do the bull. Dairy farmers have a high level of contact with cows; this level of exposure would explain the high injury level in this category (Table 4.18).

Table 4.18: Type of animal involved in injury

Type of animal	Frequency (%) (n=50)
Cows	34
Bullocks	24
Sheep	16
Bull	10
Horse	8
Weanlings	6
Sucklers	2
Total	**100**

Of the injuries that occurred while working with animals, over half resulted from being knocked over or attacked by an animal. A further 28.6% were due to animal kicks while over 10% resulted from animal crushing (Table 4.19).

Table 4.19: Specific cause of animal injuries

Cause of injury	Frequency (%) n=28
Knocked over / attacked	53.6
Animal kick	28.6
Crushing	10.7
Catching animal	3.6
Fall from horse	3.6
Total	100

4.3.3.4 Lost work days

While the majority of those injured were not admitted to hospital, over 18% spent less than two weeks in hospital while almost 6% spent more than two weeks in hospital. (Table 4.20)

Table 4.20: Distribution of injuries according to hospital stay

Number of days in hospital	Frequency (%) n=110
Not admitted	59.1
1 day	13.6
2-14 days	18.2
>14 days	5.5
Total	100

The results indicate that an estimated average of 6,000 hospital days were accounted for annually by farm work related injuries over the six-year period. This is fewer than the level found by Teagasc in both 1992 and 1997, 8,000 and 14,000 respectively. This calculation is based on the annual average for the five year period which was subject to recall issues. However, an estimated 9,500 hospital days were accounted for by farm work related injuries in 2001, which is an increase on that found in 1997.

In addition, an examination of the lost workdays experienced by those injured shows that over one quarter of those injured lost up to one week from work while almost 13% lost up to two weeks of work. Over 18% of those injured lost over 90 days due to their injury (Table 4.21).

Table 4.21: Distribution of injuries according to lost workdays

	Frequency (%) n=110
No lost days	18.2
1-7 days	26.4
8-14	12.7
15-21	8.2
22-30	5.5
31-89	10.9
<=90	18.2
Total	100

Over 67% of those that were injured resumed work while their injury was still causing difficulty. In addition almost 50% of those injured felt that they did not fully recover from the injuries they sustained due to the accident.

In almost 72% of the accident cases it was necessary for some one to take over the work of the injured person and on some farms more than one person was required. Where additional labour was required family members were cited in 63.8% of the responses of which 22.3% pertained to the spouse. In addition 24.5% of the responses indicated that hired labour was required. In the majority of cases (57.1%), those who responded said the additional labour was required for less than one month; however, in 27% of cases the additional labour was required for two-three months while in almost 16% of cases the labour was required for more than three months.

Over one third of the farms that reported an injury felt that there was an economic loss to the farm resulting from the accident. Of those who reported an economic loss, half ranked the loss as mild, 30.6% ranked it as moderate while 19.4% ranked the loss as severe.

The results indicate that injuries have a significant impact on farm labour, which inevitably must impact on efficiency and subsequentially profitability. Anecdotal evidence suggests that the labour deficiency on farms where an injury has occurred, if filled by family members very often requires family members to take time off from their own jobs or education to work on the farm.

4.3.4 Attitudes and activities toward health and safety on the farm

4.3.4.1 Perceptions of health and safety on Irish farms

When asked to classify the dangers associated with farm work over 63% of the respondents classified it as dangerous, while 26.1% felt it was safe. Almost 10% of the respondents felt that farming is very dangerous. However, when asked to classify their own farm from a safety perspective, over three-quarters of the respondents felt their farm was safe while 18% felt it was dangerous. Almost 4% of the respondents reported their farm to be very safe (Figure 4.4).

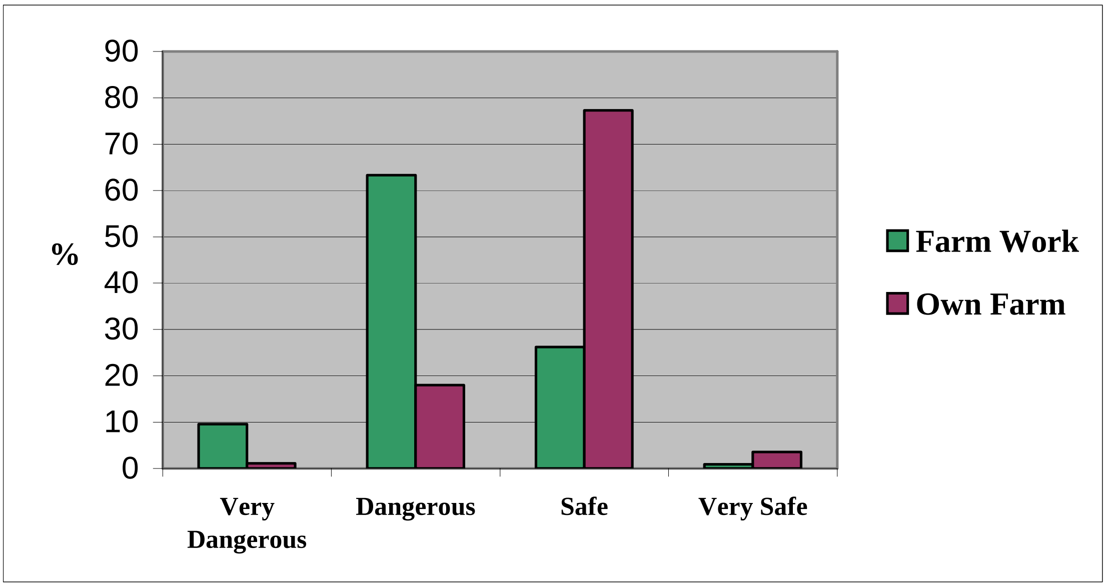


Figure 4.4: Distribution of perceptions of safety in farming

When the association between accident occurrence and the classification of the safety of the farm is examined a trend appears. Over 16% of those that classified their own farm as dangerous experienced an accident while 8.3% of those that classified their own farm as safe experienced an accident. Therefore it is likely that those who consider their farm dangerous do so because they have experienced a farm accident (Chisq=12.809, significance=. 000) this association was found to be significant (Table 4.22).

Table 4.22: Association between accident occurrence and the classification of the safety of the farm

Accident occurrence	Classification of own farm		Total
	Dangerous	Safe	
Yes	35 16.4%	75 8.3%	110 9.9%
No	178 83.6%	828 91.7%	1006 90.1%
Total	213 100%	903 100%	1116 100%

(Chisq=12.809, df=1, Significance=. 000)

In describing their own attitude to farm safety over two thirds of the respondents described themselves as concerned, while 28.1% said they were becoming more concerned about farm safety. Over 4% said they were unconcerned about farm safety (Table 4.23).

Table 4.23: Distribution of attitudes to safety on the farm (N=1116)

Attitude to safety on the farm	Frequency (%)
Unconcerned	4.5
Becoming more concerned	28.2
Concerned	67.3
Total	100

4.3.4.2 Health and safety legislation

While over 65% of the respondents understand what a safety statement is and the purpose it serves, less than half of the respondents were aware of their legal obligation, under the Health Safety and Welfare at Work Act 1989, to have a Safety Statement prepared for their own farm. Since enactment of the new legislation, after the survey was administered, the Safety Statement is no longer a legal requirement. Further, only 9.7% of respondents had prepared a safety statement for their farm. Almost 12% of the respondents were not aware of their legal obligation to conduct their farming activities in a manner, which does not put people at risk. The vast majority of respondents had heard of the Health and Safety Authority, however, almost half of the respondents said they would not welcome safety inspectors onto their farm (Table 4.24).

Table 4.24: Awareness of and compliance with health and safety legislation

	Yes (%)	No (%)	Total (%)
Understanding of safety statement (n=1113)	65.3	34.7	100
Aware of legal obligation to have a safety statement (n=1102)	46.6	53.4	100
Has safety statement been prepared (n=1119)	9.7	90.3	100
Awareness of legal obligations (n=1108)	88.3	11.7	100
Awareness of HSA (n=1116)	90.8	9.2	100
Incorporated safety into farm in last 5 years (n=1091)	58.9	41.1	100

4.3.4.3 Safety planning

Carrying out safety checks on machinery before use, may not require a great deal of time, but can alert the operator to potential hazards or problems that may cause disruption when the machine is in use and the operator under pressure. However, the results indicate that machinery checks are not always carried out before use on Irish farms. Indeed only 36% of the respondents said they always carry out safety checks on machinery before use while a further 43.9% said sometimes carry out checks. Moreover, when planning operations on the farm not all farmers account for safety. Over 50% of the respondents in this sample said they always account for safety when planning operations while 37.7% said they account for safety sometimes. Some farmers reported that they never account for safety when planning operations (Appendix 13).

Almost 85% of the respondents said that they did not perceive noise as a problem on the farm and 43.6% of the respondents said that they never use ear protection while working on the farm. In addition, over 50% of the respondents said they never supply ear protection to workers on the farm. Although 73% of the respondents feel safety signs are effective in minimising accidents on the farm, less than 20% of the respondents actually use safety signs on their own farm (Appendix 14).

4.3.4.4 Information and training needs of farmers

The results indicate a major health and safety training deficit among Irish farmers with little over 13% of the respondents having completed some form of health and safety training. Half of the survey respondents indicated that they need more information on health and safety issues. However, only 5% of the respondents had looked for information on health and safety in the previous twelve months. When asked to specify the information sought on health and safety, Teagasc literature accounted for over 26% of the responses, while information on chemicals accounted for almost 16%. Almost 11% of the responses related to electrical information and a similar proportion cited general safety issues and the safety statement (Appendix 15). The majority, 64% of the respondents, cited Teagasc as the source they would look to for farm health and safety information (Figure 4.5).

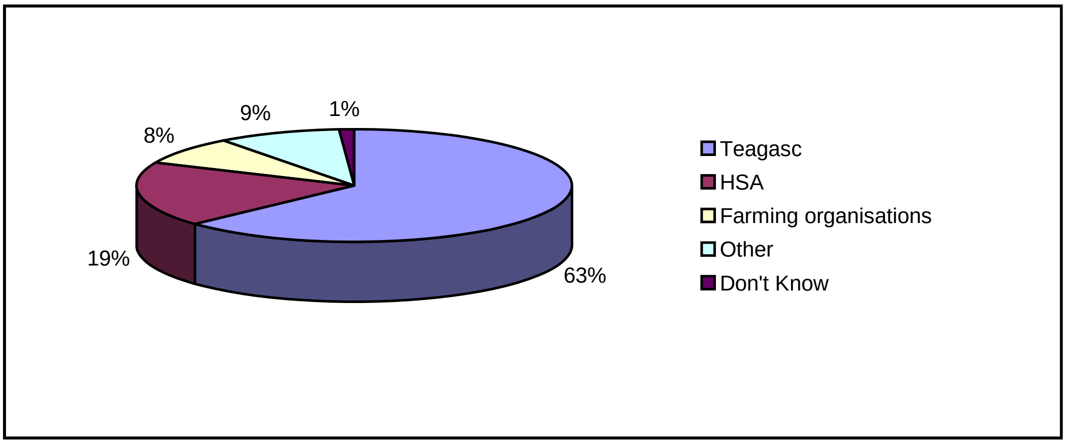


Figure 4.5: Sources of Information Sought on Health and Safety

The principal barrier to improving health and safety on their farm cited by farmers in the survey was the cost associated with safety improvements and income pressures (38% of responses). Farmers' indifference to safety accounted for over 16% of the responses while lack of safety awareness accounted for almost 14% of responses. Lack of time was cited and accounted for almost 13% of the responses, while the pressure of work accounted for almost 8% of responses. (Table 4.25)

Table 4.25: Distribution of responses to barriers to working safely

Responses	Frequency N=1360 (%)
Cost of safety & income pressures	38.4
Indifference to safety	16
Lack of safety awareness	13.8
Lack of time	12.9
Pressure of work	7.6
Lack of advice, information & training	2.3
Labour pressures	2.8
Laziness	1.8
Familiarity with work	1.2
Poor safety planning	1.0
Manufacturers lack of thought	.7
Information agencies problem	.4
Other	1
Total	100

4.3.5 Environment Factors

4.3.5.1 Incorporating safety into the farm

Almost 59% of the respondents said they had incorporated safety into their farm in the past five years. Of the changes incorporated over one quarter related to improvements in the safety of slurry facilities while 23% of the responses indicated that PTO shafts had been covered and safety guards had been applied to machines. Almost 12% of the responses referred to improvements in electrical installations while just less than 10% stated that fencing on the farm had been improved for safety reasons (Table 4.26).

Table 4.26: Distribution of responses provided for specific safety changes (n=1326)

Responses	% of responses
Improving safety of slurry storage	26
Covered PTO / Fitted safety guards	23.1
Improved electrical installations	11.8
Improved fencing	9.7
Improved cattle handling facilities	6
Adopted safer working practices	4.5
Improvements to farm yard	4
Improved safety of farm buildings	3.9
Improved safety of tractors and machinery	3.6
Made waterways and water tanks safe	3.5
Erected farm safety signs	1.4
Other	2.3
Total	100

4.3.5.2 Perception of farm hazards

Almost three quarters of the respondents perceived slurry gases to be very dangerous (Appendix 16). The majority of the respondents reported that they created an awareness of farm hazards among employees, their family and visitors to the farm. Over 85% of the respondents said that they made a planned effort to reduce risk at times of heightened activity, such as silage making, on the farm. However, only 45.2% of the respondents said getting the job done was never more important than taking safety precautions. Over one quarter felt that getting the job done was sometimes more important than taking safety precautions while a further quarter said it was rarely more important than taking safety precautions. Although in the minority, 4% of the respondents said that getting the job done was always more important than taking safety precautions.

Over three quarters of the respondents classified their farm as tidy while almost 6% classified it as very tidy. While few respondents felt that their farm was very untidy, 15.8% classified their farm as untidy (Appendix 17). The respondents perceived that accidents most frequently occurred with machinery and tractors while 15% felt livestock was the agent most frequently involved in farm accidents. Almost 11% of those that responded felt that trips and falls were the most frequently occurring accidents. There appears to be an overwhelming appreciation for machinery and tractor accidents, which may go some way towards explaining the decrease, by almost 15%, in the level of these accidents.

4.3.5.3 Management of health and safety on the farm

The hazard posed by a PTO shaft which is not properly guarded is well know among farmers and the importance of the guard cannot but be appreciated by Irish farmers given the coverage of this topic by all sections of the Irish Media. All PTO shafts were reported to be properly guarded on over 71% of the respondent farms. Yet on almost 29% of farms there were PTO shafts (one of the potentially most dangerous pieces of equipment on almost all Irish farms) that were unguarded. Lights on tractors were checked before each winter on over 81% of the respondent farms. While almost half of the respondents have the brakes on tractors checked once a year, 15% reported they never have the brakes on their tractor checked.

Chemical safety is paramount on the farm, and virtually all farms have cause to use agricultural chemicals to some degree. When handling agricultural chemicals over one third of the respondents do not wear any protective clothing. Further, over two thirds of the respondents did not have a locked storage area for chemicals on the farm; however, the vast majority (93.8%) of respondents consult the manufacturers' instructions when using chemicals on the farm (Table 4.28).

Table 4.28: Safety while working with agricultural chemicals

	Yes (%)	No (%)	Total
Wear protective clothing with chemicals (n=1094)	64.3	35.7	100
Locked storage area for chemicals (n=1100)	32.6	67.4	100
Consult chemical instructions (n=1099)	93.8	6.2	100

Almost four out every ten respondent farms had children less than fourteen years old present on the farm. It was reported that children are not allowed to play in the farmyard on almost three quarters of the farms in the sample, thus, over one third of farms permit children to play in the farmyard. In addition, 31.1% of the respondents indicated that children were not restricted from certain areas of the farm (Appendix 18). While the majority of children never have access to machinery 16.5% of the respondents reported that they sometimes had access to machinery while almost 5% said they always had access to machinery. Similarly, while the majority of children less than fourteen years old were not permitted to drive tractors on the farm 7.3% reported that they were sometimes allowed. On a small minority of farms it was reported that children were always permitted to drive tractors (Appendix 19).

Over 66% of the survey participants offered suggestions as to how safety could be improved on their farms. Of the respondents almost 14% suggested seeking training and advice on health and safety, which suggests that these farmers appreciate the role of the farmer in improving farm health and safety. The remainder of the responses relate to environmental modifications. Over 13% felt improving the safety of slurry storage and handling would improve health and safety on their farm. Over 11% of the respondents suggested covering PTO shafts, while 9.3% suggested making electrical installations safe and a further 9.1% suggested improving fencing and gates (Table 4.29).

Table 4.29: Suggestion to improve farm safety on own farm

Suggestions	Frequency (%) n=744
Seek advice & training	13.7
Improve safety of slurry storage/handling	13.4
Cover PTO shafts	11.3
Make farm electrics safe	9.3
Improve fencing / gates	9.1
Improve livestock handling facilities	8.3
Tidy / repair farm yard	7.4
Improve safety of machinery	7
Other	6.5
Repair buildings / silage pit	5.9
Be more safety conscious	4.2
Cover tanks / pits / water ways	1.6
Restrict access by children / public	1.2
Compile a safety statement	.9
Care handling stacked bales	.1
Total	100

When asked to rank the three main safety issues that give most cause for concern on the farm; livestock, machinery and power tools and slurry were found to be the top three concerns, respectively. Of the 26% of responses related to handling livestock 30% ranked it as the main safety issue causing concern on the farm and 32% ranked it second. Machinery and power tools accounted for 19% of the responses and of those over 26% ranked it as the main safety issue causing concern on the farm. Slurry and manure accounted for over 17% of the responses (Table 4.30). The same question in the SHSIF, 1997 illustrated that tractors and machinery were the principal agents for concern on the farm while few farmers were concerned about livestock on the farm.

Table 4 .30: Main safety issues causing concern on the farm (n=2341)

	Responses (%)	Rank 1 (%)	Rank 2 (%)	Rank 3 (%)
Handling livestock	26.2	30.1	31.9	10
Machinery & power tools	19	26.6	14	12.1
Slurry / Manure	17.3	13.4	17	24.9
PTO shafts	8	10.2	7.9	4.1
Other	7.3	5	6.8	12.2
Electricity	4.9	2.6	5.3	8.5
Children & members of the public on farm	4.5	3.5	4.5	6.4
Handling & storage bales	3.5	2.1	3.6	6.2
Using public roads	3.2	2.8	3.7	3.4
Tidiness of the farmyard	1.7	1.1	1.4	3.4
Working at heights	1.2	.7	1.1	2.3
Buildings in disrepair	1.1	.7	.6	2.6
Uncovered tanks & water ways	1	.1	1.2	2.4
Doors & gates	.7	.6	.7	.9
Working under pressure	.4	.4	.2	.6
Total	100	100	100	100

4.4 Discussion

Although agriculture accounts for on average 40% of all work place fatalities in Ireland, to date few studies have examined the extent of injury on Irish farms and the attitudes and activities of farmers in this respect. This national study significantly adds to the understanding of health and safety on Irish farms. However, the retrospective approach employed in this study is not without limitations, the most significant of which is recall bias. The reliability of the yearly accident levels are questionable due to the significant difference that occurs between the earliest study year and the most recent year. In addition, the injuries were not validated through medical records and in turn the data relies solely on the memory of the farmer. The increasing incidence of injuries over the study period indicates the presence of recall bias. Subsequently, it is difficult to make meaningful comparisons across the five-year period. This indicates that there may be a need for more regular and systematic collection of data relating to farm injury in Ireland. According to Jansson and Svanström (1989), medical data are most reliable when the reference period is up to three months. With periods of between four and twelve months underestimation occurs.

The absolute number of injuries reported by farms in the current study period was greater than that found by McNamara & Reidy (1997). Given that the farm population is in decline (Phelan and Frawley, 2002), a worrying trend emerges. As the number of farms in Ireland decrease, the percentage of farms experiencing an accident has in fact increased. On examination of the overall trend in farm injury, based on the five-year average data, the rate of decline in injury observed between the 1992 and 1997 studies was significantly higher than that which has been observed between 1997 and 2003. It is possible that the decrease in injury observed between the earlier studies have lulled farmers and the wider industry into a false sense of security. Dunne (2000) highlights the error in focusing too much on injury and fatality statistics, as these do not provide a true reflection of occupational accident risk. There may be cause to focus more on the level of risk present in the working environment of Irish farms in addition to recording and monitoring fatality and injury statistics.

The analysis of farm characteristics suggest that the system of farming engaged in and the size of the farm are significantly associated with injury occurrence. Farms with dairy enterprises accounted for the majority of injuries reported. However, bivariate analysis (analysing injuries in proportion to the population) found that tillage farms experience a higher incidence of injury than any other farming systems in Ireland. In addition, similar to the findings of other research having large livestock on the farm appears to be significantly associated with farm work-related injury (Sprince *et al.,* 2003; Stallones, 1990; Rautiainen, 2004). Tillage farms in Ireland are heavily dependent on machinery. Machinery is a significant hazard on farms (section 3.3.2). It is likely that the intensity of machinery use in Irish tillage farming results in a greater exposure to machinery hazards than other systems of farming. Greater accident levels were found to occur on tillage farms during autumn and summer when activity levels peak and machinery usage is high. The finding that tillage and dairy farms experienced a higher proportion of injury is broadly consistent with the findings of McNamara and Reidy, 1997. Similar to findings from other research, farm size was significantly associated with injury occurrence in this study (Section 3.5.1). Indeed, the theory that larger farms have higher annual production and thus present a higher exposure to risk as put forward by Zhou and Roseman (1994) may account for higher injury level on tillage farms.

The impact of seasonality on injury occurrence appears from the results to be complex. Not only does seasonality impact on injury occurrence in the individual farm systems, but there also appears to be a seasonal effect on accident type. Jansson (1987) found that the accident rate on farms was higher at busy periods of the farming year. The results of this study give further weight to this finding. The majority of tillage accidents were reported in autumn and summer, which are undoubtedly the busiest times on Irish tillage farms. It is reasonable to assume that the high injury level on dairy farms in summer is related to the high level of activity given that the total labour input on dairy farms was found to have peaked in May (O’Brien, 2004). However, Leahy, 2003, found that labour input on suckler cow farms peaked in spring-time yet the highest proportion of injuries occurred during autumn on suckler farms. The injury peak at this time may be related to the ‘turn in’ of the animals after the summer period, during which time the suckler herd will have required little handling by the farmer. An examination of the literature on seasonality and injury (section 3.4.5) shows that there appears to be no consistent pattern emerging from the research in relation to the peak seasons for injury occurrence or indeed type of injury experienced. It may indeed be that as Purchwitz and Field (1990) found, accidents vary by state in the USA according to the month of the year and thus would certainly vary across countries. From the results, it is apparent that injury occurrence while influenced by season is more closely associated with the level of activity underway at particular times of the year on the farm. The time of injury occurrence is broadly similar to that reported by McNamara and Reidy (1997), however, there was some increase in early morning injury (6-9am). Similar to the findings of the research reviewed (Section 3.4.5), the majority of injuries in this study occurred in the late morning to mid afternoon. The general consensus from the literature is that the majority of injuries occur in farmyards and fields (Section 3.4.6) and the results of this research concur. The results illustrate that the accident location varies according to farming system. System of farming emerges as an important determinant of the environmental consequences of farming. Seasonality, time of day and location of accident occurrence are all factors of the system of farming.

It is a global phenomenon that women of all ages are not injured to the same extent as men, with the exception of those post retirement (Diderichsen *et al.*, 1999). Similarly in this study, the vast majority of those injured were male, however, a greater level of female injury was reported than in SHSIF 1997 (McNamara & Reidy, 1997). Given that females had a higher mean age of injury than males, there is evidence to suggest that the injury profile differs between men and women on Irish farms. In this study, all of those injured were members of the immediate or extended farm family. The farmer is at the highest risk of injury.

No age group was exempt from injury in this study, however, the young and old present as particular concerns. The highest proportion of injuries were sustained by the 17-34 year old age group, yet according to (CSO, 2002), this group accounted for the smallest proportion of Irish farmers in 2001. Based on these findings, it is reasonable to suggest that these young farmers did not experience positive safety socialisation into farming. Those over 65 years old accounted for one in ten of the injuries reported in this study. According to Murphy, 1992, failing eyesight, arthritis, loss of hearing and slower reaction times are some of the age related problems influencing the safety and health of older workers. Further, there are defining characteristics of each age group which influence health and safety. Consequently intervention and education efforts to be successful must be tailored and targeted. Broad spectrum general interventions allow too much capacity for people to reject the message as immaterial to themselves (Dunne, 2001). A campaign that is targeted to a specific group is more likely to attract their attention.

Similar to the findings of McNamara & Reidy (1997), almost half of the injured persons required a hospital stay. While the estimated injury level has decreased, the hospital stay data would suggest that there are a greater proportion of more serious accidents than were previously experienced. There are significant economic and emotional pressures placed on farm families due to hospitalisation, (Finnegan *et al*., 2005), which have not been examined in this study. In addition, hospitalisation due to injury has consequences beyond the farm gate. Most notably there is an impact on the health services which is funded by the tax payer. Losses are also incurred due to loss of productivity in the economy associated with absenteeism from work by the injured person and possibly family members. Thus prevention of farm injuries is not merely an issue for the agriculture sector it also forms part of a wider debate on the global burden of injury. When a worker becomes a consumer, even temporarily, this change places a double burden on the economic system (Knapp, 1966).

The part of the body injured and type of injury were broadly similar to that reported by McNamara & Reidy, 1997. As farm work by its nature is very physical, passive injury prevention may be required to go further in protecting the body from injury. In addition, manual handling technological solutions must be embraced and applied by more farmers in order to reduce the incidence and severity of chronic back pain and other muscloskeletal problems associated with manual handling.

Working with animals has presented as the activity yielding most injuries and within this a wide variety of activities were reported. When compared to the results found by McNamara & Reidy (1997) it would appear that twice as many accidents occur now while working with animals than did previously. Injuries involving bulls and bullocks have decreased between the two survey periods, while those involving cows have increased. No differentiation was made between suckler and dairy cows in the reported data. However, according to data from the Department of Agriculture & Food (2004), there has been an increase in the national suckler cow herd since 1995 while the dairy cow herd is steadily declining. It is likely that the increase in suckler cow farming during the study period may be related to the increased incidence of injury with cows. However the decline in injuries with bulls cannot be explained in the same way as the number of breeding bulls on Irish farms has been steadily increasing over the years. It may however, be a response by farmers to Irish campaigns relating to safe handling of bulls.

While the majority of farmers in the study classified farming as dangerous, they classified their own farm as safe. This suggests that farmers are aware of the hazards associated with farming and can identify them on other farms; however they do not recognise the hazards present on their own farm. Similar conflicts were observed by Elkind, 1993. The results suggest that farmers who consider their farm to be dangerous do so because they have had an accident. It is likely that the farmers in the study evaluated 'danger' according to whether or not an accident had occurred. The emphasis on injury and fatality statistics result in farmers classifying the dangers associated with their occupation based on accident levels rather than according to workplace risk. *'Focussing exclusively on either accidents, reportable accidents or fatal accidents, or some combination of these three statistics, is not a true reflection of the real state of affairs as regards occupational accident risk'* (Dunne, 2001, P.16).

At present it seems that farmers do not have the correct tools to adequately assess risk on their own farms. Farmers are not unconcerned with farm health and safety, in fact the majority of respondents in this study said they were concerned yet their concern does not correspond to action on the farm. Thu *et al*., 1990, found that farmers were as concerned about personal safety and health on the farm as they were about other farming issues. However, according to Murphy, 1992, what farmers actually do is more indicative of their beliefs or values than what they may indicate in a questionnaire. The results of both the person factors and environment factors which are to follow indicate that farmers' actual beliefs and values in relation to farm safety may be dissimilar to what they have stated.

The fact that less than 10% of farmers had a safety statement prepared for their farm may in itself be a statement of their values and beliefs in this regard. However, more than half of the respondents were not aware of their legal obligation to have a safety statement which indicates that serious issues exist in relation to information exchange between the relevant agencies involved in farm health and safety and farmers. Further, the results suggest a level of hostility towards HSA inspectors, as half of the respondents would not welcome safety inspectors onto their farms.

The majority of safety improvements undertaken on farms in the study period related to farm waste storage facilities, safety guards on machinery and electrical installations on the farm. While not in the same order, these improvements accounted for the top three responses to the same question posed by McNamara and Reidy, 1997. Few farmers have been found to have undertaken any form of health and safety training. According to Dunne (2001) good training gives full and accurate information on aspects of these situations which are safety critical. People build up models or schema on the job at hand based on training and experience. People will pay more attention to the elements that training and experience determine as important to the job. While many of the respondents felt they required more information on health and safety, few had actually sought information in the previous year. However, farmers for the most part would look to Teagasc for information on health and safety.

There is a perception among Irish farmers that safety costs money. Irish farmers currently operate in a price cost squeeze environment which is clearly demonstrated by the decrease in the terms of trade index 2005 by 4.5% (CSO, 2006). All farmers are looking for cost efficiencies within the system in which they operate. If safety is perceived by farmers to have an economic cost and more specifically improving the safety of farm activities requires finance, it may not be pursued by farmers. In addition farmer’s indifference to safety and lack of safety awareness were cited by many farmers. It is clear from the above results that an indifference to safety does exist among certain farmers. Perhaps this indifference is related to the emphasis placed on injury and harm in the workplace rather than risk. If farmers equate safety with injury occurrence then the absence of injury on the farm may result in an indifference to safety.

An assessment of the environment factors fundamental to farm health and safety confirmed that farmers' beliefs and values, as represented by their actions, differed significantly from what they said above. Many farmers did not have PTO shafts properly guarded or lights on tractors checked before the winter. Many do not wear the protective clothing when handling chemicals and locked chemical stores are not a feature of many farms. Safety is not portrayed through the results as an important factor in planning farm activities in Ireland. While most farms make an effort to reduce risk at times of heightened activity, getting the job done on the farm is often more important than taking safety precautions on many farms. There is a potential gain from risk taking should loss not occur (Dunne, 2000), which in farming may be completing a task quicker, avoiding oncoming adverse weather or getting work completed in the given time period.

Although the majority of respondents considered their farm to be tidy, the high proportion of trip and fall injuries occurring in the farmyard suggest that general housekeeping and tidiness may be an issue on many farms. While safety signs are considered effective, they are rarely used. Noise is not perceived to be a hazard by Irish farmers despite the fact that farmers as an occupational group suffer from noise induced hearing loss to a greater extent than other occupational groups (May, 1990). In addition, noise has the potential to interfere with speech communication, audible warning signals and the normal sounds of machinery as well as concentration and affecting sleep (Murphy, 1992).

Handling livestock, machinery and power tools, slurry and PTO shafts on the farm were reported to be the main safety issues causing concern on the farm. The fact that handling livestock was the concern most voiced indicates that on the ground, there is awareness among farmers of the hazards associated with livestock. Yet the majority of farmers feel that machinery and tractors are most frequently involved in farm accidents. This may be an example of the availability bias at play (Dunne, 2001; Murphy, 1992). Many machinery accidents result in very serious injuries, often fatalities and these are widely reported in the media and also discussed among the farming community. For this reason, farmers can call these accidents to mind more easily than accidents which received less attention and had less devastating effects. Consequently, they are likely to estimate the occurrence of such accidents as higher than their actual statistical incidence. This may result in farmers being less vigilant while working with livestock or being less aware of the possibility of sustaining a serious injury through a trip or fall accident. Again, this illustrates the importance of reporting and analysing the level of risk present on farms rather than the fatality or injury levels associated with farm work.

On some farms children continue to engage in hazardous activities and many are allowed access to all areas of the farm. Because the farm and family home are often one and the same; children are injured both at work and at play on the farm (Murphy, 1992). In Ireland as with other countries, children are very much involved in farm activities and are often a valuable labour source on the farm. Children's involvement in the family farm has traditionally been very important as a business and way of life was being passed on from generation to generation. However, the speed and sophistication of contemporary farm activities often places children that engage in farm activities in situations which they do not have the skills to deal with. According to Dunne, 2001, people will not respond to exhortations about dangers if they do not believe that they are at risk. Given the culture in which farmers grew up, it is possible that many value the opportunities which growing up on a farm affords to children. If the experience of children being involved in a farms activity has been positive and has not resulted in negative outcomes, it is conceivable that the family will not identify with warnings regarding child safety as they do not believe that they are in any danger.

CHAPTER 5
THE REALITY OF HEALTH AND SAFETY ON IRISH FARMS: CASE STUDIES FROM THREE RISK GROUPS

5.1 Introduction

Although the results from the Survey of Health and Safety on Irish farms provide an indication of farmers' safety activities, they do not provide an insight into the interaction between the farmer, the physical working environment and technology present on the farm. '*Accidents involve complicated interactions between characteristics of the individual and his environment. Many processes occurring simultaneously and with differing temporal patterns coincide at the time of impact to determine the nature and consequences of an accident*' (Glasscock *et al.*, 1997).

Similarly Dunne, 2000, P.3 believes that accidents are not just chance occurrences, they arise from particular circumstances '*that are created by the interaction between the technology being used, the attitudes, beliefs and motivations of the people working there, and the policy and practices of the organisation, whether these were formally developed or allowed to just evolve over time*' .

This chapter seeks to examine the interactions between farmer characteristics and the farm environment and technology. While the results from the Survey of Health and Safety on Irish farms provided historic accident data and the findings of self-described attitudes and activities of farmers, they could not offer an insight into the interplay that exists between a farmer and his/her environment. Case study analysis was undertaken in order to provide a perspective on the contemporary reality of Health and Safety on Irish farms. This study is not designed to be representative but rather reflective of health and safety on Irish farms. Case study research provides significant detailed information in a holistic investigation of the situation (Casley and Lury, 1986).

5.2 Objectives

The objectives of the case study research were to:

- Examine the interaction between the person, the physical working environment and technology factors present on the farm;

- Examine the extent to which other factors indirectly impact on health and safety on the farm.

Neither the literature review nor the findings of the Survey of Health and Safety on Irish Farms reflected the reality of health and safety on farms. While they did provide information on farmer behaviour and indications of attitude, these were self-reported and not independently observed. In addition, the information was generic in nature and did not relate to specific scenarios which farmers are confronted with daily.

Thus far, the findings have been based wholly on the farmers' perception and while this is fundamental and vital information it provides only one perspective on farm health and safety. The survey did not challenge farmers to really consider health and safety in all of their daily activities and routines. Further, thus far the study has placed the farmer to the fore and has not adequately examined health and safety on the farm. To do this it is necessary to go to the farm, to examine the farmers' perspective within the farm environment and to challenge this where necessary in light of the reality of the farm. Based on a farm "walk-through" in Denmark with the Agricultural Engineer Gunnar Smidth simply auditing the farm environment has been determined wholly inadequate. If auditing is the correct word, then it is necessary to audit not only the physical environment and technology present but also the protocols and behaviours brought to bear in all scenarios relating to the environment and technology.

5.3 Methodology

A multiple case study design was chosen, the single case study design might be weakened by that fact that you will have put 'all your eggs in one basket' (Yin, 2003). A true reflection of the relationship between environmental, technological and person factors and their impact on health and safety on the farm requires examining several permutations of size and system. A methodology was required for selecting farms from the survey data which would be used to identify the case study farms. The Survey of Health and Safety on Irish Farms highlighted the importance of measuring risk in the farm environment and the need to focus on risk as opposed to accident and injury. It was on this basis that it was decided to conduct the case study analysis according to the level of risk in the environment. Initially cluster analysis was used to identify if groups of farms with similar characteristics existed within the survey population. However the results from this exercise were inconclusive.

5.3.1 Farm Injury Risk Index

A Farm Injury Risk Index (FIRI) was constructed for the purpose of selecting case study farms. The literature review identified a number of factors associated with injury risk on farms. The FIRI was devised using a combination of variables that were shown to have a significant relationship on the occurrence of farm work-related injuries in the bivariate analysis. A weighted index was constructed to account for the difference in the significance of the relationship between the individual variables and farm work-related injury. The variables selected for inclusion in the index were Farm Size (Chisq=12.420, df=2, Significance=. 002); System of Farming (Chisq=14.773, df=5, Significance=. 011); Hired Labour Use (Chisq=4.563, df=1, Significance=. 033); Region (Chisq=15.214, df=6, Significance=. 019). In addition to the above variables, Safety Statement preparation was also included in the index due to the importance placed on it in workplace injury reduction in Ireland. '*Preparing and implementing a Safety Statement for your farm will significantly reduce the likelihood of an accident occurring*' (HSA, 2001, P.44).

Each variable was allocated a score between zero and twenty, based on the significance of its relationship to farm work-related injury. The scale of the index was selected logically, as the index comprised twenty components. Based on the variable score, the components of each variable were then allocated a score again based on their significance. Using the strength of relationships identified through bivariate analysis and expert opinion, variables were ranked in a hierarchical fashion with those having greatest impact listed first. This process was repeated until all variables were ranked. Based on a scale of zero to twenty each variable was allocated a score. Each sub category was then allocated a score, which was a sub component of the score allocated to that variable. Applying the scoring system outlined, the highest possible score attainable was 59, this score would represent a farm greater than 100ha that is engaged in tillage and employs hired labour. The farm would be situated in region 2 and would not have a Safety Statement prepared. In other words this farm has the highest concentration of identified risk factors that were found to be associated with accidents. The lowest possible score was 17, this score would represent a farm less than 40ha that is engaged in cattle rearing and does not employ hired labour on the farm. The farm would be situated in region 7 and would have a Safety Statement prepared (lowest category).

Once developed, the index was applied to all 1127 farms in The Survey of Health and Safety on Irish Farms. The farms were then categorised into three groups that of high risk, medium risk and low risk, each comprising one third of the population. The index was validated by examining the risk scores of the farms, which experienced a farm work-related injury. The results showed that 20.9% of the farms that experienced an injury were categorised as low risk, while 29.1% of those that experienced an injury were categorised medium risk and 50% were categorised as high risk farms (Table 5.1).

Table 5.1: Percentage of farms experiencing an injury in each risk category

Risk Category	**Percent of farms experiencing an injury**
Low risk	20.9
Medium Risk	29.1
High Risk	50.0
Total	100.0

5.3.2 Farm selection

Based on the risk score assigned to each farm that participated in the survey, sample farms were randomly selected from the data set. In total nine farms were selected for case studies, three from each of the risk categories. In selecting the sample farms, care was taken to ensure that they were representative of typical Irish farms in terms of scale, system and region. As the National Farm Survey is confidential the case study farms could not be selected from this population. The profile of the nine sample farms were used to identify the case study farms.

The nine sample profiles selected were provided to Teagasc in order to identify farms that matched the criteria. Farms with matching farm size, system, labour requirements and region specifications were identified by Teagasc advisors. A letter was distributed to advisors in the relevant regions describing the study and what was involved (Appendix 20). The advisor identified farms which matched the case criteria and the initial contact was made with farmers through their local advisor. Subsequently, the researcher contacted each farmer to seek their consent to participate in the study. Suitable on-farm appointments were agreed. All farmers that were contacted were willing to participate in the research, however, the researcher experienced difficulties on one farm in engaging the farmer on Health and Safety issues. Subsequently, a replacement farm was sought. Where the farmer approved, relevant photos were taken depicting both positive and negative safety issues in the farmyard, as they arose. All of the case study interviews were recorded and later transcribed.

Prior to conducting the case study research, a pilot study was undertaken on a large tillage farm which had a beef enterprise in region 2. A farm walk through was carried out at which the researcher, the farmer, his Teagasc advisor and the Teagasc Labour and Organisation specialist were present. The farm walk through validated the proposed case study methodology and also ensured that the researcher had a sufficient understanding of the mechanics and hazards of machinery in this particular type of farm operation.

5.3.3 Data collection

A guide for the case study assessment was developed using expert opinion and the Health and Safety Authority, Farm Safety Handbook (Health and Safety Authority, 2001). The guide was used as a frame of reference for directing the farm walk through on each farm (Appendix 21). Each of the case studies was recorded using a dictaphone with the farmers permission. In addition, photographs were taken with the farmers' permission and the reason for the photo explained. Detailed field notes were also compiled by the researcher during the visit.

5.3.4 Case study analysis

Each of the case study interviews were initially transcribed and read to ensure that all relevant information was captured. Follow up phone calls were made following this phase. Subsequently the information was analysed on a case basis on a flip chart and common themes were identified. Both the transcriptions and the field notes were used for this process. Subsequently, the themes were extracted and analysed further to provide the case study findings. Again this analysis was carried out using flip charts. In documenting the results the transcripts were examined and 'ver batum' quotes were used extensively to add to the understanding of the results.

5.4 Results

The results of the case study research follow. The high risk category results are presented first, followed by the medium risk and finally the low risk. The names of all persons detailed in the results have been changed to conceal their identity.

5.4.1 High Risk Category: Case Study 1

Martin has been farming full time since 1995/1996. He farms 800 acres of tillage with his father in Co. Kildare. He completed the Green Certificate at Gurteen Agricultural College followed by a HNC in crop husbandry in Scotland. In addition he has completed an advanced certificate in crop husbandry at Teagasc Oakpark and has also taken a spraying course with Teagasc.

Both Martin and his Father are full time employed and the farm employs two seasonal labourers, a student, who is hired for three months, and a labourer who returns each year for four months. The main farmyard is situated along side the family home and directly opposite, across the main road, there is a smaller yard with grain and straw storage. In addition, there are two more yards, which are located between two and five miles away from the main yard. The farm is not in the Rural Environmental Protection Scheme (REPS). There are no children living on the farm, however, on occasional Sundays there are children visiting the farm. These children are all over ten years old and are not permitted unsupervised access to the yard. Anything that is perceived as dangerous for children; spare wheels, chemicals are locked away and visiting children are unable to access them.

Both Martin and his father have completed safety statements. They have had a number of HSA inspections and have always implemented change where recommended. Martin feels strongly that those advising on and inspecting farm safety set a good example to farmers. If farming themselves, they should employ the safety standards which they expect of farmers. The local Teagasc advisor is very safety conscious and actively encouraged them to complete a safety statement. They included their employees in the process and show it to new employees. In addition, a first aid box is provided in the farm yard.

Martin feels that in general he is in a rush while he is at work; however, a lot of that pressure is self-inflicted. In terms of stress he describes himself as extremely focused, driven and single-minded on things '*I want it done now and done well*'. Although he is driven he does find it easy to switch off from work. The weather is a major source of stress for Martin in relation to his job. In addition he finds farmers can be very small minded and there is an underlying competitiveness among neighbouring farmers. This is another source of stress in his day which can have a greater impact depending on other unrelated factors. As a young farmer he finds it can also be stressful working with his parents and trying to assert change on the farm.

In terms of work organisation, Martin and his father do engage in planning. However, they do not sit down and regimentally plan their work. Martin feels the weather dictates different things, although they know what needs to be done there is always uncertainty as to whether the weather will permit them to do it. As a result of this he feels that some days '*you more or less make up your day as you go along*'. Martin has a fairly steady annual workload with occasional peaks during the year with the exception of the harvest period. Between August 15^{th} and September 15^{th} is his peak period which he describes as, '*absolute mental time'*. He feels that his life is a lot more organised outside of the harvest period and he can make it more regular.

During the off period on the farm all the service and repair work is carried out on machinery and buildings, '*everything is gone through with a fine tooth comb if you* *can, but it far from means that you will have a trouble less harvest*'. Any problems that arise with a machine during the year are written down in a log book and each one is dealt with individually. All of the basic machinery maintenance work is carried out on the farm and a mechanic deals with any major problems. Sometimes the situation arises that a machine is not repaired until quite near to the time it is required, due to unavailability of spare parts. Martin finds this quite stressful and says it often results in things being overlooked.

To have left nothing unturned is the most important consideration to Martin when planning activities on the farm. He also feels that it is very important that he has paced his work throughout the year so that there are no periods of panic and unduely heavy workload.

Martin describes safety as a vital element of his working day, *'I would see it as being vital, in every aspect. Obviously it increases when you get busier and when you have more people coming to work on the farm with you'*. He finds that safety is quite simple when it is just himself and his dad; one of the employees has been working on the farm for a number of seasons and he knows what is expected of him with regard to safety. However, the student is new each year and is taught 'what's what' with regard to safety, often just simple things such as not standing behind a grain tail board while opening it. Martin feels this process of going through safety with the student each year gives him a chance to rethink safety issues. He believes that farming is not an inherently dangerous occupation; *'I think it depends on your attitude and your focus. Whether you keep stuff maintained as in regards to safety shields or you know if you are conscious of it yourself all the time'*. He describes his father as being very conscious of safety, which he feels, is a result of age and experience. People in the locality would identify his father as being very safety conscious.

Martin feels that a lot of farm accidents happen when people are very busy or when workloads increase. One of the biggest factors in relation to farm accidents is pushing something to a limit either your body or a machine. He feels that farm accidents are somewhat preventable. However, the nature of farming means that there is always a risk factor. The risk of having an occupational accident is greater for a farmer than it is for a person who works at a desk job.

The farmyard was found to be extremely tidy and well maintained. Everything on this farm has a place and nothing is left in the farmyard. Several machines including a hedge cutter, a loader and a grain trailer were parked in the yard. Photo one illustrates the level of organisation on this farm. All of the sheds in the yard have locked doors, which are opened on a need only basis. All electrical installations on the farm are compliant with the required standards. A separate farm entrance was put in this year for safety reasons, the old entrance passed directly outside the back door of the dwelling house onto a narrow side road which turns immediately onto a busy main road. The farm is situated on a bend on the main road. As the road was becoming busier and faster combined with the poor visibility due to the bend, accessing the road from the farmyard and vice versa became extremely hazardous.

Photo 5.1: Main farm yard

This picture represents the standard of organisation and house keeping that is in place on this farm. With the exception of a straw trailer, nothing is stored in the farm yard. The yard is regularly swept and power washed and all of the farm structures are well maintained.

On commencement of the farm walk through, one of the farm employees was found power washing the yard. General tidiness in the farmyard is deemed vital, *'you can ask the lads about it they never have a brush out of their hands, they will always be* *power hosing'*. The yard opposite the main farmyard was also extremely tidy despite there being some water lying adjacent to the field verge, following heavy rain; *'And you're actually seeing it on a mucky day, usually it wouldn't usually be as mucky out here now'*. This yard is locked at night and when unattended.

The farm has a very spacious workshop, which was very organised and tidy. Martin feels that organisation is essential in the workshop, when something needs to be repaired it is easier to do if the workshop is organised. He recently bought a new hydraulic jack system for removing and replacing tyres on tractors and machinery. This allows for tyres to be changed with ease and safety. The vast majority of farmers do not have a hydraulic jack system; however, Martin feels that many more will invest in these systems in the future.

The chemical store is situated in an old stone building in the farmyard. It has a locked sliding steel door with a dangerous chemicals warning sign fixed to the door. The chemical store is well organised and clean. There is no running water in the store; however, there is a tap outside the door (photo 2). There are rarely any chemical spillages on the farm and Martin says it is difficult for this to happen. All the empty chemical containers are rinsed out after use and burnt on the farm. The spray is purchased as it is needed on a per hectare basis and spray is rarely held over from one season to the next. The sprayer is filled from a gravity tank which allows for ease and speed of filling. Gloves are always worn while spraying however a mask is not worn. There is air conditioning in the tractor however they are not conscious of closing all the windows while spraying *' If we wanted a window open we'd spray away there happily with a window, not maybe a major back window open but a side window for a bit of air into the cab or whatever'*. Although the cab filters are such that spray cannot enter the cab an open window on a windy day may result in spray in the cab *'If you had a window open or something on a windy day you might get a blast of it but it hasn't really been any harm to us. But it's not ideal either'*. There is a tank for clean water on the sprayer and in the event of a blockage in the nossel, there is always something in the cab to free the blockage.

Photo 5.2: Locked chemical store with warning sign

The chemical store is another example of adherence to safety standards on this farm. The store, like all other buildings is well organised. The store is always kept locked. It is clear that chemicals are perceived to be a major hazard on this farm.

The hedge cutter which was parked in the farm yard is well maintained. All lights and indicators were in proper working order, a ‘flashy beacon’ on the roof of the cab is used which cutting on public roads. The PTO cover was intact and well maintained, Martin is generally conscious about keeping PTO shafts covered. ‘W*e try not get them broken in the first place. So it’s the original one that often sees a machine out. That’s an eleven-year-old machine and it’s the original PTO. To be fair to it, it doesn’t move much. It’s not like an implement that lifts and moves so there’s not much wearing on that*’. Warning signs are rarely used while working on the road unless he is working on a very bad bend. When you encounter a cyclist or a walker it is important to stop and lift the mower and look after their safety. Also operator safety is an issue as material can often fly up and hit the cab. In the event of a blockage in the head of the hedge cutter, normally the PTO is switched off and the tractor also switched off and then the blockage is manually cleared. However, often just lifting the mower and reversing back will clear the mower.

There are seven trailers on the farm and all except one have trailer braking. This trailer is used seasonally for drawing straw internally between fields and the farm yard. It is rarely used on the road. Martin feels brakes are not as important on a straw trailer as they are on a grain trailer as the load is a lot lighter. All of the trailers have lights and indicators. Last year a student working on the farm overturned a trailer on a roundabout due to lack of experience. *'He was just too flippant and even though Dad had got up with him that morning at seven o'clock and told him take it easy, don't rush and respect the weight of the load pushing him he just came to a roundabout fast and couldn't take the bend and just turned over. Nobody was injured fortunately but you know, you be thinking farming is not even worth that amount of hassle, you know'.*

The loader was also parked in the yard and was awaiting repair. The bucket on the loader would not stay back and drooped forward quite quickly when used. The loader is used for moving grain and also for accessing heights on the farm. They do not use a safety frame when lifting someone up to heights; they rely on the handle at the back of the grain bucket for support. When working at a height on the farm, helmets are not worn and there are none present on the farm, *'Well, if you fall, you're head won't be the only thing that'll you will hurt. Now ok you're head could be kind of smashed but the amount of time we're up on heights or lifted up on something is rare'*. He explains that they see themselves as half way towards having the need for safety helmets as their loader only reaches seven metres, *'but you're half way to getting to a point where you should wear a safety helmet, even though you don't need one, only five days of the year maybe'.*

There are two combine harvesters on the farm, one of which is quite new and is kept in the main farm yard, they other is older and is kept on an out farm. Although driving the combine harvester on the road is a major safety concern, Martin finds it is quite easy to drive when you are used to it. All of the lights and indicators are working on both machines; there is a small well at the side of the driver door on the main combine to allow for a grain sample to be taken safely. When accessing the well there are no moving parts exposed however, it is quite warm. The new combine has cab filters, which Martin relies on, *'if you have any problem with the air conditioning you would probably open the door and run'*. He describes how his father has a persistent cough, which he feels could not really be described as a health problem. This cough is attributed to dust exposure from working in a combine harvester over many years.

In order to clear blockages from the header of the combine everything is switched off and it is manually cleared. When somebody enters the main body of the machine to clear a blockage they put the keys into their pocket. In this way they can work inside the machine knowing that there is no possibility that the machine could be started.

Although there are no children present on the farm, experience from others has taught Martin that a farm is not an appropriate environment for children. In the locality he sees children playing in farmyards when trailers are being reversed, for example. He feels that although having children on a tractor with the operator is better than having them running around the yard, tractors with seats for children are not the answer. He highlighted the case of his uncle who got his hand caught in the slurry tanker while trying to free a blockage after his young son accidentally engaged the sluice lever in the cab.

Dust masks hang in all the grain storage sheds, however, it is up to each employee if they chose to wear them. According to Martin half of the time you would not need a mask as you would perhaps only be brushing loose grain for ten minutes at a time which would not generate a lot of dust.

There are two grain dryers on the farm, one stationary dryer in the yard opposite the main farmyard and a portable dryer which works from the main yard or an out yard. The dryer is not manned all the time, however, it is checked every twenty minutes by somebody. As fire is the primary hazard associated with the dryer there are extinguishers positioned in the yard. In twenty years of drying there has never been a fire on the farm. Generally the dryer would start at 6.00 a.m. and finish at 12.00 at night; it rarely works through the night. When checking the dryer close attention is paid to the bearings to ensure that there is no wear and also the main bearing to ensure it is not dropping grease, which can be a fire hazard. The grain dryer produces a lot of noise in the yard, the researcher found that in order to continue the conversation it was necessary to shout. Ear muffs are not worn while working with the grain dryer and

Martin does not consider the machine noisy; however, he says it does get noisy towards the end of the day. He feels that ear protection disconnects you from your environment *'somebody could come in behind you with a load of grain and you wouldn't know they were there and you could just walk out almost toward them'*. Often if a machine is starting to give problems you will hear the problem, such as slipping belts before you will see it; wearing ear protection would eliminate even the noises which the operator should be listening for.

A new grain shed was constructed beside the stationary grain dryer this year. The shed will provide storage for both wet grain and dried grain. This cuts out a lot of the labour involved in the drying process, as the grain does not have to be hauled to the site. The contractors have yet to come back to fit the shed doors. It was hoped that this would have been done before the harvest due to the level of noise and dust present in the environment resulting from drying, *'But, the contractors that are coming, we asked them to come sooner when we weren't drying. We told them we would be working now and there would be a noise factor and a dust factor. So from that point of view, they've come too late'*.

There are several straw storage sheds on the farm. As the sheds are being filled rat poison is put down to avoid problems later on in the year, *'Obviously from a health and safety point of view, well from a health point of view, the rat poison is, we see it as being very important anyway'*. There is generally never a problem with rats on the farm with the exception of sheds that have been rented where sufficient control measures were not in place. This is seen as a priority for straw storage on the farm because of the disease hazard.

In general terms Martin finds the Personal Protective Equipment recommended for farm use practical, *'the main ones I would see as being very useful are obviously ear goggles, welding masks, overalls, you know working with chainsaws, the proper equipment and even the chainsaw. You know even the safety helmet for working on heights is very simple and not in your way'*.

There are five tractors on the farm, three of which are less than seven years old, one is eleven years old and one is twenty years old. All tractors are maintained in very good condition with lights and indicators working. The twenty-year-old tractor is used for hauling, turning and drawing straw, 'It *has its place here still, just about!' 'If you didn't have it you'd really miss it. It the cheapest tractor on the farm so why sell it*'. Passengers are seldom carried on tractors and students working on the farm are not allowed to carry passengers.

5.4.2 High Risk Category: Case Study 2

Sean farms 240 acres in Co. Wexford along with his two sons. He has been farming fulltime since 1970. He has no formal agricultural training and has not taken any agricultural courses. The farm is not in the Rural Environmental Protection Scheme. He is engaged in dairying and cattle farming and also has some tillage. There are 140 dairy cows on the farm and approximately 100 weanlings, 100 yearlings and 100 one to two year olds and one stock bull.

The farm is situated on a very quiet side road. The main farmyard is adjacent to the family dwelling house although it is separated by a wall. There are both separate farm and house entrances. There is also another yard approximately a mile away from the house. There are no young children living on the farm, however, a three-year-old grandson often visits and likes to go to the farmyard. Sean prefers to see children in the yard up on a tractor where they can be seen rather than on the ground. The workload on the farm is quite variable but in general Sean feels he has a steady workload. The weather influences the workload as they try to capitalise on the good weather. Due to the seasonal nature of the farm, activities are roughly planned for when the opportunity presents, *'The job comes up, you know the job is there and the day suits you and you just go and do it then. Unless something is broken that has to be fixed'*. In general, maintenance of machinery is done as soon as a problem is encountered and seasonal machinery would be serviced before it is used. However, he highlights that in general machinery breaks down when you are using it, therefore maintenance cannot always be scheduled.

Both Sean and his wife feel that safety is a big consideration on their farm. According to his wife, 'Y*ou would be trying to have things as good as possible. It wouldn't be perfect all the time'*. Sean feels that although he is conscious of safety he would not go out in fear of things on the farm *'I wouldn't be stopped from doing something just in case something might happen, you know'*. They would not consider that farming is a dangerous occupation and asked would I feel afraid to go out in my car as more people get killed in cars than on farms. Sean feels that most farm accidents are preventable, however, he feels that '*Accidents happen and they happen so quickly, that's why they are accidents*'. Sean describes himself as not stressed. He feels that stress is caused by problems and that a problem by its nature is only something that you cannot solve.

Having had a serious accident with a chainsaw, he feels that a lot of accidents are the result of taking short cuts. In relation to his own accident, he feels that although the chainsaw may not have been perfect the accident was a direct result of his behaviour, *'If the health and safety had come in they would have faulted the chainsaw. But the chainsaw had nothing at all to do with it. What happened to me was what I did and it wouldn't make any difference if you had twenty of the best chainsaws in the world. It wouldn't make one bit of difference, when you don't do it right'*.

The farm buildings are a combination of the original stone buildings and new structures. The main farmyard was comprised of an open slurry tank, silage and maize silage pit and sheds at the lower end, machinery storage at the upper end and the dairy facilities and cattle crush situated in between. The yard was reasonably tidy, however, in the upper yard there were some tyres standing against the wall while there was a tyre stack in the lower yard. There was also some machinery stored in the upper yard and some empty barrels and oil drums along side the diesel tank.

There is a steep slope from the lower yard into the silage and maize pits, although they experience very little frost this has been hazardous in the past and resulted in Sean slipping and breaking his hip. An overhead electricity cable crosses the yard where the silage is brought in, however, it is not a concern on the farm as they feel it is a covered wire and the machinery are not high enough to contact it. Generally contractors and lorry drivers coming onto the farm are very conscious of overhead wires. This year the contractor involved in harvesting the corn was concerned with an overhead wire in a field, which was within two inches of his new combine. Sean is hesitant to bury the overhead electricity cables on the farm as they are not definitely marked and they might be safer where they are, where people can actually see them.

It is often necessary to access the shed roofs on the farm to carry out maintenance work. Generally heights are accessed using a ladder at the lowest end of the roof; however, a helmet is never worn. Sean is very conscious of Perspex sheeting on shed roofs, often, hired painters spray the entire roof including the Perspex. He feels that there should be a safety net or grate below them as you can very simply step back onto them while working on a roof, '*In my opinion, you'd be up there doing something, washing a shed or painting. Sure it's just one step back when you are doing something; there should be a mesh on them'*. Sean recalls three accidents with Perspex sheeting; two of them were local men who are now in wheelchairs. Although he finds roofs quite slippery he does not use a roof ladder. He would be very conscious while up on a roof and as he has gotten older he has become wary about very high roofs.

The cow shed divides the upper and lower yards and it is opposite the milking parlour. All the dairy cows and bullocks are over wintered in the shed. Automatic scrapers clean the shed and there is a slurry storage tank below the shed. Generally the cubicle cleaning and maintenance is done during milking time when there are fewer animals to work around. Sean estimates that there is approximately one hour of work in the cattle shed each day. Feeding in the shed is done with a diet feeder. The shed has good lighting and the electrical fittings were all waterproof. Cows and calves are kept in a shed in the lower yard before and after calving. There is a restraining gate in the shed for calving cows.

There is an open slurry tank at the bottom of the farmyard which has a high concrete wall to the front of the tank. This gives the impression the tank is very well secured. However, on closer inspection it is clear that construction of the walls has not been finished. One of the sidewalls has a large access point which is blocked of with unsecured gates while the other side is quite exposed with only barbed wire across the access. '*It's not perfect now, we have work to do on it, it was never really finished off. Actually a cow went into it on us last year*'. The cow accessed the tank at a point where the wire was knocked down and had not been repaired. The tank is about five feet deep and Sean recognises that with young children present on the farm the current safety structures are inadequate. '*It needs to be a bit more secure, we have never really thought what exactly we should do but there is some kind of security rail needed on it'*. Although Sean would prefer to have an underground ground tank he is restricted by the existing farm infrastructure. '*It's good enough, I'd sooner have it under the house to be honest about it, because you have less rain water in the tank but* *that's the way it is. It's amazing this was a green field when we started here. It's amazing how you get things so wrong. Things have changed. We have put down as much concrete as our father's had before us*'.

Generally the cattle are removed from the cubicle shed when Sean is agitating slurry. However, on very windy days they may be left in and the doors all opened, as it involves great difficulty to let the entire stock out for a day. Sean feels that people are not as conscious of removing stock while agitating slurry as they used to be. He recalls people who have killed stock and incidents where farmers were killed, '*And people have killed stock and people themselves have got killed. You know your man Tierney up there in Galway, Noel Tierney, he was the one that I remember, his son got killed and he just barely got ou*t'. There are outdoor manhole access points for emptying the slurry tank, which has a safety grate below. In the past a contractor that agitated the slurry had a poor safety record; he often wore loose clothing and stood over an unguarded PTO shaft. Sean was always conscious to be present and tried to keep him away from the PTO shaft. Generally when the tank is being emptied the safety grate will be replaced when unattended.

The milking parlour was built in the early seventies and has been remodified several times since. Most recently, two years ago the floor of the pit was raised to allow for comfort while milking and protective bars were erected between the operator and the cow. There is safe access into the pit through well-sloped steps. Although there is a lot more that could be done with the parlour, the costs of remodification are high. Already in recent years automatic cluster removers and new feeders were installed at a cost of €14,000. Sean finds the parlour comfortable to work in. Generally two people are working in the yard during milking time; therefore if help is required in the parlour there is someone nearby. The dairy is well organised and tidy. All chemicals are stored in a steel cupboard which is generally kept closed but not locked; Sean admits it probably should be. Although gloves are generally worn while milking, Sean admits that he may be careless with chemicals, '*Maybe I'd be careless with chemicals but I've never got caught with them you know*'. Both motors in the dairy were well guarded and the PTO shaft driving the milking machine was also properly guarded.

There are four tractors on the farm that are dated 2004, 2000, 1997 and one that is over twenty-five years old, which does not have a cab or roll over protective structure. The old tractor is not maintained in road worthy condition; however, it does travel on the road a few times a year to an out yard. The tractor is kept for scraping the yard and is seen as a vital piece of machinery. The remaining three tractors are all maintained in good working order and all lights and indicators are working. The basic servicing of the tractors and machinery is carried out on the farm.

Sean is acutely conscious of the dangers associated with poorly guarded PTO shafts after the death of a young neighbour. He feels that guards should definitely be in place on machines where the operator is working around the PTO shaft. However, the PTO shaft on the slurry spreader is broken and has not yet been fixed; yet it continues to be used. The PTO shafts on most other machines are well guarded. He feels that this is not as important on machines such as the harrow, where the guard is broken, as you should not be working at the PTO when the machine is operating. Sean agrees that guards should be compulsory however, the quality of the guards is not consistent and they are often too expensive '*There's one very good guard. They should be compulsory but they should be sold at a proper price you know, they definitely should be compulsory. The lads that are selling them shouldn't be allowed to clean up on them*'. If a problem arose with a machine while operating, whether the PTO would be taken out of gear before alighting from the tractor would depend on what needed to be done.

A major safety concern on the farm is cleaning out the diet feeder, which requires that somebody enter the machine and physically clean it out. Although care is required to avoid contact with blades while inside the feeder, the main concern is that somebody else would start the tractor. There is no safety practice in place on the farm to avoid the machine being started during cleaning; they rely on the fact that the others will be aware the machine is being cleaned.

The hedge cutter also has an uncovered PTO shaft; however, there is one safety guard for the back window of the tractor to protect against flying objects. The fertiliser spreader has a well guarded PTO shaft. The spreader takes half tonne bags and the front loader is used to empty bags into the spreader. In addition there is a shear grab and a loader, which are both rested at ground level when not in use.

Sean's son does most of the spraying on the farm. Chemicals are generally bought as they are needed and stored in a locked shed behind the dwelling house. There is no clean water tank on the sprayer. His son has not done a spraying course, however, he always wears a mask and has gloves in the cab of the tractor, '*he would have a mask with him, other than that he wouldn't have any special clothes you know*'. He feels that the recommended coveralls are not necessary, '*what would fall on your clothes is not going to change nothing in my opinion*'. While respecting that coveralls are recommended he says '*but clothes wise, that is the recommended clothes and you're supposed to have them and they say you know, well, some of that research is done very well and more of it is done to sell clothes!*' However, he does see contract sprayers wearing protective clothing and can identify one neighbour who has been very ill as a result of exposure to chemical sprays. Spraying conditions are very important on the farm, spraying is rarely carried out in windy conditions and if it is Sean can generally feel the effects. Of all the precautions he could take while spraying, wind conditions definitely have to be correct. All chemical containers are washed out and sent to the dump, however Sean feels that these and oil drums could be reused by manufacturers and distributors. Waste disposal is a major issue, which is often not addressed allowing 'litter' to build up in the yard.

Generally there are two stock bulls on the farm; however, there was only one at the time of the researchers visit. There is no bull pen on the farm and the bull is housed in the cattle shed. The bull is ringed but does not have a chain and there is no bull pole on the farm. The bull is generally moved along with the dairy herd and in that sense is easy to manage. Typically only one person and the dogs move the herd. Sean is always conscious that a bull is a bull and you have to maintain distance, '*you always have to remember that. That doesn't necessarily save you either you know. But you do, that lad here is very quiet but we've had lads now that weren't quiet. But they're the best lads, for performance*'. The cattle crush is positioned outside the dairy for easy handling of the herd. There are other cattle grazed on the out farm which also has a cattle crush. Sean and his wife use a temporary fence to round up cattle when there is no help. They use wire attached to reels to gather the animals and this has proved very effective both in fields and while moving animals on roads.

5.4.3 High Risk Category: Case Study 3

David farms 300 acres in Cork. He is engaged in mixed farming with dairying, beef production, sheep and tillage. He has been farming full-time for twenty years and went to agricultural college in Pallaskenry. There is one full time employee working on the farm and David's wife also works on the farm. They do not participate in the Rural Environmental Protection Scheme. There are two children present on the farm aged thirteen and fourteen. The farm is situated on a busy road; there are separate entrances to the farmyard and the house. However, the back yard of the house runs into the farmyard. The farmyard is large and spacious and is kept very tidy (Photo 5.3).

The workload on the farm is steady all year, however, as David takes a lot of time off he feels that this contributes to periods of greater pressure, *'I have a steady workload I suppose all the year round, but I would possibly have different periods where I would be under pressure alright. I do take a lot of time out from the farm so that probably contributes to some of the workloads and pressures'*.

On a day-to-day basis however, he finds they are not in a rush on the farm. This may be due to having an additional full time employee; nevertheless, he feels one person could not work the farm alone. Although he does not have a written plan, David feels that they are always working to a plan. David and his neighbours co-operate together informally on a number of tasks to ease the labour pressure on their respective farms. David describes himself as *'not a stressed person'*. Although he often works 17 or 18 hour days when required, he relaxes and takes time off when he can. He considers himself good to plan and as a result he feels he can deal with unforeseen circumstances.

**Photo 5.3:	View across the yard to the dairy and old cattle crush**

This is the view from the farm entrance into the farm yard; beyond the pillar in the left foreground the farmyard meets the back yard of the house. The yard is large and spacious and has a good system of gates for moving the cows to and from the milking parlour. Apart from the material stored at the wall in front of the parlour, the yard is tidy.

For David, safety is always an important element of his work and he would consider safety most of the time, *'I suppose we probably do take chances but at the same time we'd always be conscious of safety'*. David sees safety at work as being able to work in an environment where accidents don't occur; he does not believe farming is inherently dangerous. At times it does strike him that he could be injured on his farm, *'I mean there's always the times that it would strike you, but it's no more dangerous I think than any other profession, There's dangers everywhere you go'*. He feels that all accidents are preventable if you abide by the letter of the law. Farmers are now working too hard or too many hours under too much pressure, *'I suppose at the end of the day farming has got so much more technical now over the years, like every job has to be done today not tomorrow or the day after. People seem to be working a lot faster; the speed of operations now compared to twenty years ago is a lot faster. That probably causes a lot of accidents'*. David agrees that these changes in agricultural work have an effect on older people and children on the farm, *'I suppose I would have* *seen it probably when the children were very small, that was probably the one time safety would be focused in your mind. You know the odd time there was a few close shaves I suppose and from that point of view I suppose we copped ourselves on a small bit at times'.*

David feels that the consequences of not working safely have an impact on your future behaviour. Every year they are working more safely on the farm, *'Now maybe there are probably still 1001 things outside that could be a lot better but at the same time there would have been a lot of issues that we would have dealt with over the past 10 or 15 years that would have made the place a safer environment'.* He feels it is important to look at safety on the farm and make changes where necessary. He has responded to near misses that occurred on the farm, *'Like I can remember nearly having a close accident years ago and that I think was one of the things too. I was making up pens for sheep with gates, and the young lad was down in the shed with me and he just put his hand on a gate and it toppled over back on top of him. So that sort of focuses the mind pretty quick then and ever since if ever there is a gate loose thrown against a wall, something would be put on it or it would be tied'.* He feels they are probably lucky they have not had any accidents as most farms have had accidents at some stage.

Safety is a big consideration when contractors are working on the farm, '*We would be putting signs up on the road all the time before a contractor would come in. We would basically watch, we'd make sure there would be nobody around the yard'.* At this stage the children are present in the yard while contractors are working; however, this was not permitted when they were younger. Rather than have them in danger in the yard, they would generally be put up on a tractor.

David feels it is important that his children can be a part of the farm and being at home on the farm all the time the children are safety conscious. *'Too many kids haven't got those opportunities any more. In the unfortunate way as farming got more intensive people got too busy and they didn't have time to have children around, farmers wives were out working and the children weren't out on the farm as much and I suppose we're luckier than most we have a man here as well who is good with the children that at least we could all keep and eye to them'.* Owing to the fact that the farm is adjacent to the family home, David feels the children cannot be kept away from it. Being out in the farmyard gives them the opportunity to spend more time with their father. As small children, they were out in the yard as much as possible; yet never working with cattle. Davids wife said they were always well supervised and often tied into the tractor with their father while he was working. They always felt safer with them in the tractor rather than in the yard where tractors were operating.

The children are at a disadvantage in that they never have birthday parties or visiting friends as David feels the environment is too dangerous for visiting children. Had children's parties taken place he feels all activity on the farm would had to have ceased for a day. His wife adds that when you mix children problems often arise where one child engages in a risky activity to show off to the others.

Growing up on the farm the children have learned a lot about it and they enjoy farming and he would not change their involvement, *'I don't think I would have, I would change it. I suppose it's easy to say that when we didn't have any accident, things ran smoothly but at the same time I think it's nice for the children to be involved'*. At this stage the children are quite involved in the farm and work there every Saturday. David felt this year that both children were competent to drive tractors under supervision and they were involved in drawing bales during the summer. The children look after all the sheep on the farm and during springtime they feed all the calves. They are generally involved in moving cattle and sheep. David talks to his children about safety on the farm, especially in relation to cattle.

The milking parlour was built over twenty years ago and has been developed to a small extent over the years. David considers his parlour to be 'fairly safe' to operate. Within the parlour and dairy and indeed throughout the farmyard industrial type electrical installations are in place. The wiring in the milking parlour was upgraded a few times since the parlour was built and all installations are totally wash proof. The milking machine is housed separately and the belt on the motor is guarded. The pit is a comfortable size and was made extra deep to accommodate for David's height, *'I decided I wasn't going to be bending too much'*. However in doing so it has proved a discomfort for David's wife who is much shorter than David. The effect is not severe as David milks approximately 80% of the time.

A new machinery shed was built six years ago to house all the machinery on the farm. The workshop is located to the front of the machinery shed. The workshop was very tidy and highly organised, however, according to David it is usually tidier, *'Well at the moment it's not tidy now, I'd prefer if it was a lot tidier. But it's just you know, October seems to be the time of the year when you tidy everything up. And during the summer months, things get out of place a bit'*. The machinery shed has been important to the farm since it was constructed, '*it is a machinery shed and it's a store probably for some, a lot of bits and pieces. But, it is locked most of the time and I would be very good to lock it. But it has been an important factor in the place over the last few years, but it's the first thing that you would see that everything is tidy here so that you can get at it when you want it'*. Equipment is always plugged out after use in the shed and stored away in its correct place. In that way nobody will get caught up in or trip over loose leads or equipment.

Photo 5.4: Machinery shed and cattle shed with cattle crush to the left

Cattle handling on the farm is made simple by the system of gates in the background which run between the cattle shed and the cattle crush which then runs into the holding yard from the milking parlour.

There are two tractors and an industrial loader on the farm. One of the tractors is reasonably new while the other is twenty years old. Both tractors are used on the road and lights and indicators are working on both. David sometimes carries passengers on the tractor. Mostly they would be in the cab however occasionally there may be passengers on the trailer. He would never carry a passenger on the drawbar; he describes this practice as *'lethal'*. David finds that as the modern tractor has a closed cab, this generally occurs on older tractors *'Handy tractors, you see the modern tractor you can't put a person up on the drawbar because they cab is closed in so they won't do it. But I mean any of the older tractors like you've an open cab and they're half in and half out of the cab. That's how they are on the drawbar'*.

There are three trailers present on the farm. A cattle box which is pulled by a jeep which has lights and trailer braking, a bale trailer and a small trailer which both have lights but not brakes. David often borrows trailers from a contractor, which would have lights and brakes.

David is very conscious about keeping PTO shafts guarded, although he feels it is important, it is a bigger issue for his employee, *'probably a bigger one for the man working with me. He would be very conscious about things like that. It would always have to be right or he wouldn't work on them, that's the way it is'*. He admits that there are times that a chain might break on a PTO shaft and it would be tied with wire until there was time to repair it. All of the PTO shafts on the farm are guarded.

The industrial loader is used for handling half tonne bags of fertiliser on the farm. Throughout the year there are often small bags of fertiliser used however they would be loaded onto a height and filled into the spreader, *'we wouldn't lift a bag of the ground at this stage'*.

David and his employee carry out the crop spraying on the farm. They are quite conscious when handling sprays and always wear a mask while mixing sprays. One of the tractors has a sealed cab and if using it for spraying a mask is not necessary however a mask is always worn if using the 20-year-old tractor. If a blockage is encountered in a nossel, they usually come back to the yard to clear it as there is no clean water on the sprayer. David never uses gloves while cleaning out the nossels as he finds them too cumbersome. The chemical store on the farm is always locked.

There is one animal shed on the farm which was constructed in three sections. The first part was built in 1973 and was added to in 1989 and then again two years ago. Two pens were erected in the shed this year for bulls and appeared very strong, *'All pens and gates that we would be making for the last few years would be a lot stronger now than they would have been'*. In addition, all openings in the slats have been changed to manhole slats in the last five years, there were previously twin slats covering the openings. All of the doors have been changed to sliding doors. One section of the shed is for the dairy herd while the cattle are housed in the other. Silage is fed in the shed using a shear grab.

The cattle crush is situated in the middle of the yard between the cattle shed and the milking parlour. There is also another cattle crush on an out farm. When moving cattle there is always more than two people present, unless when moving from one field to another. However, when moving cattle on the public road there is always a minimum of four present. David tries to minimise the amount of movement of cattle between the yard and the fields as the farm is fragmented. However, he does not try to do too much with the cattle when he gets them in to the yard as he feels this is not best practice and generally results in you rushing. *'Anything with animals, I'd be doing basically what they require rather than what I require'*. When dosing animals, he generally has a 'pour on' to hand in case an animal gets excited or awkward, which eliminates the need to restrain and further stress the animal and thus reduces the risk of injury.

All slurry storage on the farm is underground; there are no open pits. There is *'a sort of a dung stead'* behind the silage pit but there is no slurry in it. David spreads some of the slurry; while, a contractor spreads the majority. The manholes are replaced on the tank when agitating is complete and while spreading slurry it is only necessary to open an eight-inch section, which again is closed as soon as spreading is complete. The animals are always out of the shed while the slurry is being agitated irrespective of how windy the day is. There is a separate tank for silage effluent, which David perceives as the worst pollutant of all and is generally dirty around the yard.

David would get up on the shed roofs occasionally and generally uses the loader to access heights, '*If I do go up it's on the loader, it is safer than a roof ladde*r'. He is very conscious of the Perspex sheeting and has one shed with an asbestos roof, which he would never get onto. When building the shed with the asbestos roof, he said he was forced to use asbestos to qualify for grant aid and ten years later the department would not allow asbestos as a roof material. David is conscious of the effect of changes in regulations on farmers, *'The other part of it is that we had no choice but to put them on….They change policy and they don't think of the consequences'*.

There is a loft on the old farm buildings adjacent to the dwelling house. The railing on the steps came off about 10 years ago and has not been replaced. The loft is accessed approximately five or six times a year and is used as a domestic storage facility. David agrees he should do something about the steps, '*Something should be done about it by right because it's definitely a danger'*.

A major issue on the farm is feeding cattle in the shed. David feels that a farmer can become so accustomed to driving in and reversing out of the shed that they may not look behind when reversing. '*You get so used to going in and out of the shed, that you won't look back. It's just something that people would need to be aware of because I mean familiarity, there's no doubt you won't keep turning around the whole time. Oh you'll give a quick glance in the mirror or you might give a quick look around. But sure by the time you get out of the shed there might be someone else coming in around the corner of the door'*. He feels this is an issue on most farms that keep animals.

David feels that a lot of commercial farmers are more safety conscious than part time or smaller scale farmers. Commercial farmers want to make things easier for themselves, '*You know you go to a lot of the bigger farms and the yards are well set up, there's good space in them and things are in such as fashion as they are easily managed'*. He feels that bigger farms are more conscious of doing things correctly *'And if you're going to do it right then safety will always come into it. And I suppose a lot of busy farmers would be conscious of that as well'*. He feels there are easier ways of doing things and generally if people stopped and thought about things they would realise this. Although money is a factor that affects a lot of farmers David feels that safety is worth investing in. *'I suppose one big example would be lights now* *around the place. In springtime when I'm calving cows and sheep and that I would leave the lights on, well the main light up on the house there, would shine, would light half the farmyard. Basically when it's dark I can do anything around the yard, without a flashlight or anything'*.

Given the size and level of activity on the farm, there is not a lot of machinery; the majority of machinery work is done by contractors. All of the major activities such as silage, slurry spreading, harvesting and bailing are done by contractors.

5.4.4 Medium Risk Category: Case Study 4

John is a dairy and beef farmer in Co. Louth. He farms 85 acres and is full-time employed on the farm, his son works with him part-time. He has 40 dairy cows and roughly 40 0-1 year olds and 40 1-2 year olds. He has been farming for 45 years and in that time he has not taken any agricultural courses. James is not in the REP scheme.

The farm is situated on a quiet road about 250 metres away from the family home. The farmyard is a mixture of old and new farm buildings. There are no small children present on the farm and although his grandchildren visit, they would not be on the farm. John tries to keep his farm as safe as possible but admits that is not always as safe as it could be. He feels that individual farmers should see what is needed to be done on their own farms and respond accordingly. He feels that familiarity with activities and the environment has possibly made him a little laxed with regard to safety. Accidents that have happened locally have made him conscious of certain activities on the farm. *'There was one instance about 10 years ago, a chap over the road got killed with a loader on a tractor. He had the loader raised up at full height and a shear grab on it. And he went to do something, to put water into the radiator of the tractor. He went between the tractor and the loader and a pipe burst and it came down and killed him instantly. Busted him. So like I'd be always, if you came in or somebody came into the farm and went to do that put diesel into the tractor and attempted to go inside the loader I'd be always aware. I will always be aware of that for the rest of my life. It's such a thing that can happen'.*

John feels that farming can be hazardous but no more so than other occupations. He feels certain situations are extremely dangerous such as children present in the farmyard during silage making or slurry spreading. James feels that all accidents are preventable and more care could often be taken on farms, which isn't always taken.

John is not involved in any type of farm planning or planning of activities. *'Well there's not much planning; it's only a matter of keeping grass in front of cows in the summer, spring and summer time and during wintertime it's keep the silage in front of them. Yeh, no there's not, I couldn't put a plan on it as such now'.* He does not find it necessary to think ahead about safety at peak periods of activity such as silage making or slurry spreading.

In terms of stress John describes himself as a bit stressed when he wants something done, he would not be laid back. With regard to workload he feels he is not rushed, *'Once I get the milking done morning and evening now, I wouldn't be rushed, unless I was rushing at silage. That would be it, or say spreading slurry, if I want to get a field finished or a tank emptied, coming onto evening I'd be rushing here, rushing there'*. However in his average day he is not rushed.

The dairy and milking parlour are situated to the front of the yard in the original farm buildings. All of the electrical installations on the farm are wired to standard and industrial fittings are used. The milking parlour is an old tie stall parlour, in which four cows can be milked at a time. The cows enter the parlour and step into raised stalls. The operator works at the yard level and there is no physical structure separating the operator and the cow. John finds the parlour comfortable to work in. A new cubicle house was built ten years ago and for grant purposes the entire farmyard was rewired. The motor in the dairy is well guarded. The dairy is always locked at night. All veterinary medicines are stored either in the dairy or in a locked shed adjacent to the dairy, which also acts as a workshop. However there is no specific locked cabinet for them. The workshop was found to be very untidy and appeared to have no level of organisation, for example power tools were left lying around on the floor. It is generally only tidied once a year. John admits the shed workshop should be tidier; however he has not got around to doing it.

The cattle crush, although very well positioned in the yard, is old and does not appear strong, however John feels it is sufficient *'Now like the gates mightn't be the best but nothing gets through them anyway'*. There is a system of gates in the yard, which allows one person to manage cattle in the yard with ease. The yard itself was found to be somewhat untidy with tyres, broken implements and other materials standing against walls. A derelict dwelling house is situated inside the main entrance of the yard (photo 5).

Two main lights, light up the entire farmyard, however, there are also lights on each shed. John never has reason to access heights on the farm and does not carry out any maintenance work on shed roofs. There are two electrical wires running through the farm yard, one which brings electricity between sheds and one which brings electricity from the old dwelling house to a water pump. John feels that these are not a hazard as his own tractor and slurry tanker is the only machinery which passes under the wires. All silage machinery uses a back entrance into the yard.

Photo 5.5: Cattle crush and yard in front of dairy

This image shows the cattle crush in the foreground with the collection yard for the milking parlour in the background. The crush and gates are all quite old and show signs of damage. The crush has no skulling gate which is used for safely restraining animals. In addition, the yard is quite dirty and untidy. The milking parlour is in an old farm building and animals pass in and out through quite small doorways.

The cubicle house is situated behind the milking parlour and it has an outdoor slatted tank, which also gathers the effluent from the silage pit. Automatic scrapers clean out the shed onto the slats. There are two additional calf sheds which both have underground slurry storage. When agitating the slurry the cattle are all taken out of the shed and the doors are opened. Initially when John built the slatted tank he agitated the slurry with the cows in the sheds as he heard many other farmers did this. However, as a result of one of the dairy cows dying in the shed while the slurry was being agitated, he now empties the cattle from shed.

There is one tractor on the farm, a loader, a fertiliser spreader, a slurry tanker, a slurry agitator, a muck spreader and a topper. Not all PTO shafts were intact on machinery. John does not replace or fix PTO shafts when they get broken and they can often be left broken for long periods of time. On machinery which is operated from the back of the tractor, such as the slurry spreader, John would be conscious to have the PTO guarded if it was being used by somebody outside of the farm. However, if John or his son were using it, it would not be a major issue if the guard was broken.

A local mechanic does the service work on the tractor. The lights are in proper working order on the tractor, however there are no indicators and the U-Guard is also missing on the back of the tractor. John does not carry additional passengers on the tractor, except for his son. *'No, no, except for him like if we're going from some of the fields down, I'd sit on the drivers seat and he'd stand up behind me. But, no passengers, no'*. When John carries his son along with him on the tractor he stands on the drawbars outside of the cab.

A contractor is used to spread the fertiliser on the silage fields. John and his son spread the remainder of the fertiliser. They use the small bags of fertiliser and store them on the trailer until they are required. This allows for ease for handling as the bags can be poured into the spreader from the trailer.

There are two isolation sheds, which are used for calving cows or separating a sick animal. One is situated at the end of the dairy cow cubicle house for calving while the other is beside the calf sheds. Both isolation sheds have water, good lighting and hooks for tying up animals. John finds this essential for caesarean births. During calving season it is necessary to come down to the farmyard and check the cows several times during the night. Generally there are few calving problems on the farm and John tries to avoid using the vet for calving procedures due to expense. He generally uses the calving jack for calving cows, *'No, I think it's the safest way for the man and, for the person working with the cow and it's easier, I think it's actually easier for the cow, if you work it right. Like you can use a calving jack but you can damage the cow too but if you use it properly, there'll be no problem'*.

The silage is cut and drawn by a contractor. The silage pit is built in a shed and the effluent drains into a slatted tank. The pit walls are 9ft high, there are no sighting rails on the exposed walls. Generally there is no reason to go up onto the pit, *'I wouldn't have to go up on the pit. You wouldn't have to go up on the pit but sure you will go up, you know but there's no work really on the pit. In the shed yeh, you might just have to keep the edges of it when it gets up over the wall. The walls are about 9ft high and when it gets over them just to keep it tidied back and in'*.

5.4.5 Medium risk Category: Case Study 5

Michael and Joan farm 150 acres in County Galway. They are engaged in sheep and suckler farming. There are 100 ewes on the farm and they have a suckler quota of 26, although they generally keep a little over this. There is also one stock bull on the farm. Both Michael and Joan are full-time employed on the farm. Michael has been farming full-time for almost forty years and along with Joan has taken several Teagasc courses. They are involved in the Rural Environmental Protection Scheme. The farm is situated on a very busy road, which services both a local a co-op and a mine.

Michael and Joan feel that safety would be the most important part of their work. Joan has previously worked in a garage where safety was an important consideration; she feels this was a good learning experience. In addition her own father was very safety conscious and she feels that also influenced her behaviour *'And I mean Dad would have been, he had to have been very safety conscious over machinery, so I would have learned that very, very early. Yeh so I suppose you inherit it'.*

Michael and Joan have three daughters, the youngest of which is eleven. Safety was always a concern on the farm when the children were small, the yard is enclosed and the children were only permitted supervised access to the farm. Joan feels that young girls do not have the same interest in machinery and farming as young boys and are therefore easier to supervise on a farm. She is also acutely conscious of the risks associated with elderly people living and working on the farm as Michaels father who had Alzheimer's lived with them. Michael and Joan feel that a lot of farm accidents are preventable; however, they feel certain animal related accidents are not preventable due to the unpredictability of animal behaviour. Although they are very conscious of safety on the farm, Michael and Joan do not believe farming is inherently dangerous, they see it as a healthy occupation and if you are sensible about it, it will not be dangerous.

Michael and Joan do not prepare a written plan for farm activities; however, they feel that they are always planning ahead and organising activities. ' *you would plan, I mean you would do more planning for some months than you would for others but I'd say there isn't a month that you wouldn't have to plan. Some kind of plan, you'd have* *to. And like I mean, to a certain extent you have work to do anyway, you certainly have to plan'*. In advance of silage making signs are always erected on the road to warn motorists of crossing machinery.

Michael and Joan have a fairly steady workload; although they are busy, they do not feel they are rushed on a day-to-day basis. Springtime is the busiest time on the farm due to lambing and calving, *'I mean if you had problems with lambs now you know and say cows calving at the same time. We try to change it but a couple of years now we got caught with things happening; you know two lots of things. But it's tough enough going'*. In terms of stress they would not describe themselves as generally stressed, according to Michael *'We're stress free you could safely say!'* Joan feels that sometimes juggling the household and the farm can often be pressurised while Michael feels financial worries can be stressful. Although they are somewhat anxious about the changes that may be brought about by the Single Farm Payment, Joan feels *'It's more wondering than worry at this stage because we'll have to wait and see'*. Although they are clearly subjected to some level of stress, Joan does not feel they are subjected to stress like others *'But I mean real stress as in, not like some people'*.

There are gates separating the farmyard and the house and there are also separate entrances to both. The original stone farm buildings are situated in a yard directly behind the dwelling house, while the new farm buildings are situated behind these. The original stone sheds, which once housed animals, are now all used for storage. With the exception of an open garage, all the sheds have bolted doors. The workshop, although quite tidy had a lot of implements and material stored at ground level. All sharp implements were stored at a height. Apart from the shed that houses the electric fence control unit, none of the old buildings have electricity installed. Although the loft steps have a railing, they appear somewhat exposed and are very steep and slippy. The steps have also been a concern for Joan and when the children were small she blocked off the steps (photo 6).

Photo 5.6: Steps to the loft in the old yard

The original stone farm buildings are used for storage on the farm. These steps are very exposed and a pallet is used to guard the open drop at the top of the steps. The general untidiness of the steps adds to the hazard.

There are two tractors in use on the farm, one that is confined to the yard for scraping which does not have a roll over protective structure. The main tractor is in good working order and has both lights and indicators working. A mechanic carries out all of the service work on the tractors. Michael never carries passengers on the tractor, *'No, never, no. It's one thing I do not approve of.'* Joan feels it's too easy for something to go wrong and totally disagrees with young children being allowed on tractors.

Although there is very little machinery present on the farm, Michael is very conscious of having PTO shafts on the properly guarded. *'That's the first thing Teagasc would say to you now when you go in you know when you're doing any of these courses or anything. Have you your PTO's covered'.* Joan dreads PTO shafts and is very conscious of them *'they're deadly, they are deadly yokes and I absolutely dread them since the very first day, I was always conscious of them'.*

Contractors carry out both slurry spreading and silage making on the farm. The silage is harvested into big bales. Typically four tractors operate to draw bale silage to the farmyard and a one-way system is operated for safety and speed of operation. They are very conscious of other people working on the farm; Joan feels that to a certain extent they loose control of the operations when outside operators are involved. They find some young tractor drivers working for contractors drive very fast and according to Joan *'you can't talk to them'*.

The main farmyard was generally tidy, although in places quite overgrown with grass. The new farm buildings are constructed in a U shape with the cattle crush in the centre. The cattle crush though very well located in the yard is old and not strong, there was one horizontal bar missing. In recent years an additional gate was added primarily for calving cows. If a cow becomes agitated the side gate of the 'calving crush' is opened and cow can be confined in a holding yard (photo 6).

The slatted shed was built in front of the original cubicle house and there is free movement of the cows between both. There is also a passage into the cattle crush, which allows for effortless movement of cows between the yard and shed. Feeding takes place in the centre passage of the slatted shed. There is minimal contact with the animals and they are confined to the slatted shed during cleaning of the cubicle house. There are three cubicles adjacent to the sheep shed for separating cows and calves or ewes and lambs depending on the situation.

Photo 5.7: Cattle crush

The cattle crush is quite old and looks quite fragile. The restraining gate is old and appears quite weak. There is no catwalk in the yard which allows for ease of handling while also protecting the farmer's feet from injury. The crush appears poorly maintained

A mobile handling unit for sheep allows for safe and easy handling of sheep, *'Its stress free for them and for you'*. Since building the sheep shed, there is little difficulty handling the sheep. Both Michael and Joan agree that sheep are not difficult to handle. A redundant deep freeze in the sheep shed houses all the veterinary medicines. All electrical installations on the farm are in accordance with the required standards. Although there is an electricity cable crossing the farmyard, Michael and Joan feel it does not pose a hazard to machinery. Joan feels that all electricity cables should now be buried underground

Generally the bull is out wintered as Michael feels that housing or confining bulls makes them cross. Typically the bull remains with herd, however, if being separated from them; four or five people are required. Most of the farm has electric fences and Joan feels that this is a sufficient escape route in the event of a problem. They originally had a ring and a chain on the bull but these fell off and were not replaced. Michael finds the chain gets caught quite easily resulting in the bull injuring itself. There is a warning sign at the entrance to the field where the bull is kept, however, from experience Michael and Joan have found that the general public often ignore warning signs and access fields in which the bull is visibly present. Michael's neighbours assist him when moving or testing animals and he does the same for them.

There is no longer an open slurry storage pit on the farm, Joan stresses that although open slurry storage was not ideal it was the only option in the past. A contractor carries out slurry agitation and spreading during the summer when the shed is vacant. They are very conscious of having access points to slurry tanks covered at all times.

5.4.6 Medium Risk Category: Case Study 6

John and his brother farm 250 acres in Co. Westmeath. They are engaged in mixed enterprises and have 110 suckler cows, 250 ewes and 30 acres spring barley for use on the farm. They also grow 5 acres of potatoes for the local market. With the exception of grain harvesting they do all their own work and the farm is quite highly mechanised. Two seasonal workers are employed to harvest the potatoes, which are harvested by hand. John has been farming full-time for 17 years. He has completed the Certificate in Farming. The farm is in REPS. The farmyard is situated on a quiet road, close to the family dwelling house. There are never children present in the farmyard.

John feels that safety is a very important part of his job, '*Well I suppose you have to make it important every day you go out every day you get up. I mean you read about accidents and you think that will never happen to me. Its only when it happens to somebody you know or maybe you have a near miss yourself that you realise how vigilant you have to be and how important it is. Yeh it is very important'*. As a result John makes a conscious effort to incorporate safety into his daily activities. Safety is more important to John than when he started farming *'I suppose if you think back 17 or 16 years ago when I started farming it wasn't that important to me. But I've heard and seen so many accidents both locally and things that you read about that it is a big deal. It is extremely; I suppose it's vital. You have to take every precautionary step that you can'*. John feels that when a farmer he knows has an accident it sinks home that it could be him.

Although he feels a lot of accidents could be prevented through extra care and less rush, John feels this is not easy to do. He feels that due to the nature of farming farmers are always rushing. *'I mean now its kind of the world we're caught up in anyway, it's a bit of a rat race and farming is just as bad as any other occupation. People want more and more and we want our free time like everybody else, so we try to get through the day as fast as we can maybe to spend time with our girlfriends or wives or whatever in the evening. We don't want to be out all night or all evening so it is a bit of a rat race too to get through the day and to get through the work as fast* *as we can. I mean maybe you're working against the weather and there's rain coming in the evening time and you're trying to get you're job done'*.

John describes his workload as constant, *'there's something going on almost every month of the year'*. However because his brother is also full time employed on the farm they are never too severely pressurised and work would not be rushed. John feels stress definitely affects his work and describes himself as a 'worrier by nature'. *'I mean obviously when you are out and a machine breaks down or whatever and you're panicking to get it fixed up again before you can even get going, things like that do stress you out'*.

John works to a rough weekly plan, allowing for interruptions or changes in the schedule as he goes along. With cows calving and the weather constraint he has to be reasonably flexible. At times of peak activity on the farm such as silage making and slurry spreading safety is an issue, *'I wouldn't say it's in the back of your mind but it would be there all the time. And even more so in the past few years because we have been made more aware, even people like you have come around be it whoever, even simple things like doing a safety statement makes you look at things you've got to look out for'*. Although John tries to have his machinery maintained and organised for when it is needed, he feels things always happen that you can't anticipate.

John compiled a safety statement for the farm and found that the process drew his attention to different things on the farm that he did not previously think about. He would like to further pursue health and safety on his farm and feels there is a market for this in Irish agriculture. *'Now ok they do a little bit, when we are doing old training courses, on health and safety but like that's only the tip of the iceberg'*. He feels that most farmers are learning about health and safety by experience on their own farms. Whatever health and safety training younger farmers have received, John feels the older farmers have received none and very often these are the people who have accidents. With the exception of near misses, he finds that generally health and safety issues are not discussed among farmers. *'I don't know maybe it's something that we don't like to discuss, but no it doesn't actually come up for discussion'*. He is unclear about who he would turn to for advice on health and safety issues, perhaps his

Teagasc advisor *'he wouldn't be an expert on everything either, he's going by the books and it's not always practical on the farm'.* John feels that farms, which have been built in the last 10-15 years, generally comply with the recommended standards. However older farms require a large investment to achieve the recommended safety standards, 'if *you were to go back to an old farmer and started say on the electrical end of it that would cost thousands and thousands to get right'.* He feels improving the safety of the physical working environment can only be done gradually.

Machinery is an important part of John's farm and he exhibits a good understanding of all the safety issues associated with his own machinery. He feels that as a lot of machines require both high revs and high speeds to operate, the operator needs to be experienced. Grain harvesting is the only activity for which a contractor is used on the farm. There are three tractors on the farm, all which are new and in very good condition. The oldest is 1998 and there is a 2002 and a 2004. As the farm is fragmented the tractors are involved in a lot of roadwork, thus John ensures all lights and indicators are in proper working order and that tractors are in roadworthy condition. John himself does all the machinery service work. Although he has concerns about carrying passengers on the tractor, he admits he often does. *'But sometimes the reason first of all why you would have somebody, I suppose is because say you are going gathering up livestock or whatever, you need help with you. Maybe there wasn't a car or a jeep available for the passenger to drive so you'd have to bring him with you in the tractor'.* John feels that carrying a passenger in the cab proves to be an obstruction to the drivers view, however, there often is no alternative. He dreads seeing people standing on the drawbar of a trailer behind a tractor and feels having passengers in the cab is certainly safer. He appreciates the importance of knowing the limitations of the machinery and respecting that. *'So things like that, would happen no matter how experienced you are or no matter how good you think you are. I suppose you do have to realise that these things can happen'.*

John is very conscious of having PTO shafts guarded on the farm '*PTO shafts above all things going'.* He describes one of his neighbours' injuries resulting from entanglement in a PTO shaft and as a result he tries to ensure all PTO's are covered. *'I have replaced one or two now that have got broken or whatever. So I would be conscious of that, I just hate open PTO shafts'.*

Blockages are common in machines such as a silage harvester and John is always vigilant about disengaging the PTO shaft before clearing a blockage. *'Oh yeh, Jesus I wouldn't, like that tractor there, that's the one we'd be driving at harvest and that has a hand clutch which you literally pull up to stop the PTO turning. But I would actually go to the trouble of taking the PTO out of gear completely rather than relying on the hand clutch'.*

Transporting machinery, in particular harvesters and mowing machines that are wide, on the road is an issue for John because the farm is so fragmented. In addition hedge cutting on narrow roads requires vigilance and warning signs are always used. John handles half tonne bags of fertiliser with a loader, although less labour-some than 50kg bags he feels they do bring other problems. He highlights the importance of having the correct counterbalance and 'picking your spot' in terms of level ground for loading. Further the consequences of mistakes with these bags could be severe. Despite this John feels this advance has been hugely positive *'Like most farmers would have gone away from handling the 50kg bag. It's too labour some and most people have bad backs from lifting those yokes. I don't want to be one of them'.* He can identify local farmers with severe back problems which are perceived to have resulted for farming activities.

Although previously accepted as something that went with the job, John feels farmers are now more concerned about reducing the strain on their bodies and their health while increasing the speed of operations also. *'Everyone is looking for an easier option, but I suppose it's a faster option too for me'.*

Dust and noise are major concerns when working with the corn roller, which generally requires 2-3 hours work per week. Ear muffs and a dust mask are essential and always worn and the machine is positioned to allow a tonne of meal to be rolled at a time and thus minimising operator contact.

Heights are often accessed on the farm, be it to service the motor on top of the grain bin or to clean or paint shed roofs. Generally John uses the front loader on the tractor and stands in the bucket. Ladders, if used, are always secured as John himself experienced a fall from a ladder. The bottom section of the ladder fixed to the grain bin was removed to prevent access to the height. Although concerned about working on heights John does not have a roof ladder and although he has a helmet it is never worn *'I have one or two in there, they just don't look the part'*.

John feels that protective equipment is now becoming more acceptable among farmers. When spraying John always wears a mask and gloves. Although he recognises the merit of wearing coveralls while spraying, he feels they are impractical. *'Say take spraying potatoes for instance, you're trying to pick the driest, warmest, calmest day you can get and the last thing you want to do, I mean you're probably going to be in jeans or tee-shirt and not much more. You don't want to be clammed up in overalls'*. He also feels that these decisions are based on perceived risk '*I suppose the bottom line is that if it means you're going to live longer you'd do it rather than getting dosed with chemicals. I suppose then you have to look at the high risk, I mean I wouldn't consider some of the sprays that we use for potato blight as high-risk sprays. Maybe the likes of Gramoxone® or Roundup® or stuff like that, you'd be paying a bit more attention'***.**

As all of the tractors have air conditioning, windows are never opened while spraying. John has no specific means for cleaning blocked nossels and does not carry clean water while out spraying, '*depending on what I had. A bit of tissue in my pocket or whatever. I'm lucky in the sense that I have a choice of nossels so if it was a bad blockage or whatever I might flick it around to one of the other nossels until I got back to base or I had fresh water or whatever. But when you're in the middle of a field, you kind of turn to whatever you have*'. John is keen to take a spraying course and has inquired about courses in his area. All chemicals are stored in a cupboard in an old dwelling house in the yard, which is not locked, John is conscious that the chemical store is less than adequate and intends to have a proper locked store made.

There are two shear grabs on the farm for feeding silage, which Johns also uses for carrying bags of meal '*I have a tendency to carry bags of meal in the shear grab. I gave myself a nick on the hand once from the actual blade of the shear grab*'. Despite injuring himself, John continues with this practice to save time, '*it's the only practical* *way I have of carrying them. It's either make a second trip back with the meal or bring it the first time when you are going with the grab'*.

There are three trailers on the farm, two that are pulled behind tractors and a cattle trailer for the jeep. Neither of the tractor-trailers have lights or brakes, although lighting boards are put on if the trailer is going into the town. The trailers are old and it is not feasible to install trailer braking on them. John is very conscious of the cattle trailer behind the jeep, if the trailer is full it can often cause the jeep to destabilise.

The majority of slurry storage on the farm is in underground tanks however there is one open slurry pit. With the exception of one tank which requires moving slats all the access points are manholes. All cattle are released when agitating slurry and manholes are never left open when unattended. John sometimes has to access the shed when agitating slurry to observe if there is a problem, which he feels, is a risk. The open slurry tank is walled off on three sides and fenced on the remaining side, which is adjacent to a ditch.

Animal handling is a major concern on the farm, the cattle crush is very strong which John feels is essential when dealing with cows and calves. Generally there are two people present when handling animals, however, the situation does arise when John is alone, '*But I mean sometimes there'd be only yourself and you'll have to try and manage, you know on your own***'.** John has a very strong restraining gate in his cattle shed which he describes as '*a must have for anyone with sucklers'* (Photo 8). John had the gate made at a cost of €300 primarily for safety reasons but also for practicality, *'I suppose in that case like with the sucklers they go hand in hand, safety and practicality'*. It allows him to safely calve cows or work with a cow and calf, '*and even for simple jobs like getting a calf to suck or whatever when it's born, at least you're safe'*. John tends to do a lot with the cows when he gets them into the yard '*it's mostly limmosins we have and we can't get them in, so when you do get them in you tend to do a lot'*. Safety is also an issue when feeding weanling bulls in the field as they tend to be quite rowdy.

Photo 5.8: Restraining gate for suckler cows

John invested in this restraining gate for both safety and practicality. The gate allows for safe handling of a suckler cow during calving or indeed after calving if working with the cow and the calf. At €300, this was seen as a necessary and good investment.

There are two bulls on the farm, both of which are ringed; however, neither have a chain for reasons which John outlines *'I don't know I think it looks bad. I think it's cruel as well. They never had one on, any of the bulls we've ever had and we've had numerous bulls'*. John and his brother are generally both present when the bull is being handled. They have never experienced any problems with their bulls and they find them relatively easy to handle, however, they are always cautious and generally bring the jeep into the field when herding or stay close to an electric fence if the bull is present.

John and his brother make their own silage, generally nobody is on top of the silage pit, however, it may be necessary in order to trim the sides. The silage backs onto a field from the yard and there are no sighting rails on the walls which at times pose as a worry, *'it's something that could be done but, like all things that were built in the olden days there were no railings put on it then'*.

5.4.7 Small Risk Category: Case Study 7

Joe is a suckler farmer in Co. Roscommon. He farms 70 acres of mixed land, some good land, bog and he also has 20 acres of callow land which is fragmented from the main farm. Joe is a part-time farmer who works full-time in a chemical manufacturing plant '*I work part-time, I farm part-time and I work full-time'*. He keeps 24 suckler cows.

The farmyard is adjacent to the family dwelling house where Joe lives with his mother. Both the farm and house have separate entrances. Although he has been farming all his life, his father died at an early age, the farm was only transferred eight years ago. At this point he joined the REP scheme. There are no children living on the farm however, nieces and nephews do visit approximately six times a year, they are all under ten.

Safety is an important feature of Joe's job in the chemical plant. He has taken several safety courses specifically on manual handling and chemical handling which he feels impacts on his farm work. Joe views work safety as being able to do any job he has to without getting hurt. He is aware of the dangers associated with farming, *'You'd be aware of them or you'd like to think you are aware of them all anyway at this stage. You'd like to think you know most of them anyway If you're handling stock, you'd be careful or out shaking slurry you would be careful'*. However, he feels that there are dangers associated with many other things also.

Joe feels that close calls on the farm make him aware that accidents are possible *'Sometimes you might have one or two close calls now and again. Nearly every year you might have one but you would be aware especially on your own'*. Some accidents, especially those involving children are considered preventable *'it's preventable if you don't bring them I suppose'*, however, Joe feels that at a certain age children want to go on tractors and it is difficult for parents to say no.

Although safety is important to Joe he feels that it costs money *'Safety costs money as well you see, it does cost money'*. In addition Joe feels that investment depends on the physical environment of the farm when it is passed down. Certain aspects of the farm needed to be changed when Joe received it to enable him to farm alone, for example animal handling facilities.

As he is full time employed, planning activities on the farm is important. Although Joe does not prepare a written plan, he works to a rough plan. Working alone he is guaranteed that equipment is always in working order, if something breaks it is repaired immediately *'it'd never be left there so that you know when you go back next time it's going to work for you. You don't just leave it on the long finger'*. Weather is the most important factor in planning activities on the farm.

Joe feels he is not a stressful type of person at all. He describes his workload as steady *'I think as you get older you have a more steady workload, when you are younger it's different. I don't see the point of it anymore'*. His priority is always to his job as that is essentially what pays him.

The original stone farm buildings are situated beside the dwelling house. In recent years a slatted shed was built further down from the house beside the silage pit. There is a separate entrance to this yard, which is also used for accessing the upper yard. The farmyard was extremely tidy, it is important to Joe to be well organised and to be able to see where everything is, a tidy farmyard helps this *'Yeh, a place for everything and everything in its place'*. Joe feels that REPS has improved the tidiness of farmyards, whereas once people tended to allow material build up in yard now rubbish is dumped immediately and everything else is properly stored.

Photo 5.9: Upper yard *'A place for everything and everything in its place'*

The original stone buildings adjacent to the house are well maintained and the cattle crush is still in use. A system of gates in this yard allows one person work with cattle. The yard is and adjacent storage sheds are well organised and reflects Joes motto which titles the image.

Most of the sheds adjoined to the house are small and serve no purpose on the farm. The calving shed is situated opposite the cowshed where a restraining gate has been fitted. Although the gate is secured with a chain, it is not very strong *'It's a bit open looking but it gives you room to work at the back'*. Joe is very conscious of the suckler cows temperament at calving time as he feels they are not at all tolerant. Generally he does not intervene in calving unless absolutely essential. After calving he finds the cows are at their most dangerous *'there are more and more every year that you can't go near'*.

Opposite the calving shed, cows and calves are housed in a converted three bay slatted shed. The conversion allows for seven or eight pens for cows and calves depending on the requirements; however it has left extremely limited operator access and working area. Bedding requirements necessitate Joe to enter the pens with cows and claves. Although he is generally aware of cows especially when they have calved, escape mechanisms from the pens are unclear *'Escape is jump the gate basically, that* *is it'*. The gates in one pen, however, allow for isolating cows in the event of difficulties.

Although the shed is well lighted, the fittings are all domestic and do not comply with the required standards. The access point to the slurry tank is outside the shed, it is a four-section access. Joe feels that this type of access is very safe and as only one section is opened for spreading slurry. Cattle are not removed from the shed while slurry is being agitated; however, Joe prefers to have a breezy day to agitate.

There is a newer three bay doubled slatted shed in the lower yard where calved cows are housed. A pen surrounds the entire shed with a cattle crush along one side, this allows for one person to move animals with ease (photo 5.10). The silage effluent is collected in the slurry tank and thus this tank is emptied twice a year. Again the animals are not released during slurry agitation.

Photo 5.10: New shed with pen and crush

The lower yard is less organised and not as well surfaced as the other. The gates and runway surrounding the shed allow Joe to move cattle with ease from the shed into the crush on the right side of the shed. This is an example of how a simple engineering solution can provide both labour and safety solutions.

The bull is housed in the newer slatted shed for approximately twelve weeks of the year. Although once ringed, it wore off and has not been replaced as Joe did not feel there was a need to have it replaced. Joe feels the bull is actually quieter than the majority of his cows; nonetheless, he is careful with him and always conscious he is a bull. *'This lad must be seven or eight years old I suppose now at this stage, he has never caused any problems. But at the same time you can never be sure you know. He's definitely quieter and easier handled than a lot of the cows we have'*. Joe does not have a warning sign in the field with the bull but he is more conscious that he should have after receiving a book from the Health and Safety Authority.

One parcel of land is removed from the house and requires that the animals are walked 20 minutes along the road. In order to move the cattle Joe gets the help of neighbouring farmers '*It would take about five of us, it's about a twenty minute walk. You'd bring the people and leave them on the road and you'd go in front of them yourself and put someone behind them. You're not covered by insurance otherwise. When you have somebody in front of them and somebody behind them you're covered by insurance then'*.

There is very little machinery present on the farm, generally a contractor is used for silage making and slurry or alternatively the machinery is borrowed from a neighbour. Joe has a 1990 tractor, which is maintained in good condition with lights and indicators working. It is however missing the U-guard, which Joe is conscious of and intends to replace. A local mechanic carries out all the machinery service work. Passengers are generally not taken on the tractor for work purposes; however, when his nieces and nephews visit he takes them for rides on the tractor. He would not take children out on the tractor while he is working as he feels it is dangerous.

He has a JCB with silage grab for feeding in the sheds, which rarely leaves the farmyard. The JCB is also maintained in good condition and all lights and indicators are working. Again the children enjoy rides in the JCB *'If they want to go on the JCB, I just park, they like just working with the back actor. Park it in a pile of muck and let them swing away themselves'*.

When spraying Joe does not wear a mask, he feels it is sufficient that he keeps the windows of the tractor closed although the tractor does not have a sealed cab. Blockages in the nossels are cleared easily as the top can be removed and the dirt can be knocked out. Gloves are always worn when handling the nossels. There is no clean water storage tank on the sprayer, *'If you needed clean water out in the fields, you'd go to a cattle trough or whatever, you know, that would be your source'*. Although he keeps very little chemicals on the farm, there is a small shed specifically for chemical storage. With only a bolted door Joe feels that it would be a step forward to put a lock on the door.

There is also a transport box, a fertiliser spreader, sheer grab, muck spreader and a share in a topper, which is not kept on the farm. All of the machinery have original PTO shafts intact.

Silage is made by contractors and Joe would have very little to do at silage making apart from covering the pit. His main safety concerns about contractors working on the farm would be that a machine would pick up a foreign object in a field that would cause it damage. Although the silage pit is not very high, there are no sighting rails and the walls are quite low. There is never any need to be on top of the silage pit while it is being filled and Joe feels that people up on the pit get in the way.

Joe keeps very little tools on the farm as he does minimal machinery maintenance; therefore there is no farm workshop.

5.4.8 Low Risk Category: Case Study 8

Sam is a farmer in Co. Donegal who farms 78 acres, 17 of which are rented. Sam keeps on average 16 suckler cows and approximately 110 ewes and has one stock bull. He is full-time employed on the farm. Sam has been farming all his life, firstly at home with his own father and brother and then renting land of his own while also working. He has been farming his own land for almost twenty years. Sam's farm is not in REPS and he has never taken any agricultural courses.

Sam has quite severe back and hip problems which both required surgery. He walks with the aid of a walking stick and has *'pains nearly everywhere'*. Sam believes that his pains are related to Organo Phosphate exposure from dipping sheep over many years *'Years ago when we were dipping sheep, we were too careless, no gloves, no hat, no nothing. You learn by your mistakes'*. This condition has had a major impact on his ability to farm and he finds that it is a struggle to carry out many routine farm activities. There are no children living on the farm, however his grandsons visit occasionally. Sam's wife always supervises the youngest child while he is in the yard, while Sam describes the older boy as '*a wee bit wild of himself*' and is more difficult to supervise.

Sam views safety as an important part of his work and feels he is conscious of safety at all times. Safety is always a consideration for Sam when he is doing tractor work. He believes that farming is a dangerous occupation, *'Farming would be dangerous, there no doubt about it now. Tractors I mean of all things, you know yourself a tractor is nearly the most dangerous thing you could drive, worse than a car. But there are plenty of accidents with tractors you know'*. He feels that a lot of farm accidents are preventable and a lot of carelessness exists among farmers.

Although he does not strictly plan and does not have a written plan, Sam feels he is always planning ahead. Depending on the activities safety may or may not feature in Sam's activity plans. However safety is always considered when he is planning activities involving tractor use. Sam describes his workload as steady going *'Oh you could rush it, like and try and do more in the one day but if you were doing something you'd spread it over a couple of days you know. When you're working for yourself you're not worrying about the hours or time or anything'*. Sam describes himself as not really stressed; he feels that because he is his own boss he is not subjected to as much pressure.

The farmyard is situated directly behind the dwelling house, which has steep steps leading from the house up to the farmyard. There is no railing on the steps. There is an entrance to the house from the road and also an entrance to the farmyard, which also serves the house. The farmyard was somewhat untidy with a lot of materials such as wood, paling posts, rolls of old fertiliser bags and oil drums stored against walls and sides of buildings in the yard. Sam says the yard is usually not as untidy, however, with his bad health he has been unable to tidy up and move anything heavy. In addition things, which once were burned, have not been disposed of since the introduction of regulations preventing the burning of waste. This has posed problems for Sam. Sam feels that good lighting is very important particularly in spring during calving and lambing; however, there is only one outdoor light in the yard which Sam feels is sufficient. Sam never has reason to access heights on the farm.

There is very little machinery on the farm, Sam's tractor is dated to the 1970's, however, it is well maintained and the lights and indicators are working. Sam never carries passengers on his tractor *'I'd be afraid to keep somebody standing on the tractor in case they would come of it, and the trailer or whatever you have behind you come over on top of them you know. No, I never would take nobody on a tractor'*. There is also a block cutter, a cattle trailer, a fertiliser spreader and a mowing machine all of which were well maintained. The PTO shafts on the fertiliser spreader and the mowing machine were both properly guarded. Sam's son and his brother in law do most of the service and repair work of the machinery. There is a chainsaw on the farm; however, it is rarely used as Sam cannot operate it any longer. He never wore safety equipment when operating the chainsaw but recognises that specific protective equipment must now be worn.

There are two slatted sheds with underground tanks on the farm, one for cattle and one for sheep. There are two outside manhole access points to the tank on the cattle shed, which is covered with a heavy steal cover. There is a safety grate present below one of the steel covers and Sam intends to install one in the second manhole. In order to access the tank in the sheep shed, the slats have to be moved. There is no open slurry pit on the farm. During slurry agitation all animals are released from the sheds. Manhole covers are replaced at night when slurry is being spread *'So you just put on the slat down when you're finished then. It'd be evening or night, I never would leave them lying open now. It's too dangerous. You never know like, as I say there are no children here but you don't know how people will come wandering in at any stage. I don't know how insurance would go, we'll say even somebody wandered down from the road, some man drunk put it that way and wandered into a hole. I don't know how that would work'*. It usually takes only one day to empty each slurry tank.

Calving pens are erected in an older shed for calving suckler cows. There is no restraining gate for calving the cows; however, there are rarely problems at calving time. Sam tries to operate a closed herd; the animals are used to being handled and are generally all very quiet. All of the electrical installations were installed to the required standard.

A new grant aided silage pit was constructed in recent years. Previously up to eighteen acres of silage was built into a pit, which had no walls. Sam felt this was very dangerous and posed specific hazards when the pit was being rolled. There is never any need for anybody other than the contractor to be up on the pit while the silage is being built *'I would find like, if you've somebody rolling and somebody putting up silage as well, it's too dangerous to be up there for starters. Because it's very hard for the man that's driving the tractor to watch you, you know what I mean. You have to watch yourself or else stay down'*.

Sam uses small bags of fertiliser, which he loads into the spreader from the trailer. If the bags are stored at ground level one of his sons will lift them into the spreader for him.

Although Sam's wife often assists on the farm, they do not move cattle unless they have additional help. The stock bull is ringed but does not have a chain; Sam describes him as very quiet. Although there is a warning sign in the field with the bull, Sam feels if people want to enter the field they ignore the sign. Despite this he is always conscious that he is a bull and more so now due to his lack of mobility *'But* *saying that like, if I was going up to the field to him I'd take the Land Rover with me. I wouldn't chance walking through the field. I'm not fit enough to walk by'*.

The cattle are all grazed on lands surrounding the farmyard and thus moving cattle on the public road is not a major issue. The sheep are grazed on lands further away from the farmyard and are always transported in the cattle trailer. Animal handling in the cattle crush is minimised and usually a number of jobs are scheduled together. The cattle crush is well situated in the yard and is quite strong. For handling sheep and lambs in the crush, Sam stands old doors against the railings to prevent them from escaping. All veterinary chemical and agri chemicals are stored in an unlocked cupboard in an old loft in the farmyard *'Well they're in a wee cupboard, there'd never be no children in there so they're very safe where they are. If there were young children about the house you'd have to have them locked up. But here there's nobody, just the missus and me and I don't think we'll start drinking it at this stage!'*.

A sheep-dipping tank has recently been built in the farmyard and Sam and his son have the materials to make a cover for the tank. He no longer takes any chances when dipping sheep and always wears a rubber suit. Sam is confident that when the dipping tank is covered and the safety grate is installed in the manhole access to the slurry tank that all outstanding safety issues will be taken care of on the farm.

Sam's main safety concern on the farm relates to members of the public accessing his land. This is a particular problem during the month of June when the car rally passes by his farm. This attracts a significant amount of spectators that enter fields without permission. Often gates are opened and not closed resulting in cattle gaining access to the road. Sam now locks all gates on the farm; however, this does not prevent people accessing the land.

5.4.9 Low Risk Category: Case Study 9

Seamus farms 83 acres in Co. Tipperary and is engaged in dairy and beef farming. His farm is divided into two segments of seventy and thirteen acres. Seamus is full-time employed on the farm and his son works part-time on the farm. Seamus has been farming for fifty years and in that time he has not taken any agricultural courses and he is not a participant in REPS. Presently Seamus has 65 dairy cows, 16 in-calf heifers and 18 calves.

There are no small children present on the farm and his visiting grandchildren are very young and would never be present in the farmyard. Seamus feels that safety is certainly an important aspect of his work and he would be conscious of safety in his day-to-day activities. Seamus does not feel that farming should be considered a dangerous occupation, though he respects there are dangers associated with farming. Seamus feels that the best intention in the world will not eliminate all accidents, although most can be prevented, accidents will always happen.

Although not written down, Seamus always works according to a rough plan. Seamus's work is quite pressurised during February and March as this is calving time and also there is extra work involved in getting grazing ready for turnout. Although not generally a stressed person, Seamus does feel stress occasionally. He feels if things do not go according to what he has planned it can cause him to be stressed.

The farmyard is adjacent to the dwelling house with a wall and garden gate separating both. The yard is very tidy and very organised and free from any obstructions and Seamus is conscious about keeping the farmyard tidy (photo 5.11).

Photo 5.11: Farm yard

The farm yard is tidy and well organised. The trolley resting against shed wall is used for moving materials in an attempt to minimise manual handling.

There are both separate farm and house entrances. The farmyard combines both original stone farm buildings and newer sheds. The original farm sheds are now used as calving units and as storage sheds. There are two calving units which allow for four cows to calve at a time, there is one restraining gate. Opposite the calving units there are three pens, which are monitored by camera. Cows within two weeks of calving are moved down to this area from the cubicle house.

There are two storage sheds, which are used for tools, implements veterinary medicines and other materials. The veterinary medicines and chemicals are stored in a double door locker. Both sheds are well organised. All of the original sheds have heavy steel hanging doors, which are all bolted shut. The straw storage shed, pre-calving units and young calf sheds each have doors made from gates sheeted with corrugated iron. Although bolted and well secured these would certainly be a hazard in windy conditions. There are two additional calf sheds for older calves; one of which has an underground slurry tank. In order to access the slurry tank in this shed four slats are lifted, which are very heavy. *'They're very heavy. They're too heavy. They wouldn't go in at all now, as big as that. They're all a lot smaller'*.

The cubicle shed, which has automatic scrapers, opens out into a slatted feeding area. There is outside manhole access to the underground slurry tank. All of the slurry is stored below ground.

The dairy is well organised and very tidy. Seamus has a guard covering the motor and belts, which he feels is not as good as it should be. *'Now I've that done a long time ago myself. Michael now, he is twenty-two but when they were small they'd be coming down, you'd hate the thought of them coming in and going near belts or anything like that'*. The cubicle house, milking parlour and dairy all have industrial type electric fittings while the older sheds have domestic fittings.

There is very little machinery on the farm as Seamus hires a contractor to cut his silage and spread slurry. There is one 1978 tractor on the farm which is well maintained and has lights and indicators working, however, the u-guard is missing. Seamus never carries additional passengers on the tractor, as he does not have room in the cab. Seamus feels newer tractors are perhaps safer and more equipped for carrying passengers '*But more tractors now are maybe more safer. Now I was talking to a man the other day who was talking about the accident you mentioned a few minutes ago and he said he has a new John Deere tractor, well it's two year old and he said there were even a place on it to put up a car seat for a child on the tractor. And maybe other tractors have the same thing*'.

In addition Seamus has a silage grab, fertiliser spreader, mower and a sprayer all of which have properly guarded PTO shafts. He is very conscious of the hazards posed by exposed PTO shafts and he feels that PTO shafts are his biggest safety concern on the farm.

When spraying Seamus always wears a mask and gloves when he is handling chemicals. However spraying is not a big activity on the farm. Chemical containers are rinsed out and burned when empty.

Table 5.2: Summary of case study critical findings

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
Attempts to eliminate hazards	✓		✓			✓	✓		✓
Good organisation & Planning	✓	✓	✓		✓	✓	✓		✓
Effective management & maintenance of physical environment	✓		✓		✓		✓		✓
Safety socialisation a key feature	✓		✓		✓				
Management of workload & stress		✓	✓				✓	✓	
Good perception of risk	✓		✓		✓	✓	✓	✓	✓
Effective management of technology	✓	✓	✓			✓		✓	

5.5 Discussion

The structure of the case studies focused on examining the specific person factors of farmers and the physical working environment of the farm that have been identified in the literature as being central to accident occurrence. The following is a discussion on the findings from the case study research. Figure 6.1 illustrates the factors as identified in the research as having an impact on health and safety on the farm.

5.5.1 Person factors

The case study interviews provide a deep insight into the knowledge, perceptions and attitudes of the farmers relating to health and safety on their farms and the key factors that influenced attitude formation. Through discussions about their own farm yards, the equipment they use and the activities they engage in, the interviews exhibited the varying knowledge and interest that exits among these nine farmers in relation to the hazards associated with farming.

5.5.1.1 Attitudes

Section 4.1 highlighted the importance of understanding people's attitude to health and safety. The importance of safety as a part of farm work ranged from being an important feature to being vital. The level of discussion engaged in, in the interviews, reflected the level to which safety was examined and considered on the farm. Three of the cases engaged more fully on safety than the other cases (1, 3, 6). These were typically of a younger age and had large commercial farms. The three farms selected from the low-risk category (7, 8,9) did not engage in the same level of discussion as those from the other two categories. This possibly reflects the degree to which they are required to confront safety issues in their day-to-day work.

While three of the farmers viewed safety as vital or the most important part of their job (1,5,6), others felt it is a big consideration but conceded that things are not always perfect (2,4). The remaining farmers view safety as always being important (3,7,8,9). According to one large farmer, commercial farmers are more safety conscious than smaller or part-time farmers because they are more conscious that they have to do things correctly (3). In addition older farmers particularly were identified as lacking in health and safety training while they were viewed as the age group that often get injured (5). Two of the farms have prepared Safety Statements (1,6), both of these were large farms and had been visited by health and safety professionals. In one situation where both a father and son were working the farm together, both had prepared a safety statement (1).

5.5.1.2 Beliefs

The findings very much mirror what was established in chapter 4, that is while farmers are aware of the dangers associated with farming and can identify them on other farms they do not consider that their own farm is dangerous. This indicates that there is a cultural belief in farming that it is a healthy and safe occupation. There is an almost passive acceptance of hazards, risks, illness and injury on many farms (Murphy, 1992). Farming is more than an occupation, it is a lifestyle. Although all the interviewees recognised and alluded to specific dangers associated with farming, as an occupation they did not perceive it as dangerous. With the exception of one farmer (8), farming was not believed to be a dangerous occupation (1,2,3,9) or any more dangerous than other occupations (4,7). Comparisons were drawn between farming and other occupations and even car driving. According to one couple (5), farming is a good healthy occupation while another felt that it is really depends on the farmer's attitude (1).

Quite varied views were expressed on accident prevention in the interviews. Literature suggests that farmers who believe that they have limited ability to prevent injury and ill health problems do not see the immediate benefit in taking precautions and are in fact less likely to take precautions (Wadud *et al*., 1998). Two of the farmers felt that all accidents, not exclusively farm accidents, are preventable (3,4). The remaining farmers felt that most accidents could be prevented (1,2,5,6,7,8,9). However, two of these farmers held the belief that accidents will always happen, that's why they are called accidents (2,9). This implies that they believe that accidents are phenomena, which are out of the control of the person. Certain types of accidents were seen as being more preventable than others. Accidents involving children on tractors can be prevented if children are not taken on tractors (7). While it is unclear if all animal related accidents could be prevented due to the unpredictability of animal behaviour (5). The three young large commercial farmers believe that increased workloads, working hours and pressure are central to accident causation (1, 3, 6). In addition two of the farmers believe that the nature of farming, in terms of exposure to hazards, increases the risk of accidents occurring (1,6).

5.5.1.3 Perception of risk

Through the course of the interview, the discussions focused quite significantly on perception of risk. While one farmer in particular had an excellent sense of the risk present in his environment and associated with his behaviour at work, particular instances arose were he could not acknowledge the risk involved (1). The most striking examples of this were spraying with a tractor window open '*it wouldn't really be any harm to us*', and accessing heights from a loader without any head protection.

In many instances the farmers interviewed could recognise the risk present in their environment. However, by assessing the risk for themselves or having previously taken risks and not suffering the negative consequences, they were willing to take the risk. For example, Sean in case two admitted that he was careless with chemicals but he has never been caught. David (Case 3) is aware of the dangers of PTO shafts; however, it is more important to his employee that they all be covered. John (case 4) knows that unguarded PTO shafts on slurry spreaders are a risk, however, if it is just himself and his son working with them it is not such a big concern. Joe does not recognise that agitating the slurry with the cattle in the shed poses a risk to both the cattle and to himself and this practice is normal on his farm. According to Fischoff *et al.* (1978) as cited by Dunne (2000) research on risk perception illustrates that people accept higher risks for themselves when there is a voluntary aspect to becoming involved in the activity. Dunne (2000) asserts that this would suggest that farmers and the self-employed would be inclined to accept higher personal risks than employees working for somebody else. '*It appears that being in a position to choose to run the risk can make a given level of risk more acceptable to the person. This is because choice gives people a sense of having more control over the situation*' (P.68). This perception of having control is a significant influence on a person's assessment of the probability of an accident happening to them. There is evidence from the SHSIF to suggest that farmers assess the danger or risk in their workplace based on whether or not they have experienced an accident. According to Dunne, 2000, P.30, *'Awareness of risk is the crucial factor in improving safety at work'*.

5.5.1.4 Habit

Dunne (2000) discusses 'strong but wrong' responses which can be implemented before the person realises that the demands of a particular situation are different in a safety critical way. The case study analysis highlighted a good example of this. David (Case 3) described feeding cattle in a shed and reversing in and out while neglecting to look behind. Generally speaking, when driving a tractor the farmer is looking ahead and therefore the automatic but inappropriate response to driving the tractor backwards is to look forwards *'You get so used to going in and out that you won't look back'*. This was perceived to be a major issue on cattle farms as feeding is a routine task carried out relatively frequently.

5.5.1.5 Safety Influences

The positive influence of peers, family and advisors on safety attitudes and practice is apparent. Those farmers that had alluded to an influence on their safety thinking or practices from their family were conscious of safety on the farm. The farmer's occupation is often inherited, with the farmer following in the fathers footsteps. The majority of farmer training for dealing with safety is gained through experience and informal observation (Knapp, 1966). Undoubtedly family, especially parents have an influence on a person's attitude and belief construction particularly in the formative years. Practically all learning can occur through observing the behaviour and consequences of other people's actions (Bandura, 1977). Two of the farmers considered their father to be important influences on their attitude to health and safety on the farm (1, 5). Both described their fathers as being very safety conscious and as a result this has impacted on their motivation to work safely. In case 1 the farmer was conscious that local farmers also identified his father as being safety conscious (1). In addition, the positive influence of health and safety information and practices from off-farm jobs or previous jobs was highlighted (7, 5). For others the impact of 'near misses', accidents in the locality and accident reports in the media clearly had an impact on their attitude to particular activities (2,4,6,7). They spoke about becoming more aware of hazards associated with different activities as a result of an injury or near miss. Very strong reactions were expressed to accident situations *'I will always be aware of that for the rest of my life'*, *'I suppose we copped ourselves on a small bit nearly at times'*, *'I've heard and seen so many accidents both locally and things that you read about that it is a big deal'*. One farmer (Case 1) highlighted that his advisor was particularly safety conscious and had encouraged him to complete a safety statement.

5.5.1.6 Children

Traditional farm culture has incorporated children into farming activities out of economic necessity and the desire to instil a work ethic in children (Tevis and Fink, 1989 as referred to by Aherin *et al*., 1992). The issues relating to child safety on the farm highlighted the differing levels to which children are involved in farm work and also how children's involvement in farming is managed. While the exclusion of children from the farming environment would eliminate the possibility of injury it would also deprive those children of involvement in a way of life that is highly valued by many. '*The line between farming as a way of life and as an industry blur where children are concerned*' (Aherin *et al*., p.6, 1992).

Only two of the farms visited were homes to young children (3,5), while five farms spoke of visiting children having access to the farmyard (1,2,7,8,9). On the remaining two farms, children were never present (4,6). There was general acknowledgement from the farmers that children need to be supervised while in the farmyard. In addition the safety of children while machinery is operating in the yard was addressed, children are perceived to be safer in tractors where they can be seen rather than down in the yard. However, one farmer gives visiting children tractor rides and allows them to use the back actor of his JCB while it is in a stationary position (7). Thus, these children are learning to use machinery for entertainment and enjoyment.

On those farms that were homes to children the approach to safety was managed differently. While one farm had an enclosed yard at the house (5), the other case had a farmyard, which ran into the back yard of the house (3). The ethos on this farm is one of including the children in the farm as much as possible as it is their home, now both young teenagers; they are allowed to drive tractors under supervision (1). This farmer highlighted the value of growing up on a farm, which many children do not have the opportunity to experience. Yet, this farmer gives the sense that there is a conflict between children's involvement in farming and the associated risks. He illustrates, however, that it is possible to integrate children and farming if safety is a priority and supervision is central.

5.5.1.7 Workload

Farming as an occupation provides variable workloads which are greatly influenced by the seasons. Work overloads occur at busy periods on the farm when work is heavy and labour units are low, while work underloads occur while carrying out repetitive, boring tasks and when working alone (Aherin, 1992). Leahy (2003) reported on labour use on suckler farms which was found to be lowest in December at 8.32 hours. Therefore at its lowest, labour input on suckler farms is similar to that of the average for all in the workforce. The case study analysis highlighted the different perceptions that exist among farmers of their own workloads. Most of the interviewees described their workload as steady (2,3,4,5,8,9). Two farmers described their workload as generally steady, however, with periods of pressure (5,9). However for two farmers their workload was not steady, one describing his as rushed (1), while the other described his as constant (6). Both of these farmers appeared to be good managers, working to some form of plan and both described themselves as stressed.

The three younger, large commercial farmers highlighted the issue of increased workloads, working hours and pressure in relation to their effect on health and safety (1,3,6). One likened farming to any other occupation in terms of a ‘rat race’, where farmers want more regular working days yet still need to complete all their work (6). In addition the speed at which operations are now required to be conducted on a farm and pushing the limits of man or machine were discussed in relation to their perceived effect on farm safety (1, 3). In most of the cases the farmers spoke of periods of pressure, which in tillage farming, for example, can last months rather than days or weeks.

Two of these farmer, however, described working long hours to get a job finished (2,8). One of these said that although he often works excessively long days, he also takes a lot of time off from farming (2), while the other described perhaps having to work until 9p.m. at night to finish a job due to the pace at which his health required he worked (8). Despite long and in some cases excessively long working days, these farmers considered their workloads steady. One of these farmers was past retirement age, was in poor health and often found himself working excessively long days in order to complete certain jobs. Given that over 27% of farms in the ROI are owned by farmers over 65 years of age (CSO, 2002), the case study example may be true for many farmers in Ireland. The issues surrounding workload and working hours are discussed in section 3.5.3. Workload has been identified as a factor affecting farmer stress (Weigel, 1980; Aherin *et al.*, 1992) and thus it is included as a risk factor inherent to the farmer which impacts on farm safety.

5.5.1.8 Stress

Farming is a very stressful occupation (section 3.3.6) and it has been suggested that stress is an important factor in many farm accidents (Aherin *et al*., 1992). Three of the farmers described themselves as being stressed (1,4,6). In addition to this two farmers described how certain situations create stress (5, 9). In the course of the interviews several issues, which served to increase pressure and add to stress, were raised by the farmers. The pressure exerted by the weather was expressed by four farmers who felt the dependence on fine weather created pressure to complete tasks (1,2,6,7). In addition, some felt that during calving season other farm activities become pressurised (6,5). Furthermore case five expressed that farming activities, particularly in springtime, exert severe pressure on the household and result in the couple 'juggling' the farm and the home. While, case one spoke of stress relating to trying to assert change while also trying to deal with interferences from neighbouring farmers. The range of stressors presented indicate that while macro stressors impact on farmers, during the course of the working day the farmer is confronted with micro level stressors which impact on the farmer at a particular point in time.

5.5.2 Physical working environment of the farm

The examination of the working environment of the farm highlighted the varied levels of safety in place on the farms. In addition to assessing the actual working environment, how farmers interact with their environment was discussed. Detailed discussion surrounding specific routines provided an insight into the dynamic which exists between the farmer and the work environment. From the case study discussions it appeared that the degree to which safety was considered on the farm was relative to the size and level of activity on the farm. The weight placed on farm size as a factor in the Farm Safety Risk Index is certainly justified. The larger farms had a greater level of activity and were typically more highly mechanised and consequently presented a higher level of risk which required consideration.

While the farms from the high risk category were found to have considered safety to a greater degree, unsafe practices were found on all farms. It was quite common to find practices that a farmer would not engage in due to the negative consequences experienced on the farm or by a farmer locally. However, other hazardous practices were engaged in, the effects of which were not perceived to be as severe.

5.5.2.1 Farmyard situation

Typical of the Irish farm, on seven of the case study farms the family home was situated on the same site as the main farmyard (1,2,3,5,7,8,9). Although on most there was a physical division, a wall or gate, between the farmyard and the house, two farms had no such division (3,8). All of the farms visited had separate farm entrances. There was also a degree of farm fragmentation found, with both yards and land situated away from the farmyard (1,2,3,5,6,7). In the ROI there is a great deal of farm fragmentation which has been identified as having a significant association with labour use (Leahy, 2003). This resulted in moving both machinery and animals on roads, often several miles away. All of the farmyards had evolved from a small farmyard with original stone buildings. Before any further development took place, plans were restricted by what was originally in existence. As many farmyards were designed in the past, they were designed with the needs of the system at that time in mind. The changes in labour supply on Irish farms in recent year's means that the current labour input can not effectively operate within the design without modification (Ruane and Phelan, 2003). In farm safety terms, the farm yard was the location of the highest proportion of accidents for most systems of farming (SHSIF). However, the high-risk farms (1,2,3) were found to have larger, more spacious well-planned yards than the farms in the other two categories. The farms were found to reflect a level of investment in farm infrastructure, which was relative to the size of the farm, with larger farms appearing to have invested considerably more than smaller farms.

'Housekeeping' in the context of health and safety refers to the everyday system of keeping the work place clean and free from danger. While housekeeping may appear trivial and unimportant and thus is often neglected, it plays a central role in maintaining a safe work environment. Poor housekeeping frequently results in accidents which are easily avoided such as trips and falls (Garavan, 1997). General tidiness of the farmyard was possibly the most striking aspect on arrival to a farm. While housekeeping was deemed paramount on two of the high risk farms (1,3), a third fell somewhat short of this standard (2). In addition, one of the low-risk category farms was found to be very tidy (7). With the exception of one, the remainder of the farmyards were reasonably tidy; however, they were not entirely clutter free. Housekeeping should become part of all employees working day and in that way it is not forgotten and enabled to get out of control (Garavan, 1997). While there was considerable variation in the level of development of yards in terms of concrete, one was found to be quite underdeveloped (5). This was well depicted in the photos. One farm was found to be very untidy and the farmer himself acknowledged that he was no longer able to maintain the level of tidiness desired (8). Overhead electric cables were an issue on three of the farmyards (2,4,5). While one farmer felt these cables should be buried (5) another felt strongly about the dangers of underground electric cables (2).

5.5.2.2 Farm buildings

The majority of sheds found on farms were relatively new and maintained in good condition and were fitted with sliding doors. Some farm buildings appeared, both outside and inside, to be excellently maintained (1,2,3). Safety should be a consideration when designing livestock housing and handling facilities. When housed there is always contact between the stock person and the animals and thus confined spaces present high potential for serious injury (HSA, 2001). Old stone sheds still served a function on some farms as both storage facilities (9,8,5,7) and also as isolation units for calving cows , housing sick animals or housing the bull (4,7,8,9). These sheds were typically small; they had small hanging doors and had some form of restraining mechanism such as a gate or a hook to tie up an animal. The use of these sheds as bull housing and calving facilities appeared wholly inappropriate.

Regarding cattle housing, three farms had a cubicle house with electric scrapers (2,4,9), while in addition all farms had some slatted sheds. On two farms the operator area inside the shed was somewhat obstructed. Animal pens were constructed in the operator area of one slatted shed (7) while another used the area as a storage facility (5). On three of the farms domestic type electrical installations were used in older sheds (5,7,9).

On the farms that had cause to access heights (1,2,6,3) three used a loader for accessing heights (1,6,3) as they felt it was more secure than using a ladder. Helmets were not worn while accessing heights, however, one farmer had a helmet but did not wear it as *'they just don't look the part'* (6).   In addition to discussing the hazards of asbestos roofs (3) and Perspex sheeting (2), solutions to the dangers of light sheets were offered.

Workshop

A high level of safety in terms of layout and fittings can be achieved in farm workshops, especially when located in new farm buildings. However, many workshops are in older converted sheds and essentially compromise buildings (HSA, 2001). This was reflected in the case study findings. Two of the farms had a workshop where tools and implements were stored and machinery maintenance took place (1,3). Both observation and discussion revealed that safety was a priority in both of these sheds. Two of the medium risk category farms had tool stores (4,5), one of which was relatively tidy although storage was mostly at ground level (5). The other however was extremely disorganised and untidy and the farmer spoke of 'meaning' to tidy it (4).

Milking parlours

Of the four dairy farms visited, three had herringbone milking parlours (2,3,9) two of which had been constructed over twenty years ago and modified since to accommodate the growing herd (2,3). In each case the pit appeared comfortable and the pit access was not steep. However the fourth farm had an old tie stall parlour, which had not received any modification (4). In each of the accompanying dairies all of the belts on motors were covered and in one case the milking machine and motors were housed in a separate locked house to the dairy (3). Two of the farms had a cabinet in the dairy for storing chemicals and daily veterinary medicines (2,3), while in the others they were stored on the floor. Two of the dairies were always locked at night (3,4). All of the dairies were found to be very tidy and well organised.

5.5.2.3 Cattle crush facilities

Good cattle handling facilities are required on all livestock farms. Farmers are required by law to ensure that their facilities are safe for use by themselves, vets, AI and other technicians, Department of Agriculture and Food officials and inspectors (HSA, 2001). While all farms had a cattle crush in the main farmyard, one farm had a cattle crush on an out farm (2). Six of the farms were found to have very strong crush facilities, while two were found to have old and quite poor handling facilities (4,5). Because of the concerns of handling cattle in a crush, one of the farmers always has a pour-on of the dose he is using in the event that encounters difficulty (3). In addition to crush facilities four farms were found to have restraining gates for calving cows (2,6,7,9), while one farm used the cattle crush for restraining calving cows (5). One of these gates was purpose built and was very strong; it offered complete safety for calving a suckler cow or for a vet to examine a cow (6). On one farm isolation sheds with hooks to tie up animals acted as the restraining facility (4).

5.5.2.4 Slurry Storage

Working with slurry has been identified as particularly hazardous farm activity. Slurry facilities should be properly fenced and precautions should be taken when opening access points to tanks to avoid people falling through (HSA, 2001). Most of the slurry storage facilities viewed were below ground (3,4,5,7,8,9), however, on two farms there was both below ground storage and also an open slurry pit (2,6). Although on both farms a reasonable effort was made to secure the perimeter of the open pit, on one farm it was found to be poorly secured (2). The majority of farms had manhole access to their slurry tanks; however one farmer still had an access which required lifting a panel of four slats (9). Although this system had been present on other farms manhole access points replaced it. Animals were not always released from slatted sheds during slurry agitation (2, 7). In addition there were differences in the practices employed when opening manhole access points and not all points had safety grates below them.

5.5.3 Farm Technology

There are many machines used in production agriculture that are powered in different ways including PTO driveline shaft, electrical power, engine power, hydraulic oil pressure and ground traction. In some instances a machine may be powered by two or more methods. These machines provide a wide variety of hazards to which the farm worker is exposed during operation, maintenance, servicing, adjusting, oiling and cleaning and clearing (Murphy, 1992). In addition agricultural chemicals and stock are also recognised as farm technology as they also reflect the application of science to commercial objectives. While farmer and animal interactions provide both health and traumatic injury hazards, the array of farm chemicals including pesticides, fertilisers, oil products, sanitising agents and veterinary medicines pose as significant ill health hazards (Murphy, 1992).

5.5.3.1 Machinery

According to the HSA, 2001, the prevention of accidents with machinery and equipment should occur on the day of purchase. Section 16 of the Safety, Health and Welfare at Work Act 2005 places particular responsibilities on those that design, manufacture, import and supplier articles for use in the workplace. In addition, the user must be provided with adequate information on how to use the item correctly. *'If accidents are to be avoided the user of the farm machinery must keep in place all the guards provided with the machinery and must adhere to the safe work practices listed in the instruction manual'* (HSA, 2001, P.33)

As would be expected the level of mechanisation increased in proportion to the size of the farm. However, the high-risk dairy farm relied on contractors for key activities and kept less machinery than a farm of its size might suggest (2). In general terms, machinery on all farms were well maintained, however, there were instances of guards broken on PTO shafts (2,4) and missing U-Guards on tractors (4,7,9). Not all trailers used on the farms were found to have brakes and lights, however all cattle trailers had both (3,6,8,9). Two tractors were found to have no Roll Over Protective Structures (2,5); both were kept for the specific purpose of yard scraping. Although neither of these tractors was in roadworthy condition, one made short road trips several times a year (2). Three of the farms each had three reasonably new tractors, which were very well maintained (1,2,6), while two were found to have tractors dated to 1990 (1,7). Six of the farms had tractors which were at least twenty years old and maintained in proper working order (1,3,4,5,8,9). With the exception of the tractors without ROPS, all of the tractors were well maintained with lights, indicators and brakes working properly.

Machinery and tractor servicing was found to take place both on the farm (1,2,3,6,8), and by local mechanics (4,5,7,9). One farmer reported that machinery is not always repaired as soon as there is a problem (4). It was highlighted that regular servicing of machinery does not mean that there will not be problems when the machine is in use as most problems occur while the machine is operational (1,3,6). Two farmers discussed transporting machinery on public roads (1,6). In addition two of the farmers highlighted that it is important to know and respect the limits of agricultural machinery (1,6). Both of these farms have defined procedures for clearing blockages from machinery and do not rely on making a judgement based on the particular situation. In addition one stressed the importance of operator experience while working with machinery (6).

5.5.3.2 Carrying passengers on tractors

There is no safe place for passengers on tractors, with the exception of additional seats in cabs of new tractors, yet the practice is common. Passengers are often taken to save time, for convenience, to teach them how to drive and as a babysitting facility. While experts advocate against carrying passengers, other factors conflict with this advice (Murphy, 1992). Four of the farmers admitted to carrying passengers on tractors (3,4,6,7) while three said it is a practice they never engage in (5,8,9). In addition the danger and dread of carrying a passenger on drawbars was expressed (3), however for one farmer it was acceptable to carry his son on the drawbars (4). Attitudes towards carrying children on tractors varied with the practice found never to occur, children getting tractor rides for their pleasure and children being tied into the cab for safety reasons. Newer tractors were perceived to be safer for carrying passengers, especially children, in the cab (9) while also reducing the ability to carry passengers outside as the cab is sealed (3).

5.5.3.3 Spraying/ chemical use

Six of the farms had spraying machines. Most of those involved in spraying wore masks while spraying and while mixing chemicals (1,2,9,6,3). For some a mask was not entirely necessary as they were operating in a sealed cab or a cab with ventilation.

Two of the farmers admitted that they never wear gloves when handling chemicals or clearing blockages in nossels of the sprayer (3,7). One farmer described himself as careless with chemicals and feels his son is much more careful than he is (2). Methods of chemical storage varied substantially among the nine cases. One farmer had a locked chemical store, which had a warning sign on the door (1), while another has a locked store in the workshop (3). Other arrangements ranged from unlocked cabinets (2,9), locked sheds or unlocked sheds (4,5,6,7) to a redundant deep freeze (5).

5.5.3.4 PTO shafts

There are specific guarding requirements for PTO shafts (HSA, 2001), yet people are routinely injured, killed or experience lucky escapes from accidents involving PTO shafts. These accidents are frequently reported by both the national and farming media in Ireland.

PTO shafts were perceived to be dangerous on all farms and all interviewees said they were conscious of having them properly guarded, although one farmer believed it more important to have PTO shafts guarded when somebody from outside of the farm was using the machine (4). One interviewee admitted that his employee's attitude to guarded PTO shafts was the driver to ensuring that they are all covered (3). For most the 'dread' of coming in contact with an unguarded shaft was sufficient to ensure that they are guarded. Two of the farmers aimed not to break the original guards on the PTO shafts (1,7) and felt that the original guard can often see the machine out. The quality and cost of guards was questioned by one farmer who felt that although they should be compulsory, dealers should not be allowed to sell them at such high prices (2). Despite describing themselves as being very conscious of having PTO shafts guarded, two of the farmers have PTO's which were not properly guarded (2,4).

5.5.3.5 PPE

Personal Protective Equipment is worn by farmers as a last resort, if possible safer products and working conditions should be pursued (HSA, 2001). The use of PPE on the farm feature throughout the discussions and in general it was in relation to particular situations. Behaviours and attitudes varied significantly according to the different types of PPE discussed. The most unacceptable item discussed was the use of a safety helmet for accessing heights. One farmer, who regularly had reason to work on a height, admitted to having two helmets neither of which he wore as they did not look the part. Other items such as coveralls were identified as being impractical and uncomfortable while gloves in certain circumstances were found to be cumbersome. In one case the farmer raised important issues in relation to the use of hearing protection. Often in cases where protection is required, it is necessary for the operator to be able to hear the machine e.g. the sound of bearings slipping. In addition, the use of hearing protection can create a disconnect between the operator and his environment and thus he is less aware of other hazards such as moving machinery in the farm yard.

5.5.3.6 Stock

Only one of the case study farms had no stock present on the farm, this was the large tillage farm. Through the discussions however, it became clear that safety issues are a reality when dealing with all types of stock. One farmer spoke of being more afraid of his ram than his bull. In relation to working with cattle, two very distinct opinions were presented by two of the younger farmers. While one farmer aimed to minimise the amount of work he would do with an animal in a day, i.e. when he had brought the animals into the yard, the other farmer tried too do as much as he could as it was difficult to get the animals in. The first farmer feels that it is important not to try to do too much with animals at one time as this stresses them. To minimise stress he usually had a pour dose for any difficult animals.

Two highlighted their awareness of the temper of suckler cows at calving time and after calving. Four of the farmers had restraining gates for calving cows, which varied quite significantly in strength and protection offered to the operator.
Five of the farms had a bull at the time of the researchers visit while one usually had a bull but had not at the time of interview. On three of the farms that had a bull it was ringed while no farms had chains on bulls or bull pole for handling. The two farmers that did not have rings on their bulls did not entirely agree with the practice, while one felt it was cruel the other thought it did not look good. All of the farmers spoke about being conscious of the bull; however two of the farmers described their bull as being quiet. One farmer felt quite vulnerable because of his age and limited mobility and thus always herded the cattle and bull from his Land Rover.

Generally bulls were found to be over wintered on slats, however one farmer had an old farm shed which was used for over wintering the bull. This shed appeared far from ideal as there was no protective barrier between the farmer and the bull for bedding and feeding. On one farm the bull was out wintered as the farmer believes housing bulls makes them more aggressive.

5.5.4 Factors having an indirect influence on farm safety

In the course of the interviews the effect of work scheduling and additional labour was discussed with the farmers. The impact of these four factors on their work was described.

5.5.4.1 Work scheduling

Glasscock *et al*, 1997 proposes that in order to manage farmer stress as it affects farm accidents, tasks should be planned in order to manage time and labour effectively. Most of the case study farmers said they always have an informal schedule, however, it is never written down (1,3,5,7,8,9). For one farmer scheduling of tasks was viewed as being very important as it allows him to deal with unforeseen circumstances (3). While in one case the farmer described himself as working to a rough schedule (2), another said he did not schedule tasks at all (4). One farmer has a rough weekly plan, which allows for interruptions (6). Although all but one farmer was involved in informal work scheduling, none had a written schedule of activities, which could be referred to in the event of unforeseen circumstances arising.

5.5.4.2 Labour

All of the farmers interviewed required additional labour at certain times of the year or when undertaking certain farm tasks. Although some had formal arrangements in the form of a full time labourer (3), or seasonal labourers (1,6), others relied on help from family or neighbours (3,5,7,8,9). On one farm the wife was very involved in the farm work (5) and a further three of the cases relied on a labour input from their wife (2,3,8). In one case both the farmer and his brother were full time employed on the farm (6). Eight of the interviewees are full time employed on their farms. Although being described as a part-time farmer, one farmer explained that in addition to his farm work he is full-time employed outside of the farm (7).

5.5.5 Conclusion

While the interaction of man and his working environment provide the context for the occurrence of occupational accidents, the case study findings illustrate the complexity of this interaction. According to the HSE (2001) successful organisations generally excel in health and safety as the skills and expertise that make the business itself a success are also employed in making health and safety in the organisation successful. This was quite clearly illustrated from the case studies in that farms where general farm management appeared to be good, the management of safety too was good.

While all farms ascribed an importance to health and safety as part of their work on the farm, this was clearly not translated into actions on the ground. A number of complex 'farmer' factors were explored in the research and the results are very interesting. By and large these farmers knew and understood the hazards present on their farms and the risk associated with these hazards. However, in many instances the farmers engaged in the risk, often to save time, because they always do it and have never gotten caught and often out of habit. In addition, where PPE could be used to eliminate or minimise the risk of the hazard farmers chose not to use them. Again as before, they understand the risks and the benefits of using the PPE.

Various aspects of the working environment were found to be hazardous by the researcher and in most cases the farmer also recognised the hazard. However, in relation to cattle handling facilities, farmers were working with restraining mechanisms (crushes, restraining gates) that were weak, badly rusted to the point of rotting and where the farmer was required to operate in a position that compromised his/her safety. The researcher found that none of these farmers truly appreciated the hazardous nature of these facilities; this fundamental lack of awareness was not found in relation to any other issue during the course of the case study research.

With the exception of two farmers, the remainder of those interviewed had inherited working environments which had inherent safety problems due to layout and design of structures that had not been improved. Obviously many factors impacted on the development of the actual facilities on these farms but one farmer begged the pertinent question *'How did we get it so wrong?'*. In reality development on farms was restricted in many ways. Many of today's problems were great solutions of the past, open slurry pit storage and asbestos roofs being two that were discussed in the interviews. While once innovations that were grant aided on farms, they are now hazards in the working environment which do require significant investment to resolve.

While all of the factors discussed above independently have an impact on health and safety on the farm, as Murphy (1992) discussed there is a synergistic effect of these factors of farm safety.

The use of the categorisation of farms according to high risk, medium risk and low risk requires some final comment. While those farms that were identified and determined to be high risk were in fact found to be so, in the main the approach to risk and the management practices employed on these farms served to minimise the level of risk present in the farm environment. Indeed, while some farms were categorised as low risk they did in fact have quite a high level of risk in the environment. Factors such as older technology and buildings, less defined protocols and a less structured management approach served to increase the risk in environments, which logically would be determined as low risk. It is evident from this analysis that risk determination is very much dependent on specific factors in individual farm environments.

CHAPTER 6
A MODEL OF HEALTH AND SAFETY IN FARMING: THE FARM SAFETY TRICHOTOMY

6.1 Introduction

The results of the Survey of Health and Safety on Irish Farms and the case study research provided an insight into the factors which influence the safety of Irish farms. Many models in safety research are constructed to represent the process of accident occurrence and thus present options for prevention (chapter 2). These models focus on the genesis of accident occurrence. However, few models examine the factors that generate risk in a particular environment. It is necessary to understand how unsafe behaviours, environments and social structures are created and how they can be changed to the better (Svanström, 1999). Accident statistics do not provide a true reflection of the real status of occupational accident risk. It is necessary to develop ways of recording the information which provides an accurate understanding of the manner through which individual workplaces are made dangerous (Dunne, 2000). The lack of knowledge that exists in relation to risk factors associated with farm injuries has long been identified as an impediment to prevention efforts (Layde, 1990). The following model has been designed from the findings of the literature review, quantitative and qualitative studies to provide a context in which health and safety exits on farms.

The research has identified factors at three levels: person, environment and technology, which interact to determine the status of health and safety on farms. At each level of the research individual factors have been identified and discussed which form the principle components of the farm safety trichotomy. This model platforms the status of health and safety on Irish farms, while also providing the context for analysing, interpreting, manipulating and improving farm safety into the future.

The objective of this chapter is to:

- Design a model that defines the context in which heath and safety exists on farms.

The case study findings defined the important and independent role that technology plays in health and safety on farms. The challenges and stressors presented by technology in the case study findings identified the need for technology to be portrayed as a separate entity to the farm environment. The findings of the literature review did not platform technology as a pivotal element of the health and safety dynamic on farms. Technology was portrayed as a function of the farm environment. However, the case study findings show that farm technology interacts with both person and environmental factors. Technology differs significantly between farms. The compatibility of technology to both person and environmental components has the potential to positively or negatively impact on farm health and safety. Going forward technology will be represented independent of farm environment. The factors that comprise technology will be outlined and the dynamics of the relationship to person and environment factors explored.

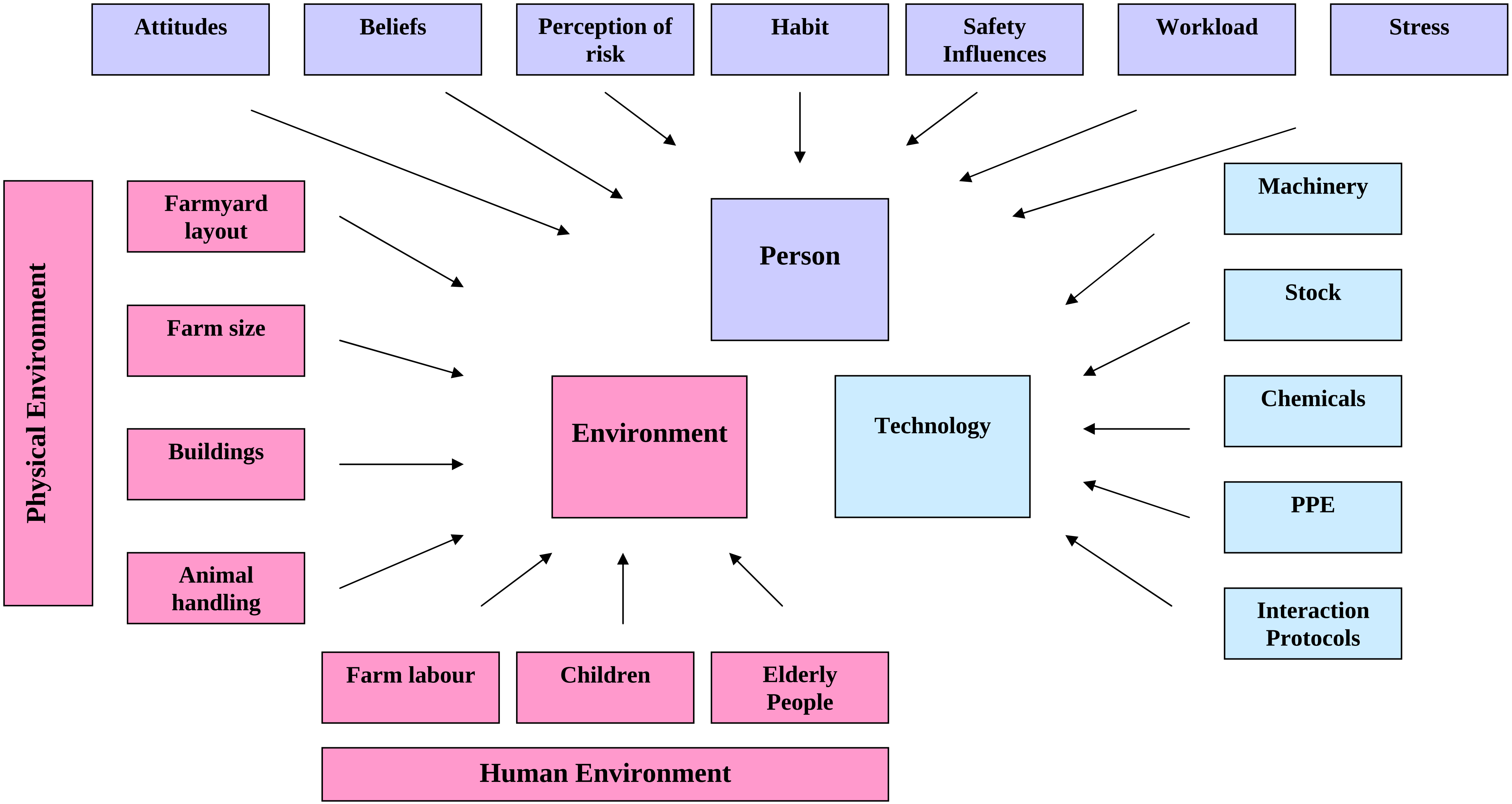


Figure 6.1: Factors identified as having an influence on farm health and safety

Figure 6.1 illustrates the three components: person, environment and technology, which have been identified as the fundamental components of the farm safety trichotomy. Further, figure 6.1 illustrates the individual factors which are the constituents of the three components. The environment component in the model has been divided into physical and human environment. Figure 6.2 illustrates the farm safety trichotomy which has been distilled from the above.

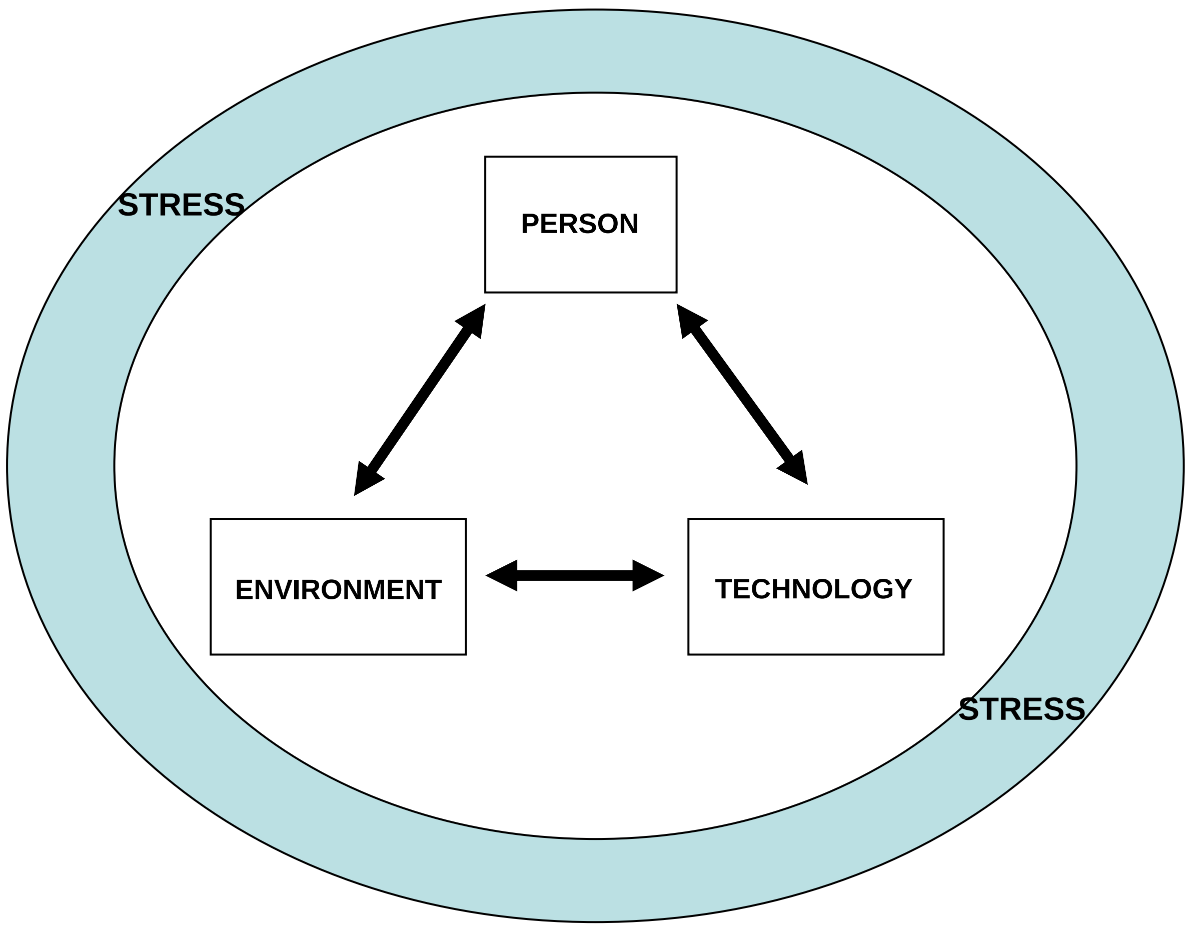


Figure 6.2: Farm Safety Trichotomy

6.2 Evolution of the model

The trichotomous model illustrates the dynamic relationship, which exists between the person, environment and technology characteristics of farming. From the literature review, the SHSIF and the case study research key person, environment and technology factors were identified as having an influence on farm health and safety. The model evolved in three stages.

From a thorough review of the health and safety literature, a conceptual framework was developed. Glasscock *et al*., 1997 developed a model of farm accidents, which assumed that risk situations arise as a function of both person and environmental factors. Glasscock's model reflects the overriding opinion from literature that person and environment are the principle components of farm health and safety. The literature review identified both the person and environment characteristics of farming which have an impact on health and safety. In addition, both the injury characteristics and the factors associated with injury risk related to either the person or the environment were identified (Chapter 3). Additionally, proactive strategies and prevention strategies are defined as either safe place strategies or safe person strategies (Section 2.4.2) as they act on the fundamental elements which give rise to accidents. Thus, person and environment were identified as the fundamental components of a farm health and safety model. This dichotomous model was applied to the design and analysis of the Survey of Health and Safety on Irish Farms in chapter 4. The case study research further pursued the relationship between person and environment characteristics as they apply to farming. The study sought to establish the reality of this relationship, how both components interact and the implications of this interaction for management. Dunne (2001) asserts that official accident enquires illustrate that the majority occur in the context of personal and interpersonal, technological and organisational situations in the workplace. In the case study research a clear distinction emerged between technology and environment components of health and safety. The analysis distinguished between the working environment and the technology that is employed in the environment. In this sense, technology was defined as the application of science to industrial or commercial objectives and thus included machinery, livestock, and chemicals. In addition, a distinction was made between the human and physical constituents of environment. The case study analysis clearly identified that person, environment and technology characteristics are discrete components of farm health and safety, each containing factors which interact during the course of farm work. It is within these interactions that the negative effects of individual factors result in negative safety outcomes and the positive effects ensure that activities are pursued without any negative consequences.

The model depicts the health and safety trichotomy in an environment in which stress is inherent. While stress was identified as an important person characteristic, it has been separated from the trichotomy as a result of the complexity of its interaction within the model. This is further discussed in section 6.3.4.

6.3 Model components

The following section examines each of the components of the farm safety trichotomy in detail.

6.3.1 Person

Person characteristics are identified as fundamental elements of the farm safety trichotomy. As discussed previously, person is comprised of the person factors which bear an influence on health and safety. It does not relate to the human presence implicit in health and safety. The literature review established that person characteristics interact with other mechanisms upstream (pre-accident) and result in harmful consequence to the human factor downstream (post-accident). Interaction can take place between characteristics of person and environment or person and technology, or between person and an environment/technology interaction. If interactions result in negative outcomes they can potentially cause harm or loss to the human factor.

The perceptions, attitudes and beliefs held by people have a significant impact on health and safety. While this was established in the literature review (chapter 3), crucial contradictions were observed and analysed (chapter 4). Farmers evaluate the danger on their own farms based on whether they experienced an accident or not. Risk perception at farm level is based on accident occurrence. Both the SHSIF and the case study research and the supporting literature indicate that farmers in general do not perceive that their occupation is dangerous. This was epitomised in the case study research by a farmer who had sustained three serious injuries resulting from three separate accidents asking the researcher if she was afraid to drive her car because of the associated accident rate. According to Dunne, 2000, P.30, *'Awareness of risk is the crucial factor in improving safety at work'*.

Socialisation into the working environment emerged as an important factor in the case study findings. This exhibited the importance of the persons learned experience which was discussed in (chapter 3). *His* (man's) *evaluation of what is safe and how safe is safe enough is governed by the cultural influences to which he was exposed during his formative years, influences that further shape the deeper causative factors implicit within his unsafe behaviour*' (Cooper and Germain, 1974, P. 23)

The case study findings illustrated the impact of safety socialisation in the workplace. Two participants had been positively influenced, in safety terms, by their father during their formative years. In one case the safety socialisation took place before the individual began working on the farm; the relevant knowledge and skills were acquired while working with her father in a non-farming environment, however, this process had an effect on her farm work at a later stage. One of the principle effects of positive safety socialisation in the workplace is that people have an awareness of risk and when they may be in danger. In accident prevention terms, Dunne (2000) advises that it is futile to expect people to react to exhortations about behaving safely because they simply do not believe they are in any danger. Safety socialisation in farming is an extremely important person factor.

The percentage of time spent farming has been associated with farm injury risk and is represented as workload in the person characteristics (chapter 3). The case study analysis highlighted the different perceptions that exist among farmers of their own workloads. The farmers spoke of periods of pressure, which in tillage farming, for example, can last up to two months. Farming as an occupation provides variable workloads which are greatly influenced by the seasons. Work overloads occur at busy periods on the farm when work is heavy and labour units are low, while work underloads occur while carrying out repetitive, boring tasks and when working alone (Aherin, 1992). Leahy (2003) reported on labour use on suckler farms which was found to be lowest in December at 8.32 hours. Therefore at its lowest, labour input on suckler farms is similar to that of the average for all in the workforce. Age also has a bearing on workload. Many farmers that continue to farm beyond retirement age are trying to maintain the level of work which they had previously engaged in. The case study analysis highlighted that case of an aging farmer in poor health that who often found himself working excessively long days in order to complete certain jobs. Given that over 27% of farms in the ROI are owned by farmers over 65 years of age (CSO, 2002). It is likely that this is not an isolated case.

6.3.2 Environment

The environment represents the actual workplace or the farm. The work environment refers to a concept broader than just the farmyard. It represents both the physical and human environment. The physical environment represents the built environment and the structural elements of the farm. The human environment represents the people that are present, at any time, in the farm environment.

Farm work takes place at locations other than farmyards, which include fields, homes, public roads and forested lands. In addition, not all work that takes place on farm is indeed production agriculture work. The farm is a site where contracted agricultural service, veterinary, mechanical and contract builder activities take place in addition to many activities relating to the home (Murphy, 1992). The case study findings illustrated the level of integration that exists on some farms between the home and the farm, which have no physical division in some cases. Environmental characteristics were identified in the literature as being associated with an increased level of risk on the farm (chapter 3). Many characteristics of the farm have been identified as being critical to health and safety management. Both the size and system of the farm were found to be significantly associated with injury on Irish farms (chapter 4) in addition the site and farm layout and farm facilities were identified as factors impacting on farm safety (chapter 5).

The size of the farm unit certainly has an impact on safety and health issues (McNamara *et* al, 1997; Zhou and Roseman, 1994). Farm size is proportionately associated to the level of risk on the farm (chapter 3, chapter 4). Larger farms are higher risk environments. Accident risk is largely determined by the types of work activity (Rasmussen *et al*., 2000). The size of the farm will inevitably determine the level of a particular work activity. Farm size also impacts on the level of farm technology. The case study research suggests that farmers and employees on larger farms do indeed have a greater exposure to risk in their work environment. However, that is not to say that smaller farms are without risk. A similar situation to that presented by Murphy (1992) was observed in the case studies in that smaller farms were frequently working with older technology, in an older environment which was sometimes less well maintained than that of larger farms. In addition, they may have a limited budget for farm improvements and often have a lower level of management skills.

According to the reviewed literature, the system of farming is associated with farm safety. While specialist dairy farms experience the highest proportion of injuries in Irish farming (chapter 4, McNamara & Reidy, 1997), tillage farms have a significantly higher incidence of injury than other systems (chapter 4). In addition, safety issues differ for the individual systems according to the seasonal requirements of the particular system (chapter 4). Undoubtedly, system of farming has a bearing on health and safety. However, it is important to emphasise that while there appears to be higher levels of risk on certain types of farms, no system of farming is without risk. Traditionally, farms in the ROI have developed on the same site as the family dwelling. In many cases there is no structural boundary between the family home and the farm. In other words there is nothing physically restricting the movement of people between the working environment and the home. Clear differences in farmyard situation were reflected in the case study research. In addition, single entrances serving both the house and farm yard remain common.

In Ireland farmyard development has commonly been restricted by the site and layout of the original farmyard. However, in the case study research one farmer spoke of the mistakes made in farmyard design given that he had started with a green field site. The case studies profiled the differences that exist in layout and size of farmyard in the ROI. Large farms were found to have large spacious farmyards, while the smaller farms had smaller yards with noticeably less planning (chapter 5). As many farmyards were designed in the past, they were designed with the needs of the system at that time in mind. The changes in labour supply on Irish farms in recent year’s means that the current labour input often can not effectively operate within the design without modification (Ruane and Phelan, 2003). The highest proportion of injuries was sustained in the farmyard (chapter 4). This is consistent with findings from other research (chapter 3).

In the ROI there is a great deal of farm fragmentation which has been identified as having a significant association with labour use (Leahy, 2003). Farm fragmentation has implications for safety as machinery and animals are moved along public roads (chapter 5). In addition, specific locations on the farm were associated with a higher incidence of injury (chapter 3 & chapter 4) while time of injury occurrence was associated with farming system (chapter 4). The case study findings brought to the fore the variation that exists in the standard of the physical working environment on different farms (chapter 5). These standards may be the difference between an accident occurring or not and in the event that it did, resulting in injury or not.

The case study findings reflected the mix of both old and new buildings which exist in Irish farmyards. The older buildings were all significantly smaller than the new structures and generally had smaller entrances. All of the older farm buildings were found to serve a purpose on the farm. In some cases the facility was less than ideal for its current purpose. An example of this was a small shed which was used for housing the bull. The shed had one small entrance that led the operator directly into the bull pen. In some cases modification of farm structures were seen to be very successful and aimed to provide ease of operation for the farmer, others however appeared to have the sole purpose of providing capacity through minimum investment. In addition, workshops were more often found in small dark sheds as opposed to large bright well-fitted sheds on other farms.

Other structures such as open slurry pits, silos, silage pits and cattle handling facilities present challenges for farm safety. While other countries opted for above storage of farm manure in the past, Ireland used open slurry pits for the storage of farmyard manure. These storage facilities are still widely used throughout the country and some are still found to have inadequate or no perimeter fencing. However, slurry storage improvements were the principal safety changes implemented on farms (chapter 4).

The case study findings also reflected the variation which exists in the quality of animal handling facilities which are present on Irish farms. Crush and isolation facilities were found in some instances to be very strong and offered ease and safety of operation for the farmer. However, others were found to have crush facilities in which the upright bars were severely rusted, lacking a catwalk and required the operator to work from within the holding yard.

The human environment encompasses farm labour – including the principal operator, children, elderly people and others outside of the farm family who have reason to be present in the farm environment. Farm labour is undoubtedly the most significant presence in the farm environment in terms of time spent. However, it is evident from the literature and statistics that there are significant health and safety concerns for other people outside of this category, principally children and elderly people. While other groups of people emerged during the course of the case study research, they were not studied to same the degree as those central to the farm environment and are thus not included in this discussion.

Children are involved in the working activities of the farm for many reasons. According to Murphy (1992) farming parents face difficult child safety issues such as, children working on the farm because of economic necessity, parents wish to instil a sense of responsibility and work ethic, lack of childcare facilities and a cultural tradition which sees the farmyard as a giant playground for children. The obvious solution to childhood injury on the farm is to eliminate children from the farmyard altogether and thus eliminating the possibility of injury. However, in many instances the lack of a distinction between the home and the farmyard results in children not only being injured while working on the farm but frequently while playing on the farm. The results of the SHSIF show that almost one third of the respondent farms did not restrict children from certain areas of the farm yard. In addition, on certain farms children were permitted to engage in hazardous activities. The case study research clearly exhibited the value and importance placed on children participating in farm activities by farm families. Supervision and assigning age appropriate tasks were highlighted as the key management tools for integrating children into farming activities. Positive socialisation into the farm workplace is an important determining factor in farmer safety behaviour into the future.

In addition, both the literature and the case study findings illustrated the risk associated with elderly people in the farm environment. The physical limitations of the ageing process were detailed in the case study analysis – a clear conflict emerged for elderly farmers who wish to continue farming yet they are physically restricted. In addition, another case detailed the conflict which emerges for families when an older family member is experiencing dementia yet is still physically fit to engage in farming activities.

6.3.3 Technology

No distinction was made between the environment and technology in the literature or the accident models reviewed. However, the case study findings reflected a distinction between the environment and other components of the farm, such as machinery, chemicals and livestock, which have an impact on farm health and safety. These elements have been collectively grouped as technology for the purpose of the model. The use and application of these technologies in contemporary agriculture is guided and driven by science in an attempt to yield economic returns. The farm environment is one that has become progressively more technologically intensive and will continue to do so into the future. Technology was differentiated from the environment after the case study analysis as the importance of equipment, chemicals and livestock as factors in farm health and safety became more apparent. These technologies give rise to risk on the farm, which could be managed through environment or person interactions. These risks may be contingent on environment factors but not always and are in many cases they are inherent to the technology.

There are a multitude of machines used in farming which are powered in numerous different ways such as PTO drive shaft, hydraulic oil pressure, electrical power, engine power and ground traction. In some cases components of one machine may be powered by two or more methods. Interactions between animals and farmers provide the opportunities for both health and injury hazards to the person. While the variety of chemicals used in agriculture are frequent farm hazards (Murphy, 1992).

The SHSIF presented alarming findings in that on almost 29% of the respondent farms not all PTO shafts which were in use on the farm were properly guarded. Less than half of the respondents had the brakes on their tractors checked at least once a year while almost 20% did not check the lights on tractors before each winter. The case study analysis provided different perspectives on machinery maintenance. Machinery is not always repaired as soon as a problem becomes apparent, often tasks are completed and the machine returned to its shed without being adequately repaired. However, regular servicing of machinery does not guarantee that there will not be problems when the machine is operational. Ensuring that all maintenance and repair work is carried out, one farmer keeps a machinery logbook into which problems are recorded and crossed off when repair work is completed. When working with machinery that is required to intake, pull, chop, grind and mix material, blockages and stoppages are not uncommon. Often when people are required interact with machines to clear a blockage or thread a bailer it is at busy pressurized periods. So do machine interaction protocols exist in farming? Do farmers simply rely on circumstances of a particular situation to determine how they interact with the machine? In the course of the case study research two farmers spoke of defined procedures for interacting in this way with farm machinery. In one case, the procedure is so clear that before entering the body of the combine harvester the person who enters put the keys into their own pocket. In this situation, the worst that can happen is that the key can be mislaid!

Many traumatic injuries, ranging from minor injuries to fatalities occur during the routine handling of animals on the farm (Murphy, 1992). The more cause there is for interacting with animals, the greater the risk of injury. The larger the animal the greater the likelihood of injury and the greater the severity of injury. Certain animals such as bulls and recently calved cows are by their nature more aggressive than others. At the outset, animal interaction, similar to machinery interaction requires a defined protocol at farm level.

6.3.4 Stress

The case study findings indicate that stress is a person factor that has an impact on health and safety. However, the literature suggests that while stress impacts on work activities, the working environment and associated activities may in fact have an impact on stress. Recent research found that in addition to safety behaviour, stressors and stress symptoms were found to be good predictors of farm work related injury (Glasscock, 1999; Thu *et al.,* 1997). In addition, the most important stressor in this regard is perceived economic problems (Glasscock, 1999). Research on farm stress in

America has consistently found that difficult financial conditions are the primary source of stress experienced by farmers and farm families (Simpson *et al*, 2004; Thu *et al*, 1997).

The relationship between stress and injury is complex in its very nature. Glasscock, 1999 has proposed two different mechanisms through which stressors can lead to accidents. Deliberate unsafe acts characterized by risk taking can result from a single stressor, time pressure, for example. In this situation the stress is not of the magnitude that results in reduced capabilities, however, reduced cognitive abilities or errors can also increase risk and give rise to accidents through this mechanism. In addition, stressful working conditions may result in increased injury risk for those that are not themselves stressed. Neglecting safety rules or failing to tidy up in a stressful work environment causes hazards for others (Galsscock, 1999).

In terms of the dynamic that exists between the farmer, environment and farm technology the farm safety trichotomy illustrates the interaction between this dynamic and stress. Similar to the above mechanisms discussed by Glasscock, the case study findings reflected the presence of both single stressors and those impacting on chronic stress levels on Irish farms. Weather, time pressure and machine breakdowns are single stressors which have an affect on the person, environment and farm technology trichotomy and consequently impact on stress and risk taking. Other stressors such as financial worries, family pressures and business management pressures do not necessarily occur within the safety trichotomy, yet over time they may have an effect on cognitive abilities. Thus stress is found to have a reciprocal relationship to the interactions within the safety trichotomy. This relationship has a significant impact on farm safety. Similar to man, machines too have limits. And like man often the workload of a machine may be stretching the machine to the limits of its capabilities. In the case study research, on two machinery intensive farms the farmers spoke of knowing and respecting the limits of agricultural machinery.

6.4 Model interaction

The safety trichotomy provides the context for analysing, interpreting, manipulating and improving health and safety on Irish farms. Within each component of the trichotomy there are factors that exert an influence on each other and on the other model components.

The most significant interactions are the person – environment interaction and the person – technology interaction. Person factors such as attitudes, beliefs, safety socialisation and perception of risk influence how humans interact with the working environment and the farm technology. In addition, the interaction between environment and person, and technology and person characteristics impact on the attitudes, perception and beliefs of the farmer. These interactions impact on the schema or working model, which the farmer builds up relating to specific jobs (Dunne, 2000).

Interactions between technology and the farm environment influence safety on the farm and lead to increased risk in the environment. These interactions may involve person factors.

The trichotomy interactions have a reciprocal relationship to stress. The interactions between factors in the trichotomy as shown above exert an influence on stress and similarly stress can exert an influence on these interactions.

6.5 Moderating the interactions within the safety trichotomy

From the research it emerged that management plays a central role in influencing the characteristics of each component of the trichotomy and moderating the interactions between the components. The stages of farm management have been discussed earlier (chapter 2), and clear similarities were identified between these and the elements of successful health and safety management. According to Häkkinen, 1978 as refereed by Suutarinen, 2004, hazards must be examined as factors of the production system; they are not isolated factors. In addition, Reason, 1997, states that management and other underlying injury risk factors in production are concealed in supposed latent, general failures.

Numerous injury risk factors were identified on the individual farms in the case study analysis, which on examination reflect more than just a hazard. General housekeeping on the farms varied quite significantly, with one in particular being quite untidy. The level of planning engaged in by farmers was apparent from the interviews. On one farm in particular, planning and monitoring appeared to be fundamental to all the business functions, including safety management. However, in other cases the impression that general management appeared wanton at times was very strong and this was true for safety management on the farm. The case study analysis indicates that safety management on the farm is a function of farm management and the farmer's ability to manage successfully. It appeared that where the skills were present to allow for successful management of the farm business they were also applied to the management of safety.

Literature implies that although safety is a function of management, farmers do not have the skills required to adequately manage health and safety on their farms. However, the skills that are required for the successful management of health and safety are no different to those required for successful farm management. When safety is part of a groups norms and culture, irrespective of individual tendencies toward risk taking, individuals will be more likely to conform and work safely (Dunne, 2001). According to Lindsay, 1992 the creation of a positive safety culture helps achieve high safety standards. Traditionally farming in Ireland has not had a positive safety culture and thus safety was not identified as an important and rewarding element of farm management. However, from the case study analysis it is clear that there are farmers that identify safety as an integral element of farm management which does add to a successful farm business.

Management acts as a moderator of the safety environment. Effective safety management practices impact positively on safety. Overwhelming, management has the ability to impact either positively or negatively on the interactions within the safety trichotomy and as such impact on safety and health outcomes on the farm.

6.6 Conclusion

The health and safety trichotomy presents the components which interact on a daily basis on Irish farms from which accidents can potentially result. Health and safety has not been traditionally part of the norms and culture of Irish farming. The case study findings suggest that certain farmers, particularly younger farmers, with large commercial operations have recognized the importance of safety in their working life. These farmers are goal orientated; they want a good quality of life that is free from injury or ill-ness. Thus certain farmers have begun to assimilate safety into their general farm management. For others however, safety is viewed as a peripheral issue that is distinct from farm management issues. In this situation farm safety is in danger of becoming a ‘paper shuffling exercise’ in which farmers will aim to meet their legal requirements and no more. According to Dunne (2001) this situation does real harm to the cause of working safely. People that complete audit documents and ‘shelve them’ and hear no more about it soon develop a cynical attitude and will act accordingly. Farmers must be encouraged and motivated to do more than complete farm safety assessment documents. A more holistic approach to farm management which situates farm safety on the same level as activities such as farm financial planning and production management should be aspired to by farmers, farm representatives, extension agents, educators, researchers and policy makers.

CHAPTER 7
DISCUSSION AND CONCLUSION

7.1 Introduction

This chapter presents a summary of the main findings of the literature review. The Survey of Health and Safety on Irish Farms and the case study research. In addition, the chapter discusses the implications of the research.

7.2 Purpose of study

This thesis set out to assess the status of occupational health and safety on Irish farms and subsequently to provide the level of understanding of this area that is required for intervention activities.

The rationale behind this study was that there was an absence of up to date comprehensive accident and injury statistics pertaining to Irish farming. This gave rise to a reliance on fatality statistics as a benchmark of the safety status of Irish farms. Further, the Irish research previously undertaken focussed predominantly on the incidence of accident and ill health occurrence on Irish farms, which provided little understanding of the safety dynamic on farms.

Ultimately the research sought to provide an understanding of all of the factors related to health and safety on farms in an attempt to provide meaningful insights that would serve the cause of injury prevention and safety promotion in the farming community in Ireland.

7.3 Summary of Methodology

Initially a comprehensive review of health and safety literature was undertaken. The literature provided an understanding of the terminology, models and structures employed in the study of workplace health and safety and provided an understanding of farm health and safety, accident and injury. Subsequently, a quantative study was designed to determine the level of injury occurring on Irish farms and to gain a better understanding of the person and environment components of safety on Irish farms. This study was designed based on the model used in two previous Irish studies that examined the incidence and nature of accidents on farms. This research involved a survey which was administered by trained recorders on 1119 Irish farms. The survey population was weighted to be representative of all Irish farms.

The second phase of the research employed a qualitative methodological approach, which consisted of nine case study interviews that incorporated a farm walk through. These farms represented high risk, medium risk and low risk farms as determined by a risk index. This study sought to examine the reality of health and safety on Irish farm and how safety is incorporated into day to day farming activities.

The final stage of this research is the construction of a farm health and safety trichotomy model which provides the context in which health and safety exists on Irish farms. The model has three components and illustrates the significance of stress in the farm environment on farm health and safety. The model illustrates the interaction between person, environment and technology characteristics on the farm.

7.4 Main findings of the research

This research has identified the factors and conditions at farm level which give rise to risk and ultimately accidents and injury on Irish farms. This has been detailed in the farm health and safety trichotomy in chapter 6 of this thesis. The model provides an understanding of the dynamics that are involved in creating unsafe working conditions on Irish farms. As such, it provides the insight required for the development of both farm level and industry level farm safety interventions. Constructed using the findings of the literature review, quantitative and qualitative analysis, the model explores the interaction of different factors and the consequent safety implications. The principal findings of the thesis are detailed below and have been presented based on the components of the model.

7.4.1 Person

The literature review identified the person factor as the most fundamental component of occupational health and safety on Farms. The quantitative study examined the human toll of occupational injury in addition to the examining the perceptions, beliefs and attitudes towards health and safety of those engaged in farming. The qualitative study further pursued the interaction between the person and the farm environment from a safety perspective.

The findings indicate that Irish farmers evaluate the level of safety of their farm according to whether or not they have experienced an accident. Irish farmers predominantly recognise that farming is dangerous however; they do not believe that their own farms are dangerous working environments. Similar findings were put forward by Elkind, 1993. Further, farmers do not believe that farming is more dangerous than any other occupation. The anchoring bias discussed by Dunne (2000) may have some effect on farmers' perception of danger. The majority of farmer communication regarding health and safety focuses on fatality statistics and accident levels to a much lesser degree. Because the number of fatalities presented is actually a low number farmers perceive that this happens to so few people that they are not at risk. In addition, the emphasis on fatality and accident statistics as a measure of safety in farming results in farmers applying the same measurements to their own farms rather than identifying and evaluating the risk present in their environment.

There is a major disparity between farmers perceived concern about safety on the farm and the action that they take in relation to farm safety. This was exhibited in both the results of the SHSIF and in the case study findings. The most blatant example was that while the majority of farmers described themselves as concerned about farm safety fewer than one in ten had completed a safety statement. The case study farmers that had compiled a safety statement had some similarities, both had been inspected by the HSA, they were young motivated farmers and they exhibited a high level of management capability. Murphy's assertion that all farmers do not have the tools for engaging in thorough and continuous health and safety management (Murphy, 1992) appears to have relevance in the Irish context. The results concur with Byrnes assumption that farmers who have expertise in management and manage successful farm businesses will have the ability to effectively manage health and safety (Byrne, 1995). The survey found that the majority of farmers themselves felt they required more information on health and safety.

Only two of the case study respondents believed that all accidents, without exception, are preventable. It became clear that some farmers believe that accidents are phenomena over which people have little control. The case study research illustrates that there are instances on Irish farms where the farmer does not recognise the risk associated with a particular circumstance. However, in the main farmers can recognise hazards and their associated risk yet they are very often willing to take the risk. Machinery and tractors were perceived as the principal agents most frequently involved in accidents (SHSIF).

Safety socialisation in farming has a significant impact on the attitudes and beliefs that people develop towards farm safety. The findings show that on farms where the farmer experienced positive safety socialisation in the work environment, regardless of whether it was farming safety was a greater priority. This is substantiated by the literature discussed in chapter 4 on safety socialisation. The findings also exhibit that few farmers had undertaken specific health and safety training and thus relied on informal observation, as Knapp, 1966 described, for health and safety training.

The importance of engendering a safety culture in Irish Farming cannot be overstated. In discussing safety culture Murphy (2003) uses words such as ‘reinforced’, ‘ingrained’ and ‘commonness’. These words all emphasise the fact that safety beliefs, attitudes and behaviours are learned when we are children and become stronger as we grow older. Embracing positive safety socialisation on farms at an early age may be of greater merit than determining that children and young adults should not be involved in farm activities. As Green (1999) outlined, farmers with spouses and children have an increased perception of susceptibility. This was also illustrated in the case study research and as such it is likely that this group of farmers would be receptive to improving farm safety. There is a real opportunity to influence future generations of Irish farmers and indeed at present their parents, by developing interventions which will enable these farmers to positively socialise their children into the working environment.

Stress is another fundamental person factor that has an impact on farm safety. Both the literature review and the case study findings illustrate that farming is a stressful occupation. Farmers experience the same stressors as the rest of the population, however they also experience stressors, which are particular to farming. The literature identified a relationship between farmer stress and safety. This association is also indicated in the survey findings. In all of the farming systems, the incidence of injury was greatest at periods of highest activity and pressure on the farm. It is not possible to determine the strength of the relationship between stress and injury occurrence on Irish farms from this study. Therefore, we cannot rule out the assertion by Yuchtman-Yaar (1991) that this relationship is related to self-employment rather than farming.

7.4.2 Environment

The environment represents both the physical and human environment and thus components of each are discussed below.

Farm work related accidents result in a high level of injury in the farm population in Ireland. Over the five-year period examined, on almost one in ten farms a farm work related injury was found to have occurred.

Farm work related ill health problems are not explored in great detail in this study; however, the results suggest that the extent of occupational ill health problems on Irish farms exceed that of occupational injuries. Similar to the profile of those injured on farm, the vast majority of the ill health cases involved the farmer. The two over-riding ill health outcomes on Irish farms were back pain and dust related allergies. Almost three in ten of the ill health cases were classified as severe and a similar proportion reported that the ill health problem was persistent.

The findings illustrate that farm injury places a substantial burden on the medical system in Ireland.

At farm level the impact of injury is significant with the vast majority of farm work related injuries reported requiring treatment in hospital and a high level of impatient admission. A high level of surgery resulted from injuries and the length of rehabilitation was found to be significant in many cases. As a result, injured persons were required to take time off work and in the majority of cases alternative sources of labour were required. Family members predominantly provide this labour. The results found that economic loss to the farm business resulting from injury was common, however, this loss was not quantified in this study.

This research illustrates that the human factor is fundamental to occupational health and safety on Irish farms. The literature review indicates that the person was central to safety. The results provide a keen insight into the attitudes, perceptions and beliefs of farmers relating to safety and the factors which impact on these.

Certain farm characteristics have an impact on injury occurrence on Irish farms. Size and system of farming were both found to have an association with injury and these associations were supported by the literature. Large farms (< 40 ha) experienced significantly more injuries than smaller farms. However, the case study analysis showed that while this is true, larger farms exhibited a high level of safety management and the working environments were markedly better from a safety perspective than the small farm.

The results indicate that system of farming is a significant factor in accident and injury occurrence. In Ireland tillage farms experience significantly more injury than other systems of farming while farms with dairy enterprises were also found to experience significantly high proportions of injury. The case study analysis illustrated that vast differences exist in safety considerations between the different enterprises. The range of risk factors varies significantly. The particular enterprise in which a farmer is involved dictates much more than simply the end produce from the farm. The type of accidents and the location in which accidents occurred differ according to farming system and size of farm and thus could not be effectively impacted upon by generic intervention programmes. As a result, system of farming should be considered as the single most important factor when developing interventions. General safety interventions or mass appeal safety messages cannot be effective. Murphy (1992) as discussed in chapter 4, questioned the effectiveness of the mass appeal approach as it does not account for the reality of farm situations. As Dunne, 2001, so rightly observed we are all receptive to education and we inherently seek a better understanding of our environment. Farm safety interventions, whether safety messages or courses should be designed to provide specific information to specific people, which is relevant to their situation.

In Ireland the physical farm environment has predominantly been inherited, that is the physical siting of the yard and its design were determined by previous generations. Farm environments vary in the type of hazard and in the level of risk present. The farm environment consists of a characteristic factor (size and system), situation, housekeeping, farm buildings, cattle handling facilities and slurry storage facilities. The case study interviews illustrated that while certain environment hazards posed considerable risk, they were not perceived as such by the farmer. This indicates that farm risk auditing carried out by farmers may not be as effective due to their perception of risk. Auditing was identified as an integral element of the safety management process in the literature review. While sometimes wrongly assumed as a management tool, it is essential to inform the safety management process. Even with the correct tools to carry out an effective health and safety audit on a farm, farmers perception of hazards and risk on their own farm, as discussed above, may compromise the effectiveness of the audit. There is a strong case for external risk assessment of farms in Ireland.

7.4.3 Technology

Farmer technology includes machinery, implements, chemical technologies and stock and is fundamental to farming operations. Similar to the environment, the importance of health and safety while engaging with farm technology varies considerably between farms. The findings of both the survey and the case studies illustrate that farmers are aware of the hazards associated with farm technologies. In addition, similar to the environment, the perceived risks associated with particular technologies vary according to farmers' experiences and safety socialisation. In addition, as discussed in the literature farmers were willing to take risks with specific technologies that they would not allow others to engage in. The safety status of technology on the farm is strongly associated with the perceptions and beliefs of the farmer. There is a significant problem with guarding moving parts on machinery on Irish farms. Farmers understand the necessity to have moving parts guarded. They are aware of the consequences of coming in contact with a moving part yet these parts remain uncovered posing extreme risks in some cases. The case study findings indicate that other things take precedence over machinery guarding. In addition, farmers tend to perceive that certain technologies pose a greater risk than others based on their experience and that of other farmers in their community. The situation regarding chemical safety is broadly similar to that of machinery. However, the findings indicate that safety is a higher priority when working with chemicals on the farm.

7.5 Implications of the research

This section outlines the implications that can be deduced from the findings detailed in the above section. The implications are assumed relevant to those involved in farming in Ireland, at policy level, The Farm Safety Partnership, extension and education professionals, farming leaders and farm managers.

7.5.1 Returning to the approaches

The literature review discussed both the macro and micro level determinants of occupational health and safety, namely legislation and safety management. In addition, the specific approach an organisation adopts to health and safety management was discussed.

Legislation

The findings illustrate that the previous body of legislation governing health and safety in Ireland while acknowledged, was not fully comprehended by the farming community. Not all farmers were aware of their responsibilities under the legislation and few were fully compliant. The new legislation allows for the development of sector specific codes of practice, which will make the legislation more relevant to those involved in farming. The dissemination of information relating to farmers legal requirements under the current Health and Safety Legislation needs to be examined. While material was published to inform and aid farmers on their compliance with the 1989 legislation, this study suggests that the process was not entirely successful.

In addition, there is a need for a continuous and visible presence of inspectors in Irish farming in order to improve compliance with the legislation and also guide and inform the farming community on risk assessment. The actual inspection process has the potential to educate farmers on effective risk assessment and how this can be applied to safety management on the farm.

Promotion and intervention

In order for safety management to develop and become part of the culture of farming effective safety intervention programmes encompassing the factors comprising the farm safety trichotomy should be pursued. As discussed in the literature, the effectiveness of mass appeal educational campaigns is questionable as is issuing warnings to those who do not perceive themselves to be at risk. '*We don't and won't respond to advice and exhortations to take care because we simply do not believe that we are at risk. We don't believe we are in danger because our unsafe behaviour has not resulted in a near miss or in injury to ourselves or damage to property in the past*' (Dunne, 2000, P.29). The research has shown that farmers in Ireland do not believe that they are working in a dangerous work environment and they continue to take risks because the consequences have not been negative and indeed are sometimes rewarding. Risk and hazard communication should be explored in order to improve the effectiveness of farm health and safety communication. The significance of system of farming should be appreciated by those involved in developing interventions. The more targeted interventions are the more relevant they will be to specific farmer groups and the more likely they are to make an impact.

Improving farm safety among the future generation of Irish farmers should begin now. Children and young adults that are involved in farming require positive socialisation into the workplace. Farm families will require support and guidance in educating their children in farm safety and developing age appropriate work schedules for their children.

7.5.2 Managing the dynamics which result in unsafe conditions on farms

The farm safety trichotomy has defined the farm level factors which exert an influence on farm safety and it explores the dynamics which exist between these factors. The potential exists to manage these dynamics in order to create a safer working environment in Irish farming.

Person

Similar to other sectors of the Irish economy, farming is now being described as a 'rat race'. Business and personal goals have to be balanced. In addition, the speed and pace of operations, particularly on large farms, is perceived to have increased yet there is less labour available. Farmers' beliefs, attitudes and perceptions relating to safety are learned at an early age and are reinforced through their own actions. In addition, the farmer is working in an industry where a positive safety culture has never existed. '*The organisation creates the possibility for safer working. It does this through its commitment to safety. People see and experience this commitment in tangible form in the policies, procedures and management practices of the organisation, and in the resources allocated to safety*' (Dunne, 2000). In terms of primary agriculture the industry could be viewed as the organisation, the commitment to farm safety by the agriculture industry as a whole may have a significant role to play in influencing the perceptions and beliefs at farm level.

Improved work organisation and greater planning of tasks could have a significant impact on workload issues on the farm. In addition, management and supervision of the activities children engage in on the farm could lead to a structured and safe introduction into farming.

Environment
General house keeping, timely maintenance and anticipation and acknowledgement of problems in the working environment can lead to a greater level of control in the environment. Larger farms have a higher level of activity and thus farmers and employees are exposed to the hazards of farming to a greater degree. The degree to which activities are planned and controlled affects the risk involved. Farmers are constantly responding to the requirement of their farm in terms of structures and buildings. However, often a 'make do' attitude prevails and facilities are used for purposes and in ways that their original design had not intended. Greater planning and anticipation allows the farmer to foresee these needs and provide appropriate resolutions.

Technology
When dealing with machinery, chemical technology and animals good management allows farmers to have greater control over issues that arise which are often termed as unpredictable. Engineering has predicted and responded to the vast majority of issues that arise in this regard on farms. In general these engineering solutions are present to varying degrees on all farms. However, they may often be poorly maintained or

discarded for a variety of reasons. For each of the above technology factors, simple protocols, if well conceptualised and adhered to serve to manage the associated risks.

Stress

Stress has a significant impact on the dynamics that exist within the farm safety trichotomy while these dynamics also have a significant impact on stress. Greater management and control of people, the physical working environment and farm technologies will have an impact on stress. In addition, better management practices will have an effect on specific stressors and how stress affects the farmer.

7.5.3 Recording data to improve farm safety

Based of the findings of this research, there is a need to re-examine our methods of accident and injury data collection and indeed examine the purposes which we require that data to serve.

Injury and ill health data

'*The aim of injury epidemiology in general is to provide information to decision makers in the field of injury control and safety promotion*' (Jansson & Svanström, 1999). In the absence of injury surveillance systems other means of collecting data such as the survey employed in this research are necessary. Comparisons with previous research illustrate that farm injuries are showing a slow but downward trend. However, as a result of recall bias it would be remiss to accept this as a reality. The differences that exist between the principal production systems have implications for farm work related injury and thus require further examination. Due to the nature of injuries, it is necessary that research take a multi disciplinary approach to data collection as farm injury has implications beyond the farm yard.

Injury and risk

'*Focussing exclusively on either accidents, reportable accidents or fatal accidents, or some combination of these three statistics, is not a true reflection of the real state of affairs as regards occupational accident risk*' (Dunne, 2001) There is evidence to indicate that farmers rely on accidents as a measure of risk in their environment and thus do not fully understand the process through which the farm is made dangerous. Risk assessment and statistics based on risk assessment would provide a more realistic picture of risk on the farm. Self assessment by farmers of their working environment may be of limited benefit to farm safety management on the farm due to the judgement process which has seen to influence farmers perception of given hazards and risks.

7.6 Final remarks

Based on the farm safety trichotomy developed in this research there are a number of issues which require more attention. A number of recommendations are identified for future research:

- Use the farm safety trichotomy to guide the development of evaluated injury prevention strategy. The contribution of management to the status of farm safety in Ireland should be explored further.
- Adopt the farm safety trichotomy to reflect the individual farming systems in Irish agriculture. This would substantially aid the development of tailored Intervention strategies.
- Future research should examine factors beyond the farm gate which have an influence on the status and development of safety on Irish farms.
- Future research should adopt a multi-disciplinary approach and include agricultural professionals, medical professionals and psychologists concerned with workplace safety. Strengthening and developing the relationships and collaboration between these disciplines would provide a more holistic approach to farm health and safety research and promotion in Ireland.
- In order to foster and develop a culture of safety in farming, this must be developed and supported throughout the agriculture industry.

References

Agri Vision Committee, (2004). Report of the Agri Vision 2015 Committee. Dublin**:** 81.

Aherin, R. A. D.J. Murphy & Westaby, J. D. (1992). Reducing Farm Injuries: Issues and Methods. St. Joseph, American Society of Agricultural Engineers.

Andersson, R. (1999). Injury Causation, Injury Prevention and Safety Promotion - Definitions and Related Analytical Frameworks. Safety Promotion Research. A Public Health Approach to Accident and Injury Prevention. Laflamme, L., Svanstrom, L. & Schelp, L. Stockholm, Karolinska Institutet.

Health and Safety Authority, HSA (2006). "Statistics and Research." www.has.ie, Retrieved 24/01, 2006.

Baker, S. O'Neill, B. Karpf, R.S. (1984). The Injury Fact Book. Lexington, MA, Lexington Books.

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs, NJ, Prentice Hall.

Barancik, J.L. Chatterjee, B.F. Greene, Y.C. Michenzi, J.L. & Fife, D. (1983). "Northeastern Ohio Trauma Study. Magnitude of the problem." American Journal of Public Health **73**: 746-751.

Barnard, C. S. & Nix, J.S. (1979). Farm Planning and Control. Cambridge, Cambridge University Press.

Beegan, T. (2002). "Carnage Continues on Irish Farms." Irish Farmers Journal **3**(38): 2.

Berry, C. (1971). "Rural Employment." American Journal of Public Health **61**(12): 2474-2476.

Byrne, R. (1995). A guide to safety, health and welfare at work regulations. Dublin, NIFAST.

Casley, D.J. & L.ury, D.A. (1986). Data collection in developing countries. Oxford, Clarendon Press.

Chapman, L.J. Taveira, A.D. Josefsson, K.G. Hard, D. (2003). "Evaluation of an Occupational Injury Intervention Among Wisconsin Dairy Farmers." Journal of Agricultural Safety and Health **9**(3): 197-209.

Cogbill, T.H. Busch, H.M. & Stiers, G.R. (1985a). "Farm Accidents in Children." Pediatrics **76**(4): 562-566.

Cogbill, T.H. & Busch, H.M. (1985b). "The Spectrum of Agricultural Trauma." The Journal of Emergency Medicine **3**: 205-210.

Cole, H.P. (2002). "Cognitive-Behavioural Approaches to Farm Community Safety Education: A Conceptual Analysis." Journal of Agricultural Safety and Health **8**(2): 145-159.

Connolly, L. Finnerty, E. Kinsella, A. & Quinlan, G. (2003). National Farm Survey 2001, Teagasc.

Cooper, A.D. & Germain, G.L. (1974). "Social Cultural Influences Affecting Safety." Journal of Labour Science **3**(1): 19-32.

Crowley, C. Meredith, D. & Walsh, J. (2002). "Population and Agricultural Change in Rural Ireland, 1999-2002."

CSO. (2002). "Census of Agriculture Main Results, June 2002. General Details." Retrieved 19 May 2004, 2004, from www.cso.ie.

CSO. (2003). "Agricultural Labour Input." Retrieved 19 May 2004, 2004, from www.cso.ie.

CSO. (2006). "Agricultural Price Indices 2005 - Preliminary Estimates." Retrieved 19.01, 2006, from ww.cso.ie.

Darragh, A.R. Stallones, L. Sample, P.L. & Sweitzer, K. (1998). "Perceptions of Farm Hazards and Personal Safety Behaviour Among Adolescent Farmworkers." Journal of Agricultural Safety and Health **Special Issue** (1): 159-169.

Denis, C.A.R. (1976). "The Farmer: Resource at Risk." Agrologist.

Department of Agriculture and Food, (2004). The compendium of Irish Agricultural Statistics 2004.

Department of Agriculture and Food, Economics and Planning Division, (2006). Factsheet on Irish Agriculture.

Department of Agriculture, Food and Rural Development (2000). AgriFood 2010. Dublin.

DeRoo, L.A. & Rautiainen, R.H. (2000). "A Systematic Review of Farm Safety Interventions." American Journal of Preventative Medicine **18**(4): 51-62.

Diderichsen, F. Laflamme, L. Hallqvist, J. (1999). Understanding the Mechanisms of Social Difference in Injuries. Safety Promotion Research. S. L. Laflamme L, Schelp L. Stockholm, Karolinska Institutet. **:** 242.

Donham, K.J. & Mutel, C.F. (1982). "Agricultural Medicine: The Missing Component of the Rural Health Movement." The Journal of Family Practice **14**(3): 511-520.

Doyle, Y. (1988). How Safe Are Irish Farms? A One Year Survey Of Farming Accidents And Their Medical Outcome.

Doyle, Y. & Conroy, R. (1989). "The Spectrum of Farming Accidents Seen in Irish General Practice: A One-Year Survey." Family Practice **6**(1): 38-41.

Dunne, E. (2000). The Psychology of Working Safely. Dublin, Blackhall.

Dunne, E. (2001). Psychology and Working Safely - A practical perspective. NISO/NISG Annual Health and Safety Conference 2001, Kilarney, Co.Kerry.

Elkind, P.D. (1993). "Correspondance Between Knowledge, Attitudes, and Behaviour in Farm Health and Safety Practices." Journal of Safety Research **24**: 171-179.

Elkind, P.D. & Cody- Salter, H. (1994). "Farm Stressors: The Hazards of Agrarian Life." Annals Agric Environmental medicine(1): 23-27.

Evans, A. (1999). Farm Accidents in Rural Areas. Wales, UK, Institute of Rural Health.

Farm Safety Action Group. (2003). Farm Safety Plan 2003 - 2007. Dublin, Health and Safety Authority.

Finnegan, A. Ruane, D. & Phelan, J. (2005). A Study of the Impact of Farmer Disability on Farm Households - Case Studies From the Republic of Ireland. Proceedings of 17th European Seminar on Extension Education. August 30th – September 3rd 2005. Izmir, Turkey. Section 2 (5pp)

Fischoff, B. Slovic, P. Lichtenstein, S. Read, S. and Combs, B. (1978). "How safe is safe enough? A Psychometric Study of Attitudes Towards Technological Risks and Benefits." Policy Sciences **9**: 127-52.

Fishbein, M. & Ajzen, I. (1975). Belief, Attitudes, Intention and Behaviour. Massachusetts, Addison-Wesley.

Freeman, S.A. Schwab, C.V. & Pollard, T. (2003). "Assessment of Iowa Farmers'

Perceptions about Auger Safety." Journal of Agricultural Safety and Health **9**(1): 61-74.

Fugelli, P. (2003). Welfare in the 21st Century - The Pathology of Toomuchness. The 17th Nordic Conference in Social Medicine and Public Health, Aarhus.

Garavan, T.N. (1997). The Irish Health and Safety Handbook. Dublin, Oak Tree Press.

Gerrard, C.E. (1998). "Farmers' occupational health: cause for concern, cause for action." Journal of Advanced Nursing Studies **28**(1): 155-163.

Gil Coury, H.J.C. Kumar, S., & Jones, E. (1999). "Farm related injuries and fatalities in Alberta." International Journal of Industrial Ergonomics **23**: 539-547.

Giles, T. & Stansfield, M. (1990). The Farmer as Manager, C.A.B international.

Glasscock, D.J. Hansen, O.N. Rasmussen, K. Cartensen, O. & Lauritsen, J. (1997). "The West Jutland Study of Farm Accidents: A Model For Prevention." Safety Science **25**(1): 105-112.

Glasscock, D.J. (1999). Psychological factors and occupational accidents in farming: An empirical study and literature review of accident theories and research with special attention to stress. Institute of Psychology. Aarhus, Aarhus University. **Ph.D.:** 159.

Green, K.L. (1999). "Farm Health and Safety: Rural Couples' Beliefs and Practices." Journal of Agricultural Safety and Health **5**(1): 83-96.

Haddon, W.J. (1980). "The Basic Strategies for preventing damage from hazards of all kinds." Hazard Prevention **16**: 8-11.

Häkkinen, S. (1978). Tapaturmateoriat ja niiden kehittäminen. Teollisuustalouden ja niiden työpsykologian laboratoriot. Helsinki, Helsinki University of Technology.

Hansen, R.H. (1986). "Major Injuries due to Agricultural Machinery." Annals of Plastic Surgery **17**(1): 59-64.

Hard, D.L. Myres, J.R. & Gerberich, S.G. (2002). "Traumatic Injuries in Agriculture." Journal of Agricultural Safety and Health **8**(1): 51-65.

Harms-Ringdahl, L. (1993). Safety analysis: Principles and Practice in occupational safety. London, Elsevier Science.

Health and Safety Authority (2001). Farm Safety Handbook. Dublin, HSA.

Heinrich, H.W. (1941). Industrial Accident Prevention. New York and London, McGraw Hill Book Company, inc.

Hodne, C.J. Thu, K. Donham, K.J. Watson, D. & Roy, N. (1999). "Development of the Farm Safety and Health Beliefs Scale." Journal of Agricultural Safety and Health **5**(4): 395-406.

Hoglund, S. (1999). "Farmers Occupational Health-The Swedish Model." Journal of Agricultural Safety and Health **5**(4): 361-365.

Health and Safety Authority (HSA). (2001) Code of Practice on Preventing Accidents to Children and Young Persons in Agriculture. Dublin, Health and Safety Authority.

Health and Safety Executive (HSE). (2001) Managing health and safety. Five steps to success, HSE.

Jannson, B. (1989). "Injuries in Agriculture-A Review of the Literature." Intern. Journal of Environmental Studies **33**: 45-52.

Jansson, B. (1987). "The Yield of Systems for Continuous and Periodic Injury Surveillance in Emergency Care with Emphasis on Farm-work-related Accidents." Scandinavian Journal of Social Medicine **15**: 247-252.

Jansson, B. & Eriksson, C. (1990). "Accident Involvement and Attitudes towards Hazards and Countermeasures in a Swedish Rural Population." Scandinavian Journal of Social Medicine **18**(2): 139-142.

Jansson, B. & Svanström, L. (1999). Injury in A Public-Health Perspective - Behind the Figures. Safety Promotion Research. A Public Health Approach to Accident and Injury Prevention. L. Laflamme, Svanstrom, L. & Schelp, L. Stockholm, Karolinska Institutet.

Jaspersen, J. List, P. Howard, L. Morgan, D. & Von Essen, S. (1999). "The Certified Safe Farm Project in Nebraska: First Year." Journal of Agricultural Safety and Health **5**(3): 301-307.

Jespen, R.L. (1976). Principles of Farm Machinery. Connecticut, The AVI Publishing Co.

Kepner, R.A. Bainer, R. & Barger, E.L. (1972). Principles of Farm Machinery. Connecticut, The AVI Publishing Co.

Kidd, P.S. Isaacs, S.G. Cole, H.P. Parshall, M. Scharf, T. & Struttmann, T. (1998). "An Economic Motivator for Safe Farming: Changing Perceptions Through Learning." Journal of Agricultural Health and Safety **1**(Special Issue): 205-212.

Knapp, L.W. (1966). "Occupational and Rural Accidents." Archives of Environmental Health **13**(October): 501-506.

Layde, P.M. (1990). "Beyond Surevlliance: Methodologic Considerations in Analytic Studies of Agricultural Injuries." American Journal of Industrial Medicine **18**(2): 193-200.

Layde, P.M. Stueland, D. Nordstrom, D.L. Olson, K.A. Follen, M.A. Brand. L. Konitzer, K. Kerr, J. Leick, I. & Lezotte, C. (1993). Identifying preventable risk factors for farm injuries. Atlanta, Georgia, Centres for Disease Control and Prevention.

Leahy, H. (2003). Counting the hours & Making the hours count-a study of labour use efficiency on suckler farms. Irish Farm Buildings Association Spring Conference 2003, Teagasc, Kildalton College, Piltown, Co.Kilkenny.

Lees, F.P. (1980). Loss Prevention in the Process Industries. London, Butterworths.

Lewis, M.Q. Sprince, N.L. Burmeister, L.F. Whitten, P.S. Torner, J.C. & Zwerling, C. (1998). "Work-related injuries among Iowa farm operators: an analysis of teh Iowa Farm Family Health and Hazard Surveillance Project." American Journal of Industrial Medicine **33**: 510-517.

Lindsay, F.D. (1992). "Successful health and safety management. The contribution of management audit." Safety Science **15**: 387-402.

Lloyd, D.H. (1983). Agricultural aspects of accidents. Agriculture and Human Health - CAS paper 14. J. L. Jollans, Centre for Agricultural Strategy, University of Reading**:** 183-199.

Mather, C.T.L. (2001). "Farm Injury in Tasmania." Australian Journal of Rural Health **9**(5): 209.

May, J.J. (1990). "Issues in Agricultural Health and Safety." American Journal of Industrial Medicine **18**(2): 121-131.

McCurdy, S. (1995). Occupational health status of migrant and seasonal farmworkers. Agricultural Health and Safety: workplace, environment, sustainability (supplement). H. McDuffie, Dosman, J., Sernchuk, K., Olenchock, S., and Senthilselvan, A. Chelsea, MI, Lewis Publications.

McCurdy, S.A. and Carroll, D.J. (2000). "Agricultural Injury." American Journal of Industrial Medicine **38**(436-480).

McNamara, J. & Reidy. K. (1997). A Survey of Health and Safety on Irish Farms. Dublin, Teagasc.

McNamara, J. & Reidy. K. (1992). Survey of Health and Safety on Irish Farms, Teagasc.

Monk, A.S. Morgan, D.D.V. Morris, J., & Bradley, R.W. (1986). "The Cost of Accidents in Agriculture." Journal of Agricultural Engineering Research **35**: 245-257.

Mullen, J. (2004). "Investigating factors that influence individual safety behaviour at work." Journal of Safety Research **34**: 275-285.

Murphy, D.J. (1981). "Farm Safety Attitudes and Accident Involvement." Accident Analysis and Prevention **13**(4): 331-337.

Murphy, D.J. (1992). Safety and Health For Production Agriculture. St.Jospeh, MI, The American Society of Agricultural Engineers.

Murphy, D.J. (2003). Looking Beneath the Surface of Agricultural Safety and Health. St. Joseph Mich., ASAE.

Myres, J. R. (1990). "National Surveillance of Occuaptional Fatalities in Agriculture." American Journal of Industrial Medicine **18**(2): 163-168.

Myres, J.R. & Hard, D.L (1995). "Work-Related Fatalities in the Agricultural Production and Services Sectors, 1980-1989." American Journal of Industrial Medicine **27**: 51-63.

National Coalition for Agricultural Safety and Health (NCASH), (1989). A report to the nation: Agricultural occupational and environmental health: Policy strategies for the future. Iowa City, NCASH.

O'Brien, B. O'Donovan, K. Gleeson, D. Ruane, D. and Kinsella, J. (2004). "Dairy Farm Structural Features for Improved Labour Efficiency." Irish Farm Buildings Association Journal **2004**: 9-13.

Ogilvie, K.R. (1990). Agricultural Safety Equipment Usage: A Survey of Iowa Grain Farmers, University of Iowa**:** 159.

O'Sullivan, T. (1995). A Study To Measure the Effectiveness of the Farm Apoprenticeship Board's Safety Management Programme. Dublin, University College Dublin. **Master of Applied Science:** 162.

Petrea, R.E. (2001). "The Theory of Planned Behaviour: Use and Application in Targeting Agricultural Safety and Health Interventions." Journal of Agricultural Safety and Health **7**(1): 7-19.

Phelan, G. Frawley, J. (2000). Off-Farm Employment: Presnt Position and Recent Trends. Presentation to Agricultural Economics Society April 2000.

Phelan, G. Frawley, J. & Wallace, M. (2002). The Structure of Agriculture in the EU - an Irish Case Study. 8th International conference of the Economics Society of Thessaloniki, Thessaloniki, Greece.

Pickett, W. Brison, R.J. Niezgoda, H. Chipman, M.L (1995). "Nonfatal Farm Injuries in Ontario: A Population-Based Survey." Accident Analysis and Prevention **27**(4): 425-433.

Powers, J.H. (1939). "The hazards of farming." JAMA(113): 1375-1379.

Pratt, S.G. Hard, D.L (1998). "Injury Risk Factors Associated with Agricultural Workplace Fatalities." Journal of Agricultural Safety and Health **1**(Special Issue): 29-38.

Purschwitz, M.A. & Field. W.E. (1990). "Scope and Magnitude of Injuries in the Agricultural Workplace." American Journal of Industrial Medicine **18**(2): 179-192.

Rasmussen, K. Carstensen, O. & Lauritsen, J.M. (2000). "Incidence of Unintentional Injuries in Farming Based on One Year of Weekly Registeration in Danish Farms." American Journal of Industrial medicine **38**: 82-89

Rautianinen, R.H. & Reynolds, S.J.R. (2002). "Mortality and Morbidity in Agriculture in the United States." Journal of Agricultural Safety and Health **8**(3): 259-276.

Rauutianinen, R.H. Lange, J.L. Hodne, C.J. Schneiders, S. & Donham, K.J. (2004). "Injuries in the Iowa Certified Safe Farm Study." Journal of Agricultural Safety and Health **10**(1): 51-63.

Reason, J. (1997). Managing the Risks of Organisational Accidents. Brookfield, VT, Ashgate.

Reiling, J. (1997). Agricultural Injuries in Norway. Third NIOSH Agricultural Health and Safety Conerence, Iowa City, Illinois, The Haworth Medical Press, NY, USA.

Reis, T.J. & Elkind, P.D. (1997). Influences on Farm Safety Practice in eastern Washington.

Rivara, F.P. (1985). "Fatal and Nonfatal Farm Injuries to Children and Adolescents in the United States." Pediatrics **4**: 567-573.

Ruane, D.J. & Phelan, J.F. (2003). The Use of Labour on Irish Livestock Farms - some research results from south Tipperary. Irish Farm Buildings Association Spring Conference 2003, Kildalton Agricultural College, Piltown, Co. Kilkenny.

Saari, J. (1986). Epidemiology of Occupational Health M. M. Karvonen, M.I. Copenhagen, WHO.

Safety, Health And Welfare At Work Act, 1989, 7/1898, Ireland

Safety, Health and Welfare at Work Act, 2005., 10/2005, Ireland.

Sanders, M. S. a. E. J. M. (1987). Human Factors in Engineering and Design. New York, McGraw-Hill Book Co.

Scharf, T. Kidd, P. Cole, H. Bean, T. Chapman, L. Donham, K. & Baker, D. (1998). "Intrvention Tols for Farmers-Safe and Productive Work Practices in a Safer Work Environment." Journal of Agricultural Safety and Health **1**(Special Issue): 193-203.

Schelp, L. (1992). "The Occurance of Farm-Environmental Injuries In A Swedish Municpality." Accident Analysis and Prevention **24**(2): 161-166.

Simpson, K., Sebastian, R. Arbuckle, T.E. Bancej, C. Pickett, W. (2004). "Stress on the farm and its association with Injury." Journal of Agricultural Safety and Health **10**(3): 141-154.

Simpson, S.G. (1984). "Farm Machinery Injuries." The Journal of Trauma **24**(2): 150-151.

Small, A.M. Ed. (1987). Design for older people. Handbook of Human Factors. New York, John Wiley & Sons.

Smith, G. S. & Kraus, J.F. (1988). "Alcohol and residential, recreational and occupational injuries: A reivew of the epidemiologic evidence." Annual Review of Public Health(9): 99-121.

Sprince, N.L. Zwerling, C. Lynch, C.F. Whitten, P.S. Thu, K. Logsden-Sackett, N. Burmeister, L.F. Sandler, D.P. & Alavanja, M.C.R. (2003). "Risk factors for Agricultural Injury: A Case-Control Analysis of Iowa Farmers in the Agricultural Health Study." Journal of Agricultural Safety and Health **9**(1): 5-18.

Stallones, L. (1989). Education,Equipment Modification and Injury Control among Farm Workers in Kentucky. Journal of Occupational Accidents. **10:** 293-303.

Stallones, L. (1990). "Surveillance of Fatal and Non-Fatal Farm Injuries in Kentucky." American Journal of Industrial Medicine **18**(2): 223-234.

Strasser, M. K., Aaron, J.E., Bohn, R.C. (1981). Fundamentals of Safety Education. London, Collier-Macmillan.

Suutarinen, J. (2004). "Management as a Risk Factor for Farm Injuries." Journal of Agricultural Safety and Health **10**(1): 39-50.

Svanstrom, M. D. (1999). Foreword. Safety Promotion Research. A Public Health Approach to Accident and Injury Prevention. L. Laflamme, Svanstrom, L. & Schelp, L. Stockholm, Karolinska Instituet.

Tevis, C. & Fink, C. (1989). "We kill too many farm kids." Successful Farming **87**(3): 18a-18p.

Thelin, A. (2002). "Fatal accidents in Swedish farming and forestry, 1988-1997." Safety Science **40**: 501-517.

Thu, K.M. Donham, K.J. Yoder, D. & Ogilive, L. (1990). "The Farm Family Perception of Occupational Health: A Multistate Survey of Knowledge, Attitudes, Behaviours, and Ideas." American Journal of Industrial Medicine **18**(2): 427-431.

Thu, K.M, Lasley, P. Whitten, P. Lewis, M. Donham, K.J. Zwerling, C. & Scarth, R. (1997). Stress as a factor for agricultural injuries: Comparative data from the Iowa Farm Health and Hazard Survey (1994) and the Iowa Farm and Rural Life Poll (1989). The Third NIOSH Agricultural Health and Safety Conference, Iowa City, Iowa, Haworth Medical Press.

Van Maanen, J.V. Schein, E.H. (1979). Toward a theory of organisational socialisation. Research in Organisational Behaviour. B. M. Straw. Greenwich, CT: JAI Press. **1**.

Wadud, S.E. Kreuter, M.W. & Clarkson, S. (1998). "Risk, Perception, Beliefs about Prevention, and Preventive Behaviours of Farmers." Journal of Agricultural Safety and Health **4**(1): 15-24.

Walker, J.L. Walker, L.J.S & MacLennan, P.M. (1986). "An Informal Look at Farm Stress." Psychological Reports **59**: 427-430.

Walker, J.L. Walker, L.J.S. (1988). "Self-Reported Stress Symptoms in Farmers." Journal of Clinical Psychology **44**(1).

Walker, L.J.S. Walker. J.L. (1987). "Stressors and Symptoms Predictive of Distress in Farmers." Family Relations **36**(4): 374-378.

Walsh, M. (2000). "A Nurse Practitioner-Led Farmers' Health Service: Setting Up and Evaluating A UK Project." Australian Journal of Rural Health(8): 214-217.

Weigel, R.R. (1980). "Helping farmers handle stress." Journal of Extension **18** (3): 37-40.

Williams, W.A. (1970). An accident prevention program for school shops and laboratories Chicago, IL, National Safety Council.

World Health Organisation and the Karolinska Institutet, Department of Social Medicine (1989). Manifesto for Safe Communities. 1st World Conference on Accident and Injury Prevention, Stockholm.

World Health Organisation (2001). International Classification of External Causes of Injuries (ICECI). Amsterdam, WHO Collaborating Centre on Injury Surveillance.

World Health Organisation (WHO), (2002). The Injury Chart Book - A graphical overview of the global burden of injuries. Geneva, WHO.

Yin, R.K. (2003). Case Study research: design and methods. London, Thousand Oaks.

Zhou, C. Roseman, J.M. (1994). "Agricultural Injuries Among a Population-Based Sample of Farm Operators in Alabama." American Journal of Industrial Medicine **25**: 385-402.

CHAPTER 1
SETTING THE CONTEXT

1.3 Introduction

The purpose of this study is to examine the reality of health and safety on Irish farms and thus provide an understanding of the issues involved in health and safety at farm level. This insight will guide and assist those involved in the development of farm safety intervention programs.

Primary Agriculture in the Republic of Ireland in 2005 accounted for 5.7% of total employment. Yet the sector accounts for an average of thirty per cent of workplace fatalities (Farm Safety Action Group, 2003). The Health and Safety Authority (HSA) regard the Irish farm as one of the most dangerous workplaces in the country (Beegan, 2002).

In order to design programmes aimed at reducing accident levels on farms and eliminating fatal accidents, it is vital to understand how farmers think, feel and act toward safety on the farm. This study aims to identify the current health and safety status of Irish farms.

1.4 Background to the study issue

In order to establish the background to the study issue, it is necessary to set both the agricultural and health and safety context in which Irish farmers operate. In addition, it is necessary to discuss the current structure of Irish farming and the changes which are occurring therein. It is also important to examine the health and safety record of farms in Ireland and that of other sectors in the Irish economy.

1.2.1 Farming in Ireland

As other sectors in the Irish economy have grown strongly over the past 10 years, the output from primary agriculture has remained relatively static. However, agriculture is nonetheless a more significant sector to the Irish economy than it is in most other EU countries. Significant consolidation has occurred in Irish farming. The number of farms declined by 17% between 1991 and 2000 while the average farm size increased by 21% (Crowley *et al*., 2002). While there has been a 30% decrease in the number of farms with less than 30 hectares during the period 1991-2002, there has been a 10% increase in the number of farms with greater than 30 hectares in the same time frame (Agri Vision 2015 Committee, 2004).

In line with the consolidation of the number of farms, the farm labour force declined by 17.5% between 1991 and 2000 (Crowley *et al*., 2002). This was facilitated by the opportunities which arose off farm as other sectors of the economy were experiencing rapid growth. Farmer numbers in Ireland declined by an annual average of 3% between 1975 and 1990, however, the average rate of decline has reduced to 2% between 1990 and the present time.

Those remaining in the farming population are increasingly undertaking farming as a part-time activity. Over half of farm households have an off farm income with either the holder or the spouse working outside of the farm (Phelan *et al.,* 2002). Approximately 42% of Irish farmers are estimated to be farming part-time (Agri Vision 2015 Committee, 2004). In addition, the breakdown of total household income on the farm has changed significantly since the early 1970's. The contribution of farming to total household income has decreased, while that of other direct income has increased. At the time of Irelands accession to the EU farm income constituted 70% of the total household income with 19% accounted for by other direct income. By 2000, however, the proportion of total household income apportioned to farming had reduced to 41% while other direct income accounted for 48% of total household income (Household Budget Survey, 1973/2000).

The age profile of Irish farmers is mainly positive with 13% of farmers under the age of 35, which is well above the EU average of 8% (Agri Vision 2015 Committee, 2004). However, there continues to remain a substantial proportion of farmers over the age of 65. While this is well below the EU average of 29%, significant variation in age profile of farmers exists in the EU, with Italy having the highest proportion of farmers over 65 years.

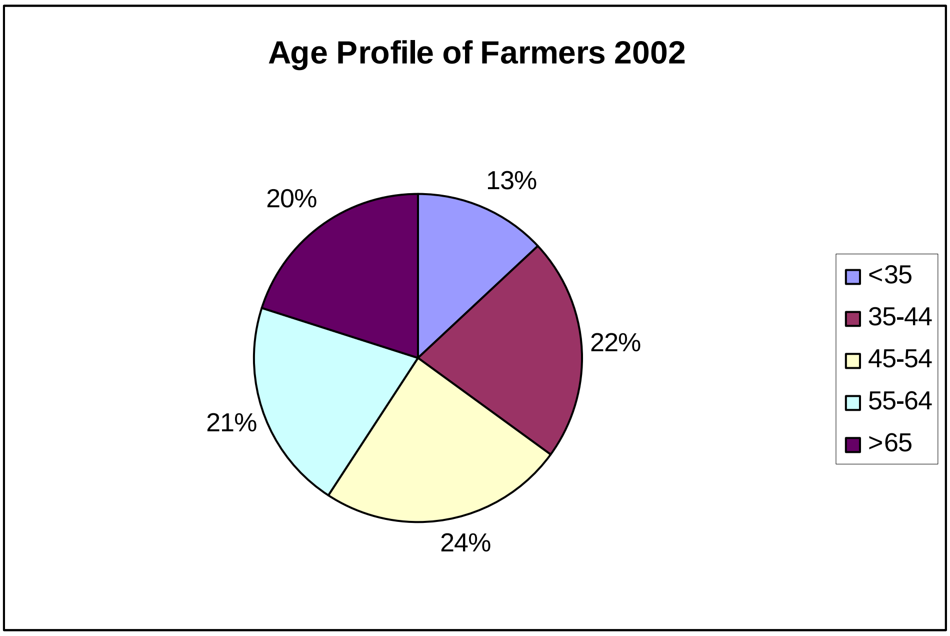


Figure 1.1: The Age Structure of Irish Farmers

Source: CSO, 2002

Thus contemporary farming in Ireland is one in which fewer people are working on fewer farms, although the scale of those farms is increasing. The opportunities in the Irish economy have attracted labour away from farming and into other sectors of the economy. Farming is increasingly becoming a part-time activity and the contribution made by farming to the farm household has decreased significantly. While the proportion of young farmers in Ireland is higher than the EU average, there remains a high proportion of Irish farmers over 65 years old.

1.2.2 Farm Health and Safety

While farming in Ireland accounts for on average 6% of the workforce, HSA statistics illustrates that farming accounts for on average one third of workplace fatalities in Ireland. In the past decade, Irish agriculture performed worse, in safety terms, than most other sectors in the Irish economy (Table 1). In total, 179 people have lost their lives on Irish farms over the period 1995 to 2005.

Table 1.1: Fatal Accidents by Sector 1996-2005

Sector	**Number of fatal accidents**									
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Agriculture and Forestry	12	15	26	23	16	24	13	20	13	17
Construction	12	15	22	18	18	18	21	17	15	23
Manufacturing	4	2	4	8	9	3	7	6	3	7
Fishing	8	5	6	2	7	2	3	0	3	2
Other	23	11	12	18	19	17	17	22	18	21
Total	**59**	**48**	**70**	**69**	**69**	**64**	**61**	**67**	**49**	**70**

Source: HSA, 2006

While accurate data exist for workplace fatalities in Irish farming, there remains significant under-reporting of non-fatal farm accidents. Fatalities are the tip of the injury pyramid. For every fatal accident that occurs on farms, many more non-fatal accidents occur resulting in injuries of varying severity. The vast majority of these accidents are not reported to the HSA and thus it is difficult to gain an understanding of the extent of the accident problem in Irish farming. '*Statistics on sources of ill-health relating to farming, particularly farm accidents, are scanty in Ireland*' (Doyle and Conroy, 1989, p.38). Several studies have examined the incidence of farming accidents in Ireland. Doyle (1988) found that on systematic examination of hospital and general practitioner records, it was estimated that roughly 3000 farm accident cases are seen in Irish accident and emergency departments annually and at least 2,500 in general practice. A survey of farmers by McNamara and Reidy, 1992 found that between 1987 and 1991, an average of 5,000 accidents occurred annually on Irish farms. This figure decreased to 2,000 for the five-year period 1992-1996 (McNamara and Reidy, 1997). Doyle (1988) reported that for every fatal farm accident that occurs, there are 100 non-fatal injuries, 28 of which will require hospital admission. McNamara and Reidy, 1997 estimated that including those persons providing on-farm services and non-working family members, up to 600,000 persons are exposed annually in one way or another to the hazards of farming.

The statistics portray an image of a sector which has a significant health and safety problem. It is also a sector in the Irish economy in which very little research in health and safety has been undertaken.

1.3 Study issue

The agriculture sector in Ireland is rapidly changing. It is a sector, which is currently facing many new challenges. The changing profile of Irish farming, as outlined in section 1.3, is placing increased challenges and pressures on those engaged in farming. Going forward improvements in the average productivity of Irish farms are required to maintain competitiveness (Agri Vision 2015 Committee, 2004). In this changing farm environment, health and safety is in danger of being over shadowed by other challenging issues. There is a need for effective intervention at farm level in order to improve farm health and safety and in so doing reduce farm injuries and farm fatalities. However, to proceed, accurate information is required in order to guide strategic planning in this area. '*In order to be able to plan preventative measures, we therefore need more knowledge about the risk-group, the attitudes towards safety and interest in participating in this work*' (Jansson and Eriksson, 1990, P.139)

1.3.1 Study objectives

In an attempt to address the study issue as set out above, the following research objectives have been identified:

5. To complete a review of occupational health and safety literature;
6. To determine the extent of injury and farm related ill health on Irish farms;
7. To determine the health and safety attitudes and practices on Irish farms;
8. To gain an understanding of the dynamics which are involved in creating unsafe working conditions on Irish farms and thus providing options for intervention.

1.4 Study methodology

A comprehensive review of health and safety literature was undertaken to provide an understanding of the study of health and safety and health and safety in farming. The primary research component of this thesis involved two studies using mixed methodology. Initially, a survey of health and safety on Irish farms was undertaken in order to quantify the accident level on Irish farms and gain an understanding of the circumstances in which farm accidents occur and the outcomes that result. A detailed questionnaire was compiled and the survey was administered through the National

Farm Survey (Appendix 1). The survey yielded 1127 completed questionnaires. In order to gain an insight into the reality of health and safety on Irish farms a qualitative approach employing case study methodology was pursued. This study examined the day to day reality of health and safety on nine farms.

1.5 Utility of the study

Developing an understanding of the health and safety landscape within Irish farming is potentially of interest to many people. Extension educators and those involved in farm injury intervention can use this information as a solid basis for the development of farm level interventions. The results may aid prioritising farmer groups and issues for intervention programs. The study provides statistics that are not captured by the Health and Safety Authority in accident reporting and thus will provide policy makers with a more accurate picture of the current injury levels in the industry. It will also allow for comparisons to be made and assessments of progress to date. The revision of the Irish occupational health and safety legislation in 2005, discussed in chapter 2, allows for industry codes of practice to be developed. This study may help to guide those engaged in developing such codes. It may also provide the medical profession with a better understanding of the context in which farm work related injuries in Ireland arise.

CHAPTER 2
LITERATURE REVIEW

The purpose of this chapter is to examine health and safety as it applies to the workplace. It aims to provide an understanding of the terminology, theoretical models and structures employed in the understanding of workplace health and safety. This chapter discusses both macro and micro level determinants of health and safety in the workplace and how these relate to agriculture.

2.1 Defining the terminology

In discussing health and safety, several language ambiguities become apparent which contribute to a lack of understanding of the issue. In particular the casual use of the words injury and accident can cause particular problems from a health and safety perspective. The argument has been put forward since the late 1980s, within public health circles, that the term accident be banned in favour of injury, which is perceived to be more scientific. The basis for this argument is that the word accident has a connotation of something unpreventable, like an act of God. Further use of this word would strengthen beliefs in supernatural explanations and thus prevent people taking preventative measures (Andersson, 1999). While luck, chance and acts of God are no longer used as explanations in the cause of disease, they remain culturally accepted explanations of accidents (Cooper and Germain, 1974). The following is a short discussion of the terminology surrounding occupational injury.

2.1.1 Accident defined

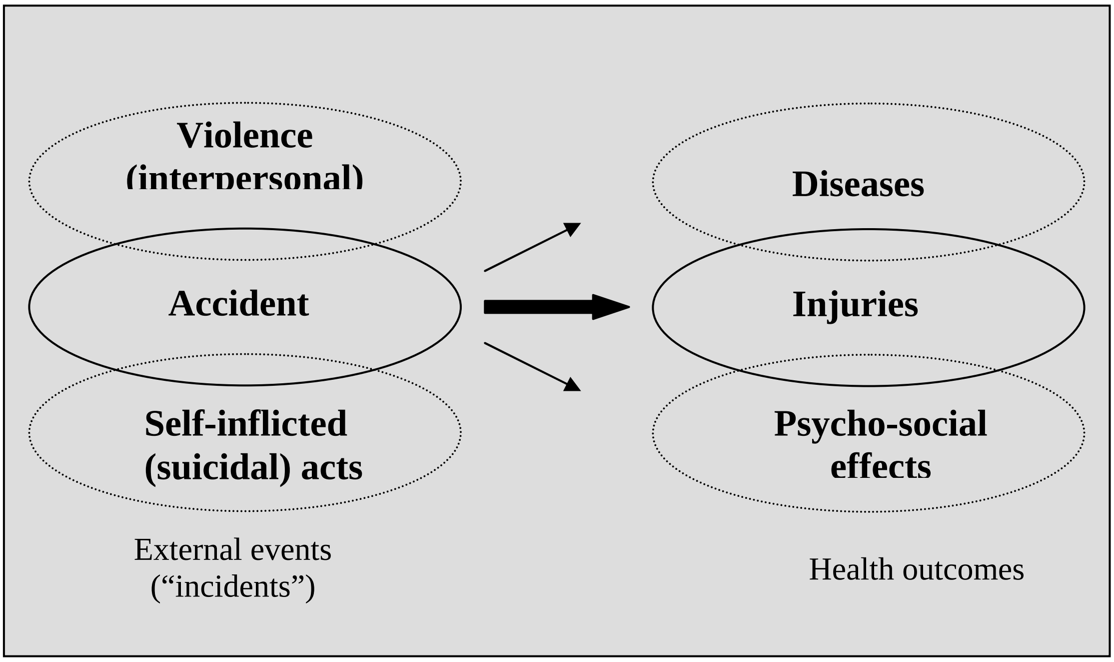
Many accident definitions exist, from very complex concepts to the more straightforward. One of the earliest definitions of an accident was put forward by Heinrich, who defined an accident as an event in which the contact or exposure of a person with an object, substance, another person or conditions causes personal injury or suggests the probability of such injury (Heinrich, 1941). Similarly the World Health Organisation define an accident as an event that results or could result in an injury (WHO, 1989). Both definitions indicate the distinction between accident and injury, accident being the event and injury being the outcome. However, Saari (1986) describes an accident as a process of parallel and consecutive events leading to a harmful consequence. This loose definition allows much scope in terms of accident consequences. However, Strasser *et al.*, 1981, extend the concept of an accident by including outcomes other than injury in the definition and add another dimension to the accident definition, which is that accidents are unplanned. '*An accident may be thought of as an unplanned act or event resulting in injury or death to persons or damage to property'* (Strasser et al., 1981, p.4).

This definition suggests an absence of acts or events resulting in injury, death or damage in the planned environment while a presence of such acts in the unplanned environment. Harms-Ringdahl (1993, p.1) proposes a simplistic accident definition *'an accident is an undesired event that causes damage or injury'*. In addition he uses the same definition for an incident however, he includes the word 'might', that is might cause damage or injury.

2.1.2 Injury defined

The most widely referenced definition of injury is that proposed by Baker *et al.*, 1984, which defined injury as a bodily lesion which results from acute exposure to amounts of energy (mechanical, thermal, electrical, chemical or radiant) that exceed the threshold of physiological tolerance. In some cases the injury results from an insufficiency of a vital element (e.g. drowning, strangulation, freezing). This definition by the very nature of the language included, '*resulting from***',** indicates that injury itself is an effect. Andersson (1999) details that those arguing in favour of the use of the term injury believe it consists of two main categories, intentional and unintentional. However, Andersson proposes that medically an injury is an injury irrespective of intention – *'Intentionality is not to be determined at the level of health outcome, but at the level of causal mechanism. Correspondingly, if we look at the health outcomes from the level of harmful events, such as accidents, it becomes clear that injury is not the only health effect to take into account, when assessing health consequences of events such as accidents' (p.17).*

Consequently the scope of safety research needs to be widened to include broader types of effects and causal mechanisms, unintentional as well as intentional (Figure 2.1). It is important to recognise that injury causation can be intentional (violence of self-inflicted acts) or unintentional (accidents). Similarly accident outcomes are wider than injury and encompass both disease and psychosocial effects. The manifestation of these effects occur according to different timescales, injury is an immediate effect and thus research can determine incidence rates with some degree of ease. However, disease and psychosocial effects may take longer to manifest and incidence may not be as straightforward to detect.



(Andersson, 1999)

Figure 2.1: A wider perspective on safety research

However, while the Baker *et al*. definition is that which is used by the World Health Organisation (WHO), the following has been written on injury. '*Injuries have traditionally been regarded as random, unavoidable 'accidents'. Within the last few decades, however, a better understanding of the nature of injuries has changed these old attitudes, and today both unintentional and intentional injuries are viewed as largely preventable events. As a result of this shift in perception, injuries and their health implications have demanded the attention of decision-makers worldwide and injury policy has been firmly placed in the public health arena. Furthermore, the growing acceptance of injuries as a preventable public health problem over the past decade or so has led to the development of preventative strategies and, consequently, a decrease in the human death toll due to injuries in some countries*' (WHO, 2002).

This study assumes the position that the terms injury and accident refer to clearly different phenomena. Farm accidents are understood to be undesired events, which result in harmful consequences. Farm injury is an effect. It is as Andersson, 1999 illustrates a health outcome of an external event such as an accident.

2.1.3 Hazard and risk

A similar explanation of the terms hazard and risk is required. Similar to accident and injury, confusion between the two terms frequently occurs. Murphy (1992, p.15) uses the definition of hazard listed by the American Society of Safety Engineers, which is *'a condition or changing set of circumstances that presents a potential for injury, illness, or property damage'*. Similarly Dunne (2000, p.9) defines a hazard as *'a situation with the potential to give rise to injury to persons, damage to property or damage to the environment – or a combination of these'*. However, Harms-Ringdahl, (1993) states that a hazard denotes a likely source or cause of an accident. While the word risk can be used in a variety of contexts, Dunne (2000) provides a comprehensive definition: '*Technically, risk concerns the likelihood of the danger potential of a specific hazard becoming an actuality and the degree of injury and/or damage likely to result from that event'* (Dunne, 2000, p.9). Harms-Ringdahl (1993) provides a much simpler definition which is that risk is the possibility of an undesired outcome. According to Lees (1980), as referred by Harms-Ringdahl (1993), risk is defined as the probability of loss occurring.

In the context of the current study, farm hazards are viewed as conditions that provide the potential for injury or damage. Based on the above discussion farm injury risk, however, is seen to relate to the likelihood of that injury or damage actually occurring. Farm injury risk is dependent on the existence or otherwise of hazards in the farm environment.

2.2 Models of accidents and injury

Those proposing to ban the use of the word accident were predominantly concerned with the perception that accidents are chance occurrences which cannot be prevented. However, accidents do not happen by chance alone. They arise from circumstances in the workplace which are created by mans interaction with technology; attitudes, beliefs and motivations of all employees and managers and the policies and practices of the organisation. When two or more or these elements are present they provide the conditions for the occurrence of an accident (Dunne, 2000).

While Dunne refers specifically to occupational accidents, Andersson (1999) proposes a more holistic accident concept. According to Andersson the word causation is central to the accident concept as all accidents include a time dimension. He defines causation as something that comes before in time, which influences the outcome of a subsequent variable. The accident is generally seen as sudden and unexpected leading ('downstream') to harmful consequences. Considering this, the genesis of an accident can be explained as a series of causal and mutually interrelated mechanisms ('upstream'), which can be explained at various distances in time and at various social and societal levels. Similarly, Strasser *et al.*, 1981 include a time dimension in their perspective on why accidents occur. They view an accident as *'a complex sequence of events representing a break down in the proper interrelationship of man and his environment. For man, an accident is a manifestation of his inability to adjust to given conditions or circumstances within the environment. An accident may also indicate a weakness in the design of the environment that permits the occurrence of such an event'* (Strasser *et al.*, 1981, P.23).

Dunne (2000) believes that most occupational accidents arise *'in the context of particular personal and interpersonal, technological and organisational situations in the workplace'* (P.1). In addition she presents four issues that have been identified as critical in creating the conditions from which occupational accidents result:

- Inadequate staff training;
- The acceptance of dangerous work practices by managers;
- The failure of equipment designers to understand the way people process information;
- The psychological pressure on employees and managers to cut corners for economic and/or political reasons.

Dunne feels that in time, the unsafe management practices, employees or organisation policy that goes unchecked combine with a system disturbance and inevitably result in an accident. However, Cooper and Germain (1974) proposed that a lack of ability, lack of knowledge and lack of proper attitudes are the reasons for mistakes and accidents. In contrast to most other theories, Cooper and Germain place the burden of the accident problem on shortcomings in ability, knowledge and attitudes of the individual and do not examine the complex interaction that occurs between individuals and their environments.

Several models have been put forward over the years from a range of disciplines, which aim to explain why accidents and injuries occur. All of these models include the time dimension discussed by Andersson (1999), while some include social and societal level analysis.   The models can be divided into three main types 1) linear stage models, 2) Surveillance models and 3) Systems-oriented models. The linear models view accident causation mechanisms as a linear flow of time-ordered stages or events. Heinrich, with an industrial background was the first to present accident causation visually. He developed the 'Domino' model which is seen as five dominos in a row representing *the environment* which exerts an influence on *human activities* which give rise to *hazards* which in turn result in *accidents* which lead to *injury*. In addition to portraying the accident sequence, Heinrich's model also provided options for prevention at various stages (Heinrich, 1941 & Andersson, 1999). At the same time the public health field applied the epidemiological model to accident and injury situations. This model had been developed from the perspective of infectious diseases. The model illustrates the interaction between Host (human), Agent (hazard) and Environment (Figure 2.2).

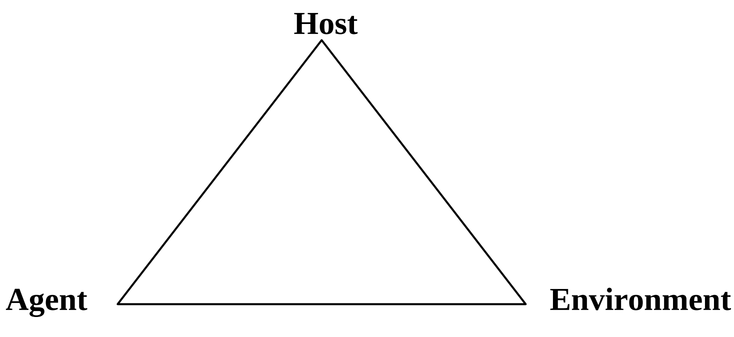


Figure 2.2: The Epidemiological triangle

Haddon, however, went further and developed a model for epidemiological research on accidents and injuries which cross-tabulated the host, agent and environment against time. The time dimension was broken down into pre-event, event and post event. The resulting model is known as the Haddon matrix. Haddon viewed the model as an aid to identifying preventative measures rather than for understanding the exact causes of accidents and injuries. Further research held that the agent is in fact energy. This resulted in the addition of a fourth category, that of “vector” which is defined as the carrier of the agent factor. In addition, environment can be split into both physical environment and social environment (Haddon, 1980, Andersson, 1999, Murphy, 1992). Thus the Haddon matrix provides a holistic view of the accident scenario and options for prevention are easily identified.

Surveillance models are being developed to *‘support the development of preventative-oriented classifications, and to act as mental maps for data recording and analysis’* (Andersson, 1999, p.21). These models reflect a multivariate approach to collecting, compiling and feed-back of information which results from in-dept analysis of accident scenarios. These models portray the “triggering event” e.g. slip, “the contact event” e.g. cut and often “intermediate events” e.g. fall. The Swedish ISA model was the earliest prevention-oriented computerised system on injuries.

Systems-oriented models examine *‘mutual and complex interactions in virtually all types of applications from technology and biology, to economy, psychology and sociology’* (Andersson, 1999, p22). Surry’s model examined man-environment interactions from a behavioural and systems-oriented view in an attempt to understand why these interactions result in accidents. One of the criticisms of this model is that it is biased towards the behaviour of the individual. Because many accidents occur in disturbed situations that require corrective action, it is necessary to analyse these deviations as opposed to focusing on why the situation was not managed properly (Andersson, 1999). Other systems models were developed based on the theory of homeostasis or equilibrium. When a system is in balance it is found to be running according to how it was designed, however, disturbances result in a loss of balance within the system. Benner’s model described how and why systems change into an unstable manner. Similarly the deviation model was founded on the belief that accidents are the result of deviations from the intended process. Therefore a preventative approach of searching for deviations is suggested. Wilde however, held that the deviation model depended on the perceived norm in identifying deviations, that is to say how much risk we are willing to accept. His widely debated ‘Risk Homeostasis Theory’ says that as people accept a certain amount of risk, providing safer environments is of little benefit if the level of risk acceptance of individuals is not adjusted (Andersson, 1999).

In order to develop a model for preventing farm accidents Glasscock *et al.,* (1997) constructed a model of farm accidents (Figure 2.3). The model assumes that risk situations arise as a function of both person and environmental factors. Examples of person factors are knowledge, attitudes and perceptions. Environmental factors are farm characteristics (size and type), the safety standard of farm machines and whether or not children live on the farm. The model assumes that farmers have a major influence on their own working environment and therefore two types of behaviour are proposed. Behaviour A supposes that farmers can improve safety standards on their farm via safety checks, maintenance and planning. Behaviour B supposes that in risk situations farmers can behave in a safe manner like everyone else. They can use personal protective equipment and not engage in risky behaviour. The model hypothesises that stress can affect both types of behaviour by reducing the quality of maintenance activity or by increasing risk taking behaviour. The authors also propose that a persons previous accident record will influence attitudes or behaviour, for example long term risk taking which does not result in accidents will increase the tendency to take risks.

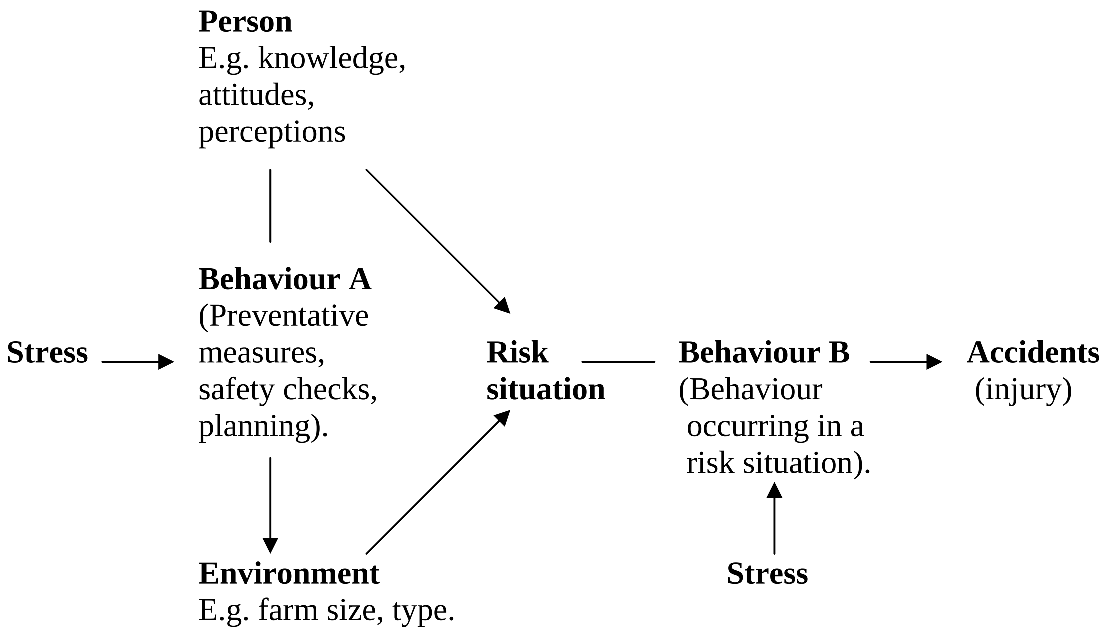


Figure 2.3: The West Jutland Study of Farm Accidents–Model of farm accidents

The fundamental essence of all of the above models is that they provide a means to examine the elements, which comprise an accident event. Each model seeks to identify the causal mechanisms, which result in accident occurrence and thus provide opportunities for intervention. An examination of the interactions within a particular system is fundamental to this process.

2.3 Irish health and safety legislation

Legislation acts as a macro-level determinant of safety, in essence it is a form of intervention and that, which is most widely used. In farming, legislation has been very successfully used in many countries to make tractor roll over protective structures (ROPS) compulsory.

The current legislation governing safety, health and welfare at work was enacted into the Irish statute book in September 2005. This body of legislation represents a modernisation of Irish occupational Health and Safety Legislation. Its predecessor, The Safety, Health and Welfare at Work Act 1989 applied occupational health and safety legislation to all Irish workplaces for the first time. This legislation can be traced back to the recommendations of the Barrington Commission, which reported in

1983. This report highlighted the weaknesses in the Irish occupational health and safety system (Garavan, 1997). Prior to the enactment of the 1989 legislation, there were twenty statutes, which had a bearing on safety and health at work. These were supplemented by approximately two hundred regulations. Ten government departments in addition to local government and state-sponsored bodies played a role under this body of legislation. Unlike previous health and safety legislation in Ireland, the 1989 Act included both the self-employed as well as employers. This was a significant advance for agricultural health and safety in Ireland as it was the first time farmers were covered by health and safety legislation.

The new act has provided inspectors with a system of on-the-spot fines, which were not previously available to them. In addition, there are provisions, which allow testing for intoxicants in particular circumstances within particular sectors. Under the legislation, managers and directors have a significant responsibility to protect the health and safety of all present in the workplace. In addition to providing the body of occupational health and safety legislation the 1989 Act also provided for the establishment of the Irish Health and Safety Authority (HSA) and this remains under the new legislation. It also allows for inspectors to be put in place to enforce the statutory provisions. Under the 1989 Act all employers and self-employed persons were required to compile a Safety Statement, which would specify the manner in which the safety, health and welfare of people would be secured at work. However, the Safety, Health and Welfare at Work Act (2005), which repalled the previous legislation, is framework in nature, in that it focuses on the broad general duties and the organisational and structural arrangements required to achieve better workplace health and safety.

2.3.1 The Health and Safety Authority (HSA)

The Health and Safety Authority has responsibility for the administration and enforcement of Irish health and safety legislation. The authority monitors compliance with legislation and also has an enforcement arm. The HSA is also charged with providing information and advice to employers, employees and the self-employed on workplace health and safety.

The main functions of the HSA as set out in the legislation are as follows:

- To arrange the enforcement of all relevant health and safety statuates;
- To promote, encourage and foster the prevention of accidents and injury to health at work in accordance with the 2005 Act;
- To promote, foster, encourage and provide education and training in the safety, health and welfare of people at work;
- To encourage and foster activities and measures which are directed towards the promotion of safety, health and welfare of persons at work;
- To monitor, evaluate and make recommendations to the Minister regarding implementation of and compliance with the relevant statutes and occupational health and safety best practice;
- To promote, encourage and foster co-operation with persons representing employers and employees regarding the prevention of risks to safety in accordance with the relevant statuates;
- To make arrangements as it considers appropriate for providing information and advice on matters related to safety, health and welfare at work;
- To make such arrangements as it considers appropriate to undertake, to promote, to sponsor, to evaluate and to publish the results of research, surveys and studies relating to hazards and risks to the safety and health of persons at work or arising from work activities;

(Safety, Health and Welfare at Work Act, 2005)

2.3.2 Inspectorate

The inspection arm of the Health and Safety Authority is the direct instrument of intervention. The primary function of the inspectorate is to ensure that workplaces comply with the provisions of the legislation (Garavan, 1997). Inspection concentrates on assessing the management of health and safety in the workplace and also examines the safety statement.

The HSA inspectors have specific powers, which allow for them:

- To enter, inspect and search any work place;
- To employ the services of the Garda Siochana if they feel they will be obstructed in their duty;

- To carry out inspections or investigations in accordance with the relevant statutory provisions;
- To examine, copy, remove and retain any documents or records (including electronic) required for investigation purposes;
- To require persons with information relevant to the inquiry to answer reasonable questions relating to the investigation;
- To direct that workplaces remain undisturbed for the examination purposes;
- To remove articles or substances from the workplace or to sample the atmosphere.
- To have articles or substances which have caused or are likely to cause danger to be dismantled or subjected to any process or test;
- To take measurements, photographs or recordings necessary for the examination;
- To direct that a safety statement be amended;

(Safety, Health and Welfare at Work Act, 2005)

Inspectors have certain options available to them under the 2005 Act which were previously available under and the 1993 regulations, which allow them to take action in three ways. The strategy is one of graduated enforcement:

- **Improvement Direction and Plan**

When an inspector finds that workplace activities involve risk or are likely to involve risk to the health and safety of people they can serve an Improvement Direction. This requests those managing the workplace to provide an Improvement Plan within a specified time outlining the remedial action to be taken.

- **Improvement Notice**

When inspectors find a workplace breaches any of the statutory provisions they may issue an Improvement Notice which will: specify the provisions in question; state reasons for their opinion; where relevant state that a workplace has failed to comply with an Improvement Direction.

- **Prohibition Notice**

Where an inspector feels that the activities in a workplace involve or are likely to involve a risk of serious personal injury to persons at work a prohibition notice can be served which prohibits the carrying on of activities in the notice (Garavan, 1997).

2.3.3 Safety Statement

Section 20 of the Safety, Health and Welfare at Work Act (2005) provides the requirement for all employers and self-employed to formulate a Safety Statement and to bring the safety statement to the attention of employees or others at the place of work that may be affected by the Safety Statement. The Safety Statement is a programme in writing which is based on identifying the hazards and assessing the risks to safety and health at the place of work to which the statement relates. The act states that the Safety Statement specifies the arrangements made and the resources provided for safeguarding the safety, health and welfare of persons at work. It should also detail the co-operation required by employees with regard to safety, health and welfare and where relevant the names of those responsible for the tasks as set out in the statement. The safety statement is informed by risk assessment, which involves identifying and assessing the hazards in the workplace. Where a safety statement is seen to be inadequate by an inspector they may direct that it be revised within a specified time (Safety, Health And Welfare At Work Act, 2005).

Ironic as it may be the safety statement itself may act as a safety hazard. Once the safety statement has been prepared it can often be shelved and not referred to again. Completing a safety statement can lull people into a false sense of security, a sense that compiling it is enough to create a safe working environment (Dunne, 2000). According to Dunne *'it is essential that, once drawn up, a safety statement becomes a real benchmark for the work practices of the organisation'* (Dunne, 2000, P.12). In order to do this the safety statement should be reviewed regularly to include new hazards that have been introduced into the workplace. The 2005 legislation has lifted the requirement for farmers or small businesses, with three or less employees, to prepare a safety statement. Instead, a sector specific code of practice will be devised for these groups.

2.4 Safety management

Achieving a high level of safety is a goal of companies (Harms-Ringdahl, 1993). For those that have the liberty to determine the way in which they work, some degree of control exists over the risks they face, however, for many more it does not. *'Safety management is essentially concerned with the effective use of safety measures in the pursuit of specified safety goals'* (Garavan, 1997, P.476). The basic premise of this statement is that in order to manage safety, goals must be set. Safety management is defined as *'the decision making procedure that applies in relation to accidents and other types of undesired events'* (Harms-Ringdahl, 1993, p.190).

According to Garavan (1997) an organisations safety policy should be integrated into all management activities and therefore viewed and managed as any strategy fundamental to the success of the business. Many of the features of successful health and safety management are the same as good management practices advocated by those striving for business success (Byrne, 1995). As a result successful organisations generally excel in health and safety as the skills and expertise that make the business itself a success are also employed in health and safety management. Organisations that achieve high health and safety standards are structured and function in a way that puts health and safety policies into effective practice. This is aided by the establishment of a positive safety culture, which assures involvement and participation at all levels (Lindsay, 1992). *'The visible and active leadership of directors and senior managers develops and maintains a culture consistently supportive of health and safety management. They aim not simply to avoid accidents, but to motivate and empower people to work safely'* (Lindsay, 1992, p.390).

2.4.1 The safety management process

The safety management process is not dissimilar to other functions of the organisation and is very much dependent on the safety culture within the organisation. *'To manage safety and health is to take a proactive stance toward the elimination, prevention, and control of risks. Managing is resolving the conflicts between ever-present risk and the equally ever-present desire for safety and health'* (Murphy, 1992, p.104).

The degree of importance placed on a safe and healthy work environment impacts greatly on the management response to workplace safety. The safety management activity within a business encompasses four areas:

- The management of health and safety operations;
- The measurement of health and safety performance;
- The motivation of managers to improve standards of health and safety performance;
- The design of effective organisational structures and cultures which contribute to effective safety performance (Garavan, 1997).

The Health and Safety Executive (HSE), 2001 examine the process in more detail highlighting the key elements of successful health and safety management (Figure 2.4). This model identifies three principles elements of successful health and safety management; policy development, organisational development (putting together structures which allow for successful health and safety management) and developing techniques of planning, measuring and reviewing the safety management process. This model relies on control and information links to function effectively. Auditing is central to the information collection and feedback. However, while auditing is an essential element of successful health and safety management systems, it alone is not sufficient management of health and safety issues (Lindsay, 1992,). *'Auditing has value only in so far as it forms part of an overall health and safety management system, is attuned to that system and is systematically and imaginatively, applied'* (Lindsay, 1992, p.389). Many organisations rely too heavily on auditing to manage workplace safety. However, auditing provides the medium through which the effectiveness of other components can be measured and reviewed and thus should not be relied on to the exclusion of other components (Lindsay, 1992). In order to successfully manage workplace health and safety, each organisation must have a clear health and safety policy and organisational structure, such as that outlined in figure 2.4, for implementing this policy, In the case of farming, these structures may be much less complex than in other businesses yet each step will be essential and no one step, such as auditing, will be more important than the others.

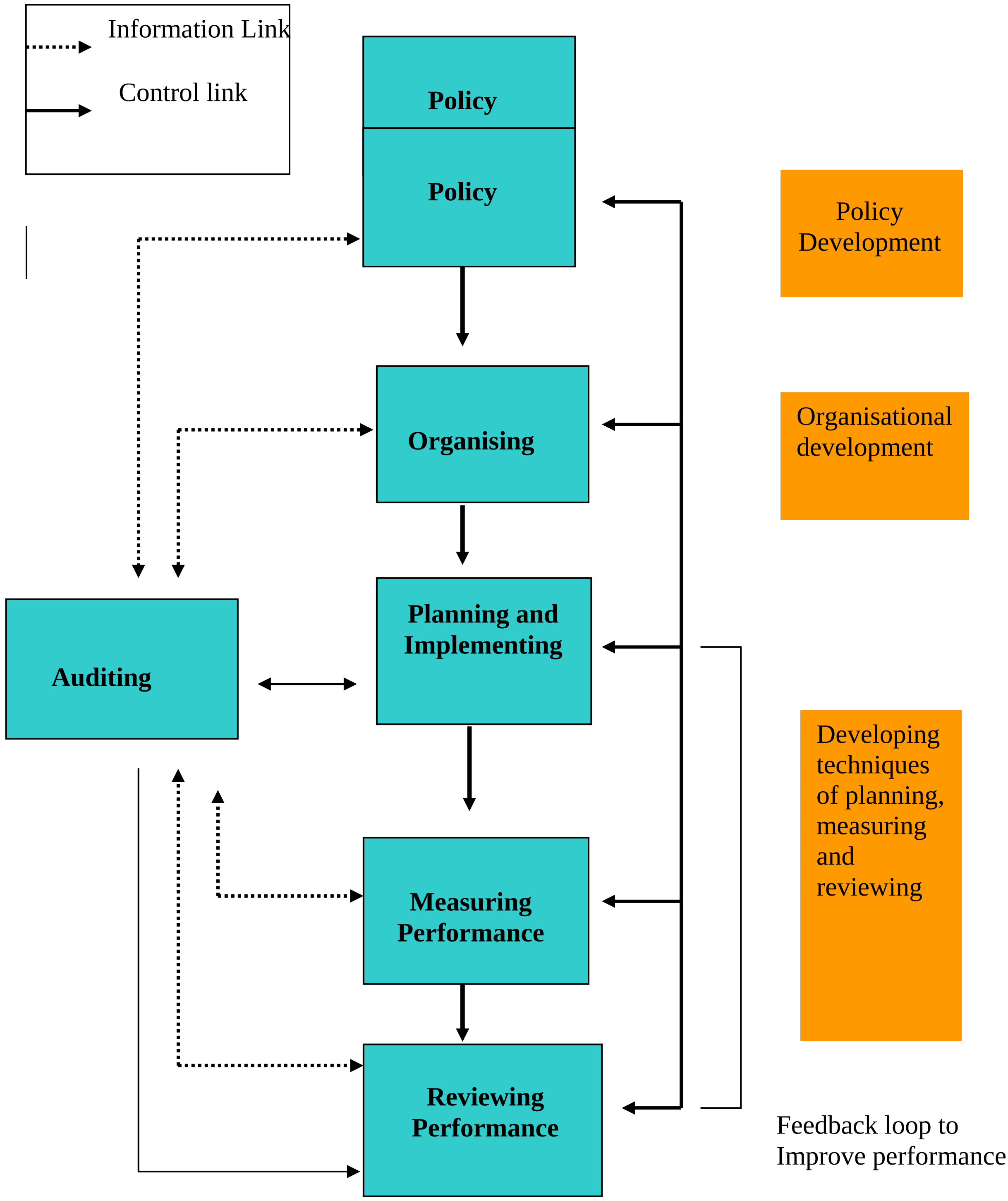


Figure 2.4: Key elements of successful health and safety management

The health and safety policy once developed must be implemented according to a plan and subsequently will require evaluation. '*The best health and safety policies are concerned not only with preventing injury and ill health as required by minimum standards set in health and safety legislation but also with positive health promotion going well beyond the minimum which gives practical expression to the belief that people are a key resource*' (Lindsay, 1992, p.389). The specific policy adopted by the organisation will determine the management approach employed toward health and safety.

2.4.2 Approaches to health and safety management

Garavan (1997) examines the four main approaches to health and safety management that have prevailed in the literature; The Legalistic approach, Socio-Humanitarian approach, The Financial-Economic approach and The Human Factor approach. While the legalistic approach is largely based on the principle of investing the minimum effort into health and safety management in order to comply with the law, the human factor approach requires a major investment and commitment by both management and employees. This approach considers the system as a whole as opposed to considering the safety of personnel or the cost of safety.

1) The Legalistic Approach. In this approach the organisation simply aims to comply with their legislative duties.

2) Socio-Humanitarian Approach. This approach works on the principle that personnel are integral to the success of the business and therefore should not be exposed to danger at work.

3) The Financial-Economic Approach. This approach holds that all accidents and incidents cost money. Therefore the motivation is to bring about an improvement in health and safety performance in order to reduce safety related costs.

4) The Human Factor Approach relies upon identifying the organisational characteristics that influence safety behaviour. Garavan (1997) outlines the importance of five factors in this approach; importance of a safety culture or climate, the need for policies and systems to control risk, a commitment to improving health and safety performance, an active interest by management in health and safety issues and the creation of an environment where safe behaviour is encouraged. The human factor approach is a holistic approach to health and safety management, which requires a management process such as that outlined in figure 2.4. The safety approach adopted by an organisation is also a factor of safety ambition. What exactly do management want to achieve in safety terms in this work environment. Safety ambition can vary considerably; Harms-Ringdahl (1993) uses a stairway to illustrate the different levels that exist.

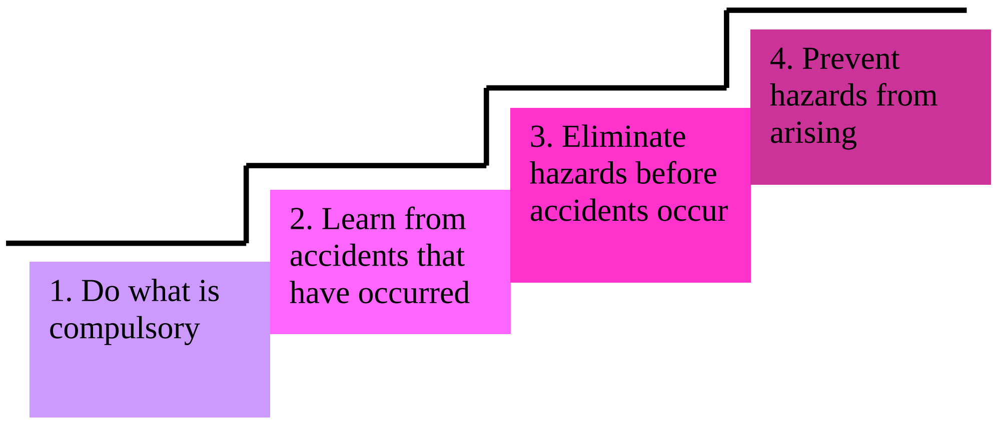


Figure 2.5: Level of safety ambition in safety work (Harms-Ringdahl, 1993)

Those at the very bottom of the stairway do only what is compulsory, they take the legalistic approach. While some learn from accident situations, others aim to eliminate hazards before they result in an accident. Those who are most ambitious will try to prevent hazards from arising in the first instance; those employing a human factors approach will be working at this level of motivation (Figure 2.5).

Two types of safety management strategies exist; proactive and reactive which are examined by Garavan (1997) and again these strategies are a function of the safety management policy. While proactive strategies are concerned with prevention of accidents and incidents, reactive strategies are post-accident strategies and should never be uniquely relied upon. Proactive strategies are an integral part of safety management, however, reactive strategies may also be required in the event of an accident occurring. Proactive strategies can be broken into both safe-place strategies and safe-person strategies. Safe-place strategies aim to reduce the physical danger present in the workplace, while safe-person strategies rely on employees adhering to health and safety standards and practices of the organisation. Both strategies aim to reduce accident occurrence by confronting elements identified as fundamental in accident causation; human activities and the environment (section 2.2). Neither strategy can be successfully employed without the other.

The safety management process is two dimensional, involving both management of personal and the working environment. The overall safety culture dictates the organisation policy which in turn determines the type of approach taken to managing health and safety on the farm.

2.5 Safety management in farming

Giles and Stansfield, 1990, p.7 define management as *'a comprehensive activity, involving the combination and co-ordination of human, physical and financial resources, in a way which produces a commodity or a service which is both wanted and can be offered at a price which will be paid, while making the working environment favourable for those involved'.* Human resources are identified as being an integral element of all businesses and the farm business is no different. Giles and Stansfield, 1990 believe that acceptable and agreeable working conditions could be as important in the long-term survival of that business as the profit itself. Agriculture is a scientific field, which requires an educational background reinforced by practical experience. It requires knowledge of agronomy, economic projection and fiscal management, personnel management, and government regulatory policy (Elkind, 1993).

Agriculture differs to other sectors of the economy in that the farmer must be competent in diverse areas. In other sectors, different people are responsible for the different functions of management. In industry there are separate management and labour functions but in agriculture the farmer does both (Berry, 1971). According to Murphy, 1992, no evidence can be found that supports the belief that farmers have the organisational, social or political support for engaging in thorough and continuous health and safety management adequate for dealing with the scale and difficulty of the problem. Therefore, while safety management is the responsibility of the farmer, the literature suggests that those skills required for health and safety management at farm level may not be present on all farms. A comparison between the elements included in successful health and safety management (HSE, 2001) and the stages in farm planning and control as outlined by Bernard and Nix, 1979, P.15 (Figure 2.6), illustrate that both management processes are similar. While the steps are not identical, both schemes include fundamental functions of management such as auditing, planning and implementing, control or measuring performance and reviewing or evaluating. Bernard and Nix outline a seven stage planning and control process which involves both policy development and developing techniques of planning, measuring and reviewing. Organisational development is understandably not part of the Bernard and Nix farm management model. Similar to the HSE model the stages in farm planning and control involve control and information feedback. Based on a review of both models it is apparent that health and safety management is not vastly different from the management function of planning and control as it applies to farms. Hence, as Byrne, 1995 has suggested, it is reasonable to assume that those farmers that have skills and expertise in management and thus manage successful farm businesses will also effectively manage health and safety on their farms. Managing health and safety provides a structure for prioritising health and safety endeavours. Safety management allows farmers to examine the nature, consequences and costs associated with risks and make informed decisions on which risks to address (Murphy, 1992).

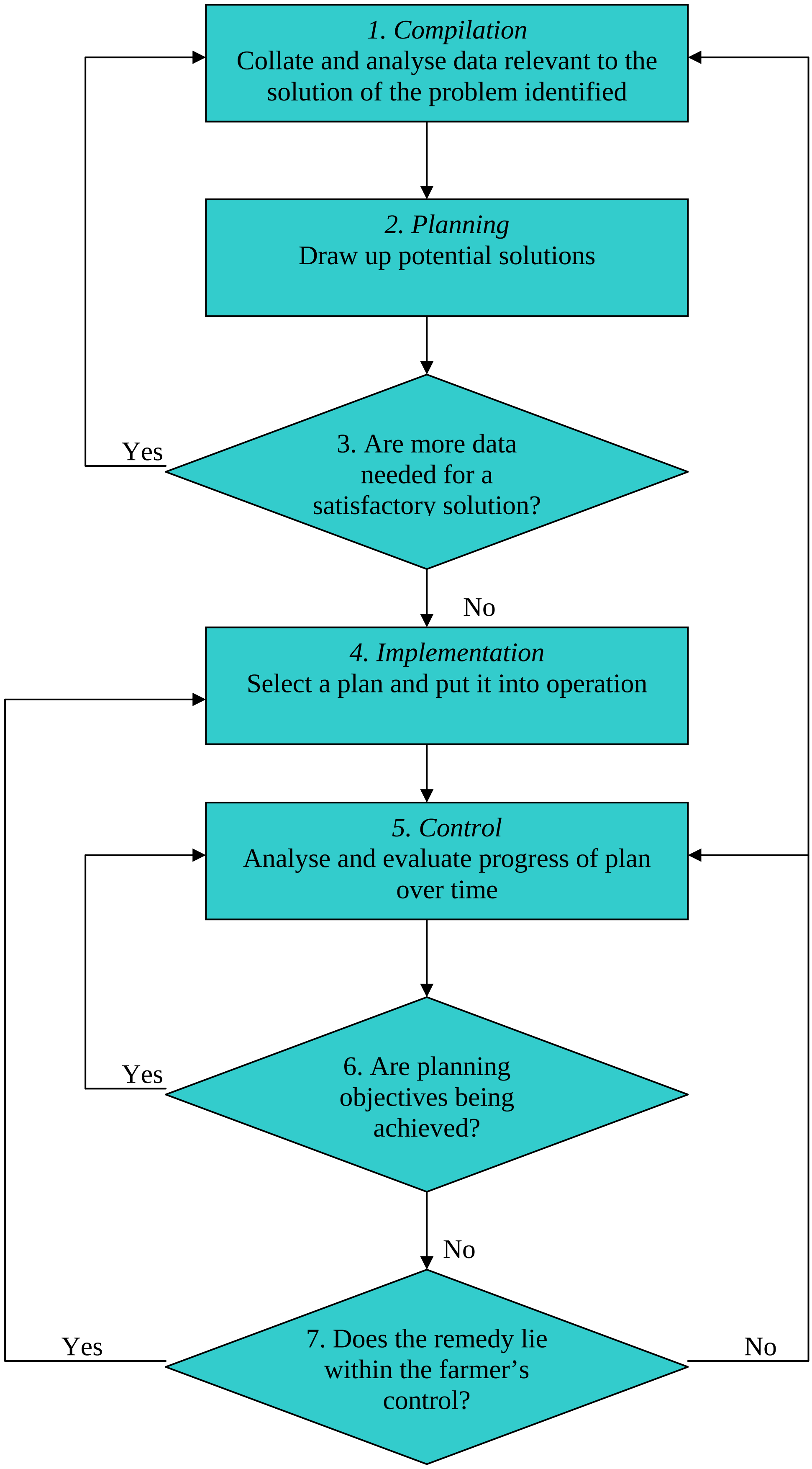


Figure 2.6: Stages in farm planning and control (Barnard & Nix, 1979, p.15)

CHAPTER 3
LITERATURE REVIEW

In contrast to the industrial accident setting where health and safety requirements are pre-determined due to established work routines and a stable environment, agricultural work involves a small work force, a high level of self reliance and multi activity orientation (Knapp, 1966). As far back as the 1930's, farming has been recognised as having significant health and safety issues, which were not adequately addressed. Power, 1939 as referred to by May, 1990 identified farming as the occupation in which most accidents occurred and in which the least accident prevention effort had been made. The farm population is unique in many ways and consequently poses problems for those concerned with injury prevention (Aherin & Murphy, 1992).

3.1 Mortality and morbidity in farming

Agriculture is reported to be one of the most hazardous industries in America. While fatality statistics are widely available, data on non-fatal injuries is not well documented. In terms of occupational fatality surveillance, the agriculture industry is the least sufficiently dealt with (Myers, 1990). Rautiainen & Reynolds, 2002 reported that during the 1990s the fatality rate in farming was approximately 22/100,000 workers. According to McCurdy and Carroll the data regarding the number of people at risk from farm work related injury and the numbers of persons suffering injury are totally inadequate. An analysis of agricultural fatalities between 1980 and 1985 shows that agricultural production has a fatality rate more than three times that for all industries combined. While the agricultural services fatality rate is higher than that of all industries, it is not nearly as large as the rate for production agriculture (Myers, 1990). The National Safety Council have estimated that in the USA approximately 780 occupational fatalities occurred in agriculture in 1998, which is a rate of 22.1/100,000. The rate of non-fatal injuries however, was estimated at 140,000 in 1998 (McCurdy and Carroll, 2000). Myres and Hard, 1995, cite three data sources which estimate fatality rates in agriculture ranging from 17 to 42 deaths per 100,000 workers which puts agriculture in the four most hazardous industries in America.

However, problems do exist in definitively quantifying the extent of injuries in America.

The agricultural injury problem in the USA is difficult to enumerate due to the issues posed by hired farm workers. This population are transient by nature and are very often marginalised for social, economic and linguistic reasons. As a result, many hired workers go unaccounted for in agricultural labour statistics (McCurdy, 1995 as cited by McCurdy and Carroll, 2000). While numerator data pertaining to agricultural injuries and fatalities can be calculated using various sources, a particular problem exists in establishing accurate denominator data. In addition, there is a significant lack of data relating to farm workers under the age of 16 years (Myers, 1990). The issues surrounding numerator data are not relevant in the Irish context, although, establishing denominator data is more challenging for the reasons discussed in section 3.3.1 below. Similar to America, agriculture in Finland has been described as one of the most hazardous industries with a fatality rate of 6.5/100,000 workers (Rautiainen, 2002). Sweden also reports a high level of fatal accidents in agriculture, 11.6/100,000 workers per year (Thelin, 2002). Research indicates that workers in one Swedish municipality found that farmers displayed the highest work-related injury level. Agricultural injury in Australia represents a significant health, social and economic issue. It is the fifth most dangerous occupation in Australia with a fatality rate of 19.5/100,000 employed compared to 5.5/100,000 for all employees (Mather and Lower, 2001).

3.2 Ill health problems associated with farming

> *'Farmers make very little issues of their health problems individually or collectively. They are stoic and independent, accepting that there are certain risks associated with their occupation. Work comes first; illness and injury are just part of farm life.'* (Donham *et al*., 1982, P. 513)

Farming is often considered a healthy lifestyle, those engaged in it are often envied for their healthy and outdoors way of life (Gerrard, 1998). Many people think farmers and farm workers spend their time working in healthy conditions outdoors and therefore enjoy a healthy lifestyle (Walsh, 2000). However, according to

Donham *et al*. (1982) the health status of the people engaged in farming is poorer than would be commonly believed. Compared to other populations this group of workers have excess rates of chronic illness, excess disability from respiratory conditions and the highest death rate from occupationally related accidents. Hazards in the farmers working environment extend beyond the risk of accidents. There are many hazards in the farm environment that are capable of producing chronic health problems. In order for improvement to occur in the health status of farmers and farm workers, it is necessary to recognise their unique health problems. Farmers collectively make little issue of their health problems as they accept that there are risks associated with their occupation (Walsh, 2000). A study by Gerrard (1998) revealed that farmers in England perceived their industry as one which poses serious risks to their health. Walsh (2000) asserted that the economic problems facing farmers exacerbated the serious health problems already in existence. Yet they are largely not recognised by the majority of health professionals and policy makers from urban backgrounds. Consequently the health needs of the UK farming community are not being met by the National Health Service (NHS). There is a need for health care workers to understand the nature of farming in order to provide an effective service to farmers.

3.2.1 Extent of farmer ill-health

McNamara and Reidy, 1997, reported that in a study of health and safety in Ireland three quarters of those who reported disability said the disability was attributed to farm related ill health. Eight out of ten of the cases were related to respiratory problems. All of those who reported an ill health problem, felt the problem was persistent. A similar study by McNamara and Reidy in 1992 also found a high occurrence of respiratory problems among those who reported ill health problems. Back problems and allergies also constituted a large proportion of the ill health problems. Health problems associated with agriculture vary significantly, with specific health problems being related to specific agricultural practices. As agriculture changes and becomes more mechanised, the associated ill health problems also change. It is therefore important for those involved in health promotion to be aware of the changing health problems associated with farming. Donham *et al*., 1982, list twenty-five infectious diseases common to animal and man, which are significant to farmers. Many of these diseases are difficult to diagnose and therefore there is very little data available on the incidence of these diseases (Donham *et al*., 1982).

However, it is thought that they are more common than is generally recognised. Gerrard (1998) recognised that farmers health can be endangered through contact with animals due to exposure to the hazards of zoonoses, i.e. diseases caused by infective agents common to animal and man such as leptospirosis, ringworm and orf.

It is generally accepted that similar to many industrial environments, the farm environment is contaminated with many pollutants that may cause chronic lung problems. Owing to the fact that all farmers are exposed to these pollutants, the most severely affected are generally 'self selected', that is, they do not take the necessary precautionary measures. Another common respiratory problem among farmers is farmers lung. Similar to the infectious diseases common to man and animal, it is difficult to get a picture of how wide spread these problems are among the farming community. According to Gerrard, 1998, farmers exposure to air borne hazards may produce acute, sub-acute and chronic health problems. Agricultural pesticides have received much more publicity than any other agricultural hazards, in the United States. However, the majority of hospitalisation records in relation to pesticide poisoning are related to accidental ingestion and suicide attempts. These chemicals are the cause of many skin irritations among farmers (Donham *et al.*, 1982). Gerrard, 1998, felt that exposure to agricultural chemicals has greatly increased in the United Kingdom which has lead to possible health risks from acute and chronic poisoning.

3.3 Characteristics of farming which impact on health and safety

Farming has many unique factors which from a safety point of view, place those involved in the sector in a unique position compared to those in other sectors (McNamara and Reidy, 1997). While agriculture thinks and acts like industry, health and safety problems are not comparable. Even as industrial thinking is applied to the production aspects of agriculture, there is an obvious disparity between an effective health and safety program in a manufacturing facility and one that applies to the unique requirements of agriculture (Berry, 1971). The inherently dangerous characteristics of farming are widely acknowledged by farm health and safety professionals. '*When the conditions of work are intrinsically dangerous or when they encourage the worker to get through it quickly, or with increased comfort at the expense of safety, or when his/her task is intricate or so demanding that his/her* *capability to perform it suffers, that the greatest risk occurs. The very nature of farm work makes these occurrences commonplace'*. (Lloyd, 1983, p190).

In contrast to other industries farming has many characteristics which prove challenging to the management of health and safety. Doyle and Conroy (1989) compared the industrial working environment where working hours are limited and the worker is supervised to that of the farm where farmers work long hours to complete tasks alone. In addition, deteriorating economic conditions increase the probability that farmers will cut corners with regard to health and safety in order to save money (Walsh, 2000). Accordingly, this 'make do and mend' approach results in increased risk of both injury and farm work-related ill health. While individually these characteristics have a definite impact on farm accidents, there is a synergistic effect of these factors on agricultural injury prevention (Murphy, 1992). '*Collectively, these factors have a huge negative impact in changing the status quo of safety and health beliefs and practices on the farm, and pose obstacles for professionals engaged in agricultural safety and health research, education and intervention*' (Murphy, 1992, p27). In addition to the impact of the unique characteristics of farming on injury causation, Donham (1982) proposes that they may also have an impact post accidents, which consequently affects the medical outcome.

3.3.1 Age profile of those exposed to farming hazards

Farming provides a unique problem in that people of all ages are at risk on farms. The nature and location of farm enterprises is such that in general the farm and the family home are one and the same. It is not unusual to find three generations of one family present on a farm with women, children and the elderly including those that are non-workers exposed to the hazards of the farm (Berry, 1971; Simpson, 1984; Purschwitz & Field, 1990; McNamara and Reidy, 1997). In contrast to other industries, children constitute a significant proportion of the agricultural workforce and are thus exposed to the hazards of farming at an early age (Rivara, 1985). Children often become involved in situations on the farm that they cannot control. These situations require knowledge, strength and skills that children lack (Schelp, 1992). Economic hardship and poor access to childcare often results in children being required to act as additional labour on the farm or being supervised in an environment where farm work is being carried out (Aherin *et al*., 1992). Consequently, toddler injuries on farms may be related to increased curiosity and activity before they have developed mature decision-making and caution (Cogbill *et al*., 1985a). Minimum estimates by Rivara, 1985 indicate that more than 25,000 children and adolescents are injured on farms, in the United States each year, of which almost 300 die. The majority of children fatally injured on farms died before they reached a hospital, however, not all of these injuries can be attributed to farm work.

The aged farm population are also subject to the hazards of farming. Because there is no standard retirement age for farmers many remain working past the ages of 65 and 70 (Purchwitz and Field, 1990). In Ireland a large number of older farmers remain despite the incentives that have been provided to encourage land transfer. Farmers over 65 years old control nearly 20% of farm land (Department of Agriculture, Food & Rural Development, 2000). Elderly people over 65 years old have been found to be the least conscious of accident hazards (Janson and Erikson, 1990). Similar to child farm labour, it is proposed that aged workers continue to work on farms due to labour shortage and economic necessity (Aherin *et al*., 1992). Degeneration in sensory, information processing and muscoskeletal capabilities may contribute to the increased levels of risk among aged workers (Small, 1987 as cited in Aherin *et al*., 1992). Older people may have physical problems that mean they do not have the same degree of agility, which in turn increases their accident risk (Thelin, 2002). Older farmers very often use older machinery and tractors and neglect to use protective devices. Slower reflexes and carelessness have been associated with injuries and deaths among the aged farm population (Hansen, 1986 as cited in Gill Coury *et al*., 1999).

3.3.2 Mechanisation

Modern agriculture is heavily dependent on mechanisation. There has been an increasing trend in farming towards larger scale enterprises and the use of large capacity machinery, which often needs to work long hours in order to be economic. This has led to an increase in the level of specialisation needed in some farming activities and often results in exposure to hazardous jobs for long periods of time (Lloyd, 1983). The modernisation of farming and in particular the mechanisation has left farmers and farm workers exposed to greater risks than those faced by workers in other industries (Monk *et al.*, 1986). Because many farm machines are very expensive they are replaced very infrequently and therefore this affects the safety of these machines. The average life span of tractors in Wisconsin was found to be 20 years and many were built before the development of some safety features (Cogbill *et al.*, 1985b). Similarly, the average age of tractors in England that were involved in fatal farm accidents between 1992 and 1997 were found to be 19 years old. This may also be true for farm machinery in Ireland, particularly in specific farm systems and sizes. In response to the mechanisation of agriculture, agricultural engineering has provided many hazard reduction possibilities. However, often these are rendered useless once they reach the workplace as they are often removed. No standards are applied when farmers sell machinery between one another (Aherin *et al.*, 1992). Therefore while agricultural engineering may produce safer farm machinery, there is no guarantee that once sold to the farming community that these safety innovations will be maintained, used or in effect valued. In many cases, smaller sized farm units that are operated by a fulltime farmer often have a very limited budget and consequentially their machinery and equipment is usually older, less well maintained and therefore hazardous (Murphy, 1992).

Not only has agriculture become increasingly mechanised, the declining labour force combined with an increase in the speed and sophistication of many operations has resulted in farmers and farm workers being left alone and perhaps unsupervised for long periods of time. Additionally, while technological advances have reduced the physical burden on man, the machine operator has more decisions to make and functions to perform in order to use the machine (Kepner *et al.* 1972 as cited in Murphy, 1981). This demand may result in mistakes being made which can lead to accidents. Ultimately, farm machinery present many hazards on the farm. New machinery in themselves provide new hazards for the farming community in addition to those posed by older, poorly maintained machinery.

3.3.3 Working hours and seasonality of farm work

Due to the nature of farm activities farmers tend to work long hours and at certain times of the year bear more pressure than others. Farmers often have to work long hours under severe time constraints (DeRoo, 2000) and are often subjected to shortage of time when completing tasks due to the weather (Pickett *et al*., 1995; Gill Coury *et al*., 1999). In other industries the work routine is usually regular with limited hours of work and training is provided for specialised work. However, in farming, the farmer is usually self-taught and has very irregular work patterns (Doyle, 1988). The farmer has no limit to his daily or weekly work regime compared to his industrial counterpart who works a forty-hour week and in addition holidays are unusual for the farmer (Berry, 1971). Farmers may accept long, irregular hours and short holidays too readily; however, this is associated with 'living over the shop' (Giles and Stansfield, 1990). Many farmers work at least twelve hours per week more than their employees, with great seasonal variation (Lloyd, 1983). According to Leahy, 2003, the average labour input per farm per day on Irish suckler farms was 9.90 hours per day. However, this was seen to increase to as high as 11.45 hours per day at times of heightened activity. In reality, many farmers are pushing themselves beyond their limitations. The commitment required by farmers in terms of length of working day, lack of adequate holiday leave and irregularity of work results in an insecure working environment in which the farmer does not know what to expect from his day.

3.3.4 Part-time farming

For some farmers the working day is more defined as they are also engaged in employment outside of the farm. In Ireland the uptake of off-farm employment has been increasing over the past decade. In 1998, 30% of Irish farm operators were engaged in off-farm employment (Phelan & Frawley, 2000). Although this change has been positive in terms of farm income it may have an adverse affect on farm safety. The economics of farming have forced many family farms to decide between increasing the scale of the farm and production or engaging in off-farm employment in addition to farming part-time. Both scenarios may have adverse effects on health and safety on the farm. According to Murphy (1992) multiple job holding has important implications for production agriculture safety and health. It results in the farmer having less time to devote to farming and given the nature of farming this often means hurrying to complete work. This in turn increases the risk of errors occurring which could result in accidents. Part-time farmers are required to work long hours in the evening and at weekends (Rautiainen & Reynolds, 2002). Multiple job holding leads to less experienced farm workers, which again can lead to a greater risk of injury. If farming is not profitable enough to sustain a full time operator then it will not have the resources to invest in farm health and safety (Murphy, 1992).

3.3.5 Isolation

In addition to working long hours, perhaps 7 days a week, farmers often work alone. Unlike in industry where the worker is supervised, the farmer works alone, often continuously until the job is finished (Doyle and Conroy, 1989).

As farmers work alone, if an accident occurs the victim may not be discovered until hours after the accident. In addition, the location of the accident may not be easily accessible to emergency rescue vehicles and may indeed be isolated from medical assistance (Donham *et al*., 1982; Cogbill *et al*., 1985b, Simpson, 1984). As farm accidents occur in rural areas, response and transport times can be long. For farmers working alone, an accident could go undiscovered for several hours if the farmer is trapped or unconscious. This serves to intensify the traumatic effect of a serious accident (Cogbill *et al*., 1985b; Pickett *et al*., 1995). In the case of machinery related injuries, extraction from heavy machinery can be time consuming (Cogbill *et al*., 1985b). This situation can be contrasted with that of workers in industry where there are generally adjacent workers and isolation is rarely an issue (Berry, 1971). The solitary nature of farm work means that in cases where the injured person has been unable to raise the alarm they can go unmissed for some time. This presumably has an impact on the medical outcome of the injury. Where the alarm is raised, geographic isolation can be an issue in responding.

3.3.6 Stress

The National Institute for Occupational Safety and Health ranked farming as one of the ten most stressful occupations in the USA (Elkind, 1994). Walker and Walker, 1987 found that the body of literature on farm stress indicated that farming is significantly less idyllic than is frequently portrayed. While farmers were found to share some stressors that were common to all occupational groups, they also experienced stressors that are specific to farming. In addition it reflected that farm families exhibited a high incidence of stress-related symptoms. Walker and Walker (1988) found that farm men and women reported symptoms commonly associated with chronic stress. Those engaged in mixed grain and livestock operations, younger farmers and those with off-farm jobs reported significantly higher stress symptoms than non-farmers. According to Thu *et al*., (1990) farmers identified stress as one of their major family health and safety concerns. Walker and Walker (1986, P.427) suggests that *'farmers are experiencing chronically high stress intensified by* *perceptions of lack of control over the major stressors of government policy, weather and market conditions'.* Economic factors including low commodity prices, increasing expenses, high debt load and irregular cash flow, unfavourable weather conditions and government policies and regulations have been identified as the top farm stressors (Walker and Walker, 1987). In addition, other major farm stressors categorised as daily hassles were identified, these included machinery breakdowns, worries about market conditions, deciding when to sell, worries about the weather, heavy work loads, time pressures and unplanned interruptions (Walker *et al.*, 1986). Similarly Weigel (1980) identified stressors that were unique to farming, these included machinery breakdowns, disease outbreak, weather conditions, government regulations and heavy workload. Research from Canada, Washington and the Midwestern United States found farmers experiencing a significant amount of stress, which is specifically related to economic stressors. Farmers' anxiety and worry arises from unstable markets, competition and day-to-day economic concerns. Additionally, they experience work overloads at peak times when labour is scarce and workload is heavy and work underloads while completing boring, repetitive tasks (Aherin *et al.*, 1992).

Literature suggests that there is a relationship between farmer stress and safety on farms. The combination of the interactions between farmer-equipment-agricultural environment along with physical stress, economic burden and heavy workloads has introduced a variety of hazards to farmers and the farm family (Ogilvie 1990 as cited in Elkind 1994). Elkind, 1994, found that according to the literature ongoing patterns of stress trigger distractions and these in turn lead to events, which may cause accidents, and threats to health. A focus group of practicing farmers in Washington felt that the primary cause of unsafe and unhealthy behaviour was stress. In addition, it was concluded that stress prevents farmers from taking appropriate safety precautions when they are aware of danger in their work practices. In order to concentrate on injury prevention farmers must learn to recognise the cause of their stress and learn to manage their reaction to these circumstances in an appropriate way. Thu *et al.*, (1997) identified stress as a significant risk factor for agricultural injuries. Their study found that those farmers reporting high stress were 1.7 times more likely to sustain a serious injury than those reporting moderate to low stress. Glasscock (1999) found an association between stress related variables and injury occurrence among farmers. Similarly Simpson *et al*., (2004) found a strong association between stress and the incidence of farm injury. However, Glasscock proposes that the stress-accident relationship may be in part related to self-employment rather than simply related to farming. Lewin-Epstein and Yuchtman-Yaar (1991) as cited in Glasscock (1999) found self-employed men had a higher perceived stress than employed men. The author proposes that this may be due to a greater burden of uncertainty, the effects of market fluctuations and the threat of loss of assets. Contrary to this, Rautiainen *et al*., (2004) found that the injury rates did not differ according to stress level. As stress was measured at the same time as injuries, the presence and effect of stress pre-injury is questionable.

3.4 Injury characteristics

Accurate national occupational injury data relating to non-fatal injuries in farming is not readily available from many countries. In many cases the legal workplace health and safety requirements differ between agriculture and other industries and thus this affects reporting requirements. Where farmers are required to report injuries, under-reporting is common. According to Purschwitz and Field (1990) data collection is costly both in time and money due to the physical dispersion of farms. In addition, the variety of people living and working on farms leads to inconsistencies in data. Studies of farming accidents identify many factors which appear significant in the analysis of farm injury data. According to Knapp (1966, P. 503), *'who is injured and by what is of considerable importance in the development of any educational program or recommendation with respect to design changes for injuring devices'*.

3.4.1 Agent of injury

From their review of the Traumatic Injury Surveillance of Farmers, Hard *et al.,* 2002, found that machinery and livestock were the leading causes of farm work related injury in America between 1993 and 1995. In 1988, the National Coalition for Agricultural Safety and Health (NCASH) reported that farm fatalities and injury predominantly result from interactions with machinery, which accounts for over 50% of traumatic farm deaths (Hard *et al.,* 2002). In the American context the tractor has been consistently identified as the predominant causative agent associated with farm fatalities (Purschwitz, 1990). However, for non-fatal accidents, the National Safety

Council's (NSC) 31-state report showed that animals were involved in 16.8% of all injuries and machinery (excluding tractors) accounted for 16.3% of all injuries. Machinery injuries, however, accounted for the majority of permanent injuries where as animals accounted for only 6.3% of permanent injuries. The machine most often involved in farm-work related injury is the tractor (May, 1990). During the period between 1976 to 1989 machinery injuries in Canada accounted for on average 55% of annual farm injuries (Gill Coury *et al*., 1999). Similarly Doyle and Conroy (1989) found machinery and falls to be the most common agents of injury on farms in Ireland. If a league table of farm accidents were developed machinery would comprise the leading single category, accounting for half of fatalities and a quarter of non-fatal accidents (Lloyd, 1983). Lloyd also ranked falls and animals as major agents involved in farm work- related injuries. Evans (1999) found that two thirds of accidents in mid-Wales involved machinery or implements of some kind while animals were involved in one third of accidents. Cogbill *et al*., 1985b and Pickett *et al*., 1995, also found machinery to be the main agent of injury. Gill Coury *et al*., 1999, identified excess of self-confidence and carelessness as causal factors in accidents involving animals.

3.4.2 Age of victim

From the literature reviewed, the majority of victims of farm-work related injury appear to be middle-aged men. Doyle and Conway (1989) found the victims of farm accidents in their study to be mostly young fit middle-aged men, followed by children. Children were found to be particularly vulnerable at peak times on the farm, when their help was required. Evans (1999) found the mean age of those injured to be 39.71 years, however, both children and the elderly were among the injured. Cogbill (1985) reported a similar mean age for those injured while Reiling (1997) found the average age of those sustaining injury to be 43 years, although, it was slightly higher (55 years) for those sustaining fatal injuries. A Canadian study found male farmers between the ages of 31-40 to be at the highest risk of injury in Ontario (Pickett *et al*., 1995). The NCASH report as cited in Hard *et al*., (2002), stated *'Agricultural injuries affect, in substantial numbers, children under the age of 16 and the elderly 65 and older'* (NCASH, 1989, p.19). Purschwitz (1990), in examining results from the NSC's 31-state report found that the age groups 5-14 and 15-24 had the highest rates of farm work injury per million hours of work exposure.

Zhou and Roseman (1994) found that injury risk is inversely related to age, younger farmers are involved in more high-risk activities; lack training and experience and are greater risk takers. Correspondingly, Sprince e*t al.* (*2*003) identified a significant relationship between younger age and farm work-related injuries. They suggest that inexperience related to younger age may indirectly be a significant factor in injury risk. In Sweden, injuries to the over 64 year olds and under 30 year olds were found to be significantly greater than for farmers as a whole (Thelin, 2002). In addition, McCurdy and Carroll (2000) identified several studies showing increased rates of farm work-related injuries among the extreme age groups. The literature suggests that older farmers and farm workers are at highest risk for work-related agricultural fatalities (Hard *et al* 2002; Reiling, 1997; Myers, 1990; Myers *et al*., 1995) however the relationship is not as strong for non-fatal injuries (Reiling, 1997; Myers, 1990). The consensus appears to be that a higher proportion of middle aged men sustain farm work related injuries than all other age groups, however, those in the young age groups and older farmers are at the highest risk of farm work related fatalities.

3.4.3 Sex

According to Diderichsen *et al.*, (1999) in all age groups women are not injured to the same extent as men with the exception of perhaps after retirement. Purchwitz (1992) interpretation of the NSC's 31-state report found that while males were involved in almost 84% of the injuries they constituted approximately 62% of the population, and accounted for about 77% of the hours worked. Cogbill *et al*., (1985b) found in their study of agricultural trauma that similar to other forms of trauma the male female ratio was 4:1. Similarly, Evans (1999), Schelp (1992) and Mather and Lower (2001) found that the majority of those injured on farms were male. According to McCurdy and Carroll (2000) the increased risk for men is most likely related to working longer hours and engagement in more hazardous jobs than women. Traditionally roles within the farm family were quite well defined. Women tended to play the major role in managing the household and children and perhaps took on farm chores such as rearing fowl and tending to young animals. Men on the other hand, took on the vast majority of the farm tasks and in the majority of cases carried out all machinery work and heavy work on the farm. In Ireland, while men's roles have remained the same with regard to farm activities, by and large women's have changed in that they play a lesser role in farm activities and more frequently engaged in work activities off the farm. Consequently women were and even more so are now exposed to less risk in the farm environment.

3.4.4 Who was injured

When reviewing the results of the Traumatic Injury Surveillance of Farmers Hard *et al.*, (2002) found that the majority of farm work injuries occurred to the operator or a family member, followed by hired farm labour. Evans (1999) found the farmer to be the victim in 60% of reported accident cases in his study in the UK. Similarly Doyle and Conroy (1989) found the farmer to be injured in the majority of accidents presented in Irish general practice, however, children accounted for 16% of the cases. Purschwitz (1990) presented a similar picture from his synopsis of the NSC's 31-State report where 73.4% of farm work injuries involved family members who accounted for 70.8% of the population. In addition, Mather and Lower (2001) found employers were injured most frequently (58%) while employees sustained a relatively high level of injury (31%) on farms.

3.4.5 Time of year

Due to the seasonal nature of farm work (Section 3.3.3) one expects the majority of accidents would occur at peak periods in the farming calendar. Cogbill *et al.*, (1985b-) found a clear seasonal variation in injury with the majority of injuries occurring between May and November. Similarly, Jansson (1987) found that the accident rate on the farm was higher at busy periods of the year such as April, July and September. While Evans (1999) found that the majority of farm accidents occur in June. Zhou *et al.*, (1994) found the seasonal pattern of farm injuries to be bimodal, with one peak in spring and a larger peak in September while much fewer injuries occurred in winter. Gill Coury *et al.*, (1999) found that the majority of both injuries and fatalities, in the previous decade, were reported during the harvest season. A study in Ontario reported a seasonal distribution according to the type of accident. While machinery accidents were concentrated in summer and autumn, more animal related injuries and falls occurred during the winter months (Pickett *et al.*, 1995). However, Purschwitz and Field (1990) found that farm accidents varied widely by state for the month of the year in which they occurred. In addition to a seasonal factor farm accidents have been found to occur predominantly in the late morning and early to mid afternoon times (Jansson, 1987, Purschwitz & Field, 1990, Evans, 1999, Rautiainen *et al.*, 2004). There is a clear relationship between periods of peak farm activity and injury occurrence. While different studies have reported different peak times for injury, it may well be that they are closely related to particular systems and thus as Purschwitz and Field found can vary by region depending on the predominant system.

3.4.6 Location

According to Denis (1976), as cited in O'Sullivan (1995), almost 40% of accidents recorded in a survey of farm accidents in Canada occurred in the farmyard. Similarly McNamara and Reidy (1997) found that the majority of farm work-related accidents in their study of Irish farms occurred in the farmyard. However, according to Evans (1999) almost 42% of accidents took place in fields while just over one third took place in farmyards. Similarly most farm injuries in Canada during the period 1976 to 1989 occurred in fields while somewhat fewer were found to have occurred in the farmyard. Zhou *et al*., (1994) found that the majority of injuries occurred in fields or pasture followed by animal facilities and farm buildings. Stallones (1990) found that injuries were more likely to occur in the barn, barnyard or fields. Both Jansson (1987) and Evans (1999) found that somewhat more accidents occurred outdoors than indoors. This may be due to a greater level of activity taking place in the outdoor environment and the impact of environmental conditions, e.g. carrying out activities in inclement weather conditions or working under pressure in good weather to complete tasks before weather conditions deteriorate.

3.5 Factors associated with injury risk on farms

Many studies seek to identify injury risk factors in an attempt to determine what approaches will be most appropriate to reducing or eliminating injuries (Pratt & Hard, 1998). Findings generally confirm the theory on accident causation, in that a series of events create the conditions under which the incident occurs.

3.5.1 Farm size

'Size of farm is clearly an important factor as regards farm accidents in terms of the incidence of accidents generally and serious accidents' (McNamara and Reidy, 1997, P.18). According to Jansson (1987), the size of the farm is a significant factor in the occurrence of accidents. Although farms of more than 50 hectares constituted only

15% of the farms in the study area, they accounted for 39% of all accidents. Zhou and Roseman (1994) found that the greater the farm size and the higher the annual production tended to result in a higher injury risk. They also propose that larger farms have a higher exposure to hazards due to the fact they have higher livestock densities, are more mechanised and are possibly under heavier economic pressure. Rautiainen *et al*., 2004, did not find an association between farm size and injury rate. However, Pickett *et al*., 1995 support the association between injury and farm size based on the results of their population based survey. In addition, they suggest there is a clear association between higher farm income and increasing risk of injury. Larger farms tend to have a higher activity level and also possess a higher level of animals and machinery both of which have been cited above as the predominant agents of injury in farming.

3.5.2 System of farming

Reiling (1997) found that the majority of work related accidents on Norwegian farms occur on farms where more than 75% of their time is spent on animal husbandry. However, this is the predominant system of farming in Norway. Having large livestock on the farm has been significantly associated with farm work-related injury (Sprince *et al., 2003,* Stallones, 1990, Rautiainen, 2004). Zhou and Roseman (1994) found that dairy farms and farms with forestry have the highest risk. McNamara and Reidy (1997) found that over one third of farming accidents in Ireland, over a five year period, occurred on specialist dairy farms while tillage farms were also found to have a high proportion of accidents.

3.5.3 Work load characteristics

Sprince *et al.*, 2003 found an association between work characteristics and farm work-related injury in their study. This is similar to the finding of Zhou and Roseman (1994) who found an association between proportion of time spent farming and farm work-injury risk. Jansson (1987) found that over half of the accident victims they encountered did not have continuous leave (of one week or more) during the year. However, Rautiainen *et al*., 2004 did not find a significant association between farm work hours and injury rate. In addition, part-time farming has been found to have an impact on work-related injury in farming. Zhou and Roseman (1994) found that part-time farmers had an excessive injury risk compared to full-time farmers. Reiling, 1997 found that when injuries were analysed per million working hours, the injury rate was higher on farms with the lowest level of working hours. Part-time farmers, who work under severe pressure both early in the morning and late in the evening on their farms, may explain this. Furthermore, the production systems on small farms may not be as modern as on large farms and the variety of tasks is much greater on small farms than on large farms. A more recent study from Iowa found no significant association between part-time farming and injury rates. However, Sprince *et al.,* 2003 found that working part-time on the farm was protective against farm work-related injury.

3.5.4 Other factors

Pickett *et al.,* (1995) observed a two-fold increase in risk of injury associated with third level education as opposed to a primary level education. Zhou and Roseman (1994) also found an association between higher education level and increased injury risk. According to Sprince *et al.,* (2003) this association may be explained by the possibility that younger farmers are more likely to recall and report accidents. According to Jansson (1987) 24% of those injured on farms in their study had a short work experience in farming (0-5 years). However, Rautiainen *et al*., 2004, did not find education to be an injury risk factor. In addition, farmers who had suffered a prior residual injury were found to have an almost three fold risk of injury, farmers who have been previously injured were more likely to be injured again (Zhou and Roseman, 1994). Alcohol use has been associated with virtually every type of injury, especially those that are severe and fatal (Baker *et al*., 1984; Smith and Kraus, 1988). Farmers in Ireland do not tend to drink at work; rather they drink late at night, at the weekend and when they go to agricultural shows (Doyle and Conway, 1989). Some Irish evidence, however, suggests that a higher proportion of serious accidents occur on farms with larger size households irrespective of whether children were present or not (McNamara and Reidy, 1997)

Figure 3.1 below illustrates both the person and environment characteristics identified from the literature, which play a role in farm health and safety. Person relates to the farmer or the decision maker, should they be different, in the farm business. It is the person who determines the management ethos of the farm. Environment in this context relates to the farm environment in which farm activities take place. The literature identifies characteristics of farming, injury characteristics and factors associated with injury risk, which can be described as either person characteristics or environment characteristics. Person characteristics were found to have been examined and discussed in greater detail in the literature reviewed than were the environment characteristics.

Characteristics of farming

Person

- Age Profile
- Working hours
- Part-time farming
- Isolation
- Stress

Environment

- Mechanisation

Factors associated with injury risk

Person

- Work load characteristics
- Person factors

Environment

- Farm Size
- System

Injury characteristics

Person

- Age
- Sex
- Who injured

Environment

- Agent of Injury
- Time of injury
- Location of injury

Figure 3.1: Person and environment characteristics

3.6 Attitudes to health and safety

Attitudes have been associated with accident occurrence from the genesis of the industrial safety movement. Many people believe that in order to prevent accidents in the workplace, good safety attitudes are necessary (Strasser *et al.,* 1981). Safety educators and researchers have frequently linked attitudes and behaviour and intervention programmes have been frequently based on this relationship. '*Attitudes signify a predisposition to act in a specific way. The advantage that can be gained from a knowledge of attitudes is that it allows for some prediction of behaviour in certain situations'* (Cooper and Germain, p.27, 1974). Fishbein and Ajzen (1975) define attitude as *'a learned pre-disposition to respond in a consistently favourable or unfavourable manner with respect to a given object'* (P.6). The essential difference between both definitions is Fishbein and Ajzen view attitude as learned and actions are considered to be consistently favourable or unfavourable. This basic premise is supported by Strasser *et al.*, (1981) who asserted that attitude formation toward safety starts early in life. These influences shape the causative factors rooted in unsafe behaviour. Therefore if farm safety was not prioritised when a child was growing up on the farm, that child would be less likely to be concerned with safety management when farming in later life.

Fishbein and Ajzen (1975) offered a conceptual framework relating beliefs, attitudes, intentions and behaviours with respect to an object. They proposed that attitude is related to a set of intentions, which in turn relate to specific behaviours. There is not a direct correlation between attitudes and behaviours; i.e. a positive attitude toward an object does not reflect a positive behaviour toward the object. Instead a positive attitude toward performing behaviour (intention) generally provides a high consistency between attitude and behaviour. Thus behaviours towards an object cannot be predicted from knowledge of a person's attitude toward the object.

3.7 Attitudes and safety

Attitude of the person has been proposed as one of the most important causes of accidents. Since attitudes were thought to be involved in controlling human activities, it was accepted that they determined whether people would react safely to particular circumstances (Strasser *et al.*, 1981). However, Murphy (1981) disputes this. He found no significant difference in attitude scores of farmers that experienced an accident and those that did not. He asserts that other factors are more directly related to farm accidents than safety attitudes. The pressures exerted by society and the low value placed on safety in the decision making process is likely to cause more risk behaviour and accidents. Similarly, Elkind (1993) found that knowledge about farm safety and health hazards is not necessarily linked to deep-seeded values and attitudes' regarding what is right in farm life. Farm family attitudes may be related to economic well-being of which productivity and costs of preventative safety measures may be factors. If people with good farm safety attitudes sustain farm work related injuries and continue to pursue unsafe activities, a balance between education and environmental modification is perhaps the only way to prevent injuries occurring or to reduce the severity of injuries that do occur (Stallones, 1989).

According to Williams (1970) as referred to by Elkind (1993) attitudes, in terms of farm work, also appear to be influenced by interest in the activity at a given time, understanding of the inherent risk of the job, and pressure from others relative to job output. In addition, a high level of safety consciousness often competes with other issues which may well be stronger, such as lack of holiday relief, time and money. Societal dynamics have also been proposed as having an effect on farmers' safety attitudes. Society in general expects farmers to be tough, independent and rugged individuals. Using safety equipment goes against this perception of the farmer (Jespen, 1976 as cited in Murphy, 1981).

There may also be a cultural effect at play as suggested by Cooper and Germain (1974); people are governed by the influences they were exposed to in their formative years. In addition, according to Murphy, 2003, P.27, '*Culture is reinforced by everyday experiences on the farm. That is, the commonness of the personal experience of interacting with hazards and not being injured, and the earliness at which it starts for many (e.g. in childhood or adolescence), results in an ingrained belief that hazards and injury are as integral to farming as seed and feed'*. When safety is part of a groups norms and the organisation culture, individuals will be less likely to take risks and will be more likely to conform and work safely (Dunne, 2001). Traditionally safety has not been part of farmers' norms and consequently risk taking and lack of safety precautions has been prevalent. Research found that adolescents from northeastern Colorado felt that sustaining injuries was part of growing up on a farm. The study found that adolescents learned most of their safety information from observing parents and other workers on the farm (Darragh *et al*., 1998).

3.7.1 Attitude change

'*As an enduring tendency to react positively or negatively, attitudes are difficult to change or modify*'. (Strasser *et al.,* 1981, p.90) Given that most attitudes are developed over many years, they often involve complex personality traits. Therefore, any attempt to change or modify the attitude is often construed as an attack on the beliefs and behaviour of the individual. Hence, modifying socially unacceptable attitudes is a very complex and challenging task (Strasser *et al.*, 1981). The approaches of specific propaganda campaigns which serve to change attitudes towards risk taking have been ineffective (Cooper and Germain, 1974). Many resources were invested in safety attitude development as the principal means of accident prevention; however, by the early 1980s the success of this method was being questioned. Murphy (1981) proposed a re-examination of the high priority given to safety attitude development as the principal means of accident prevention. Consequently, research looked beyond safety attitudes as a means to prevent accidents. Elkind (1993) proposed that in order to make agriculture safer for the farm families and their employees, it is vital to motivate people to protect themselves from health and safety hazards. Nevertheless, several authors continue to emphasise the need to explore safety attitudes and the psychology of working in order to plan preventative programs. Dunne believes that in order to improve safety at work it is essential to understand how people think, feel and act in relation to hazards and dangerous situations. *'If we don't put effort and time into understanding the personal or human factor in safety, we are missing a very real opportunity to improve safety at work'* (Dunne, 2001, P.35). In order to plan preventative measures it is necessary to know the attitudes towards safety of the at risk group (Jansson and Eriksson, 1990). Wadud *et al.,* (1998) assert that if farmers don't believe that occupational ill health problems are preventable they will not take the necessary precautions to minimise the risks. Therefore understanding the relationship between farmers' beliefs about prevention and their safety practices is important for developing effective prevention programmes. Traditionally, farm health and safety education focussed on the presentation of safety rules and guidelines. However, this method largely ignored the factors that actually influence farmer behaviour. Hence, although the majority of farmers understand the safety messages, they continue to engage in risky behaviours (Cole, 2002). He uses three learning theory perspectives: behaviourism, constructivism and socioculturalism to explore why distribution of knowledge alone is ineffective in developing safe work practices. Cole concludes that replacing risky behaviours with safe behaviours requires a change in attitude. *'Attitudes are changed primarily through our interactions with human models and parables. Furthermore, changing attitudes of the members of a practice community is best approached from within that community'* Cole (2002, P.157).

While the priority given to proper safety attitudes as a means of accident prevention has diminished substantially, there is an increasing emphasis on understanding the broader psychology of workers in order to design systems, which are compatible with the people that use them.

3.8 Safety behaviour

'Unsafe behaviour is a contributing cause of 85% of all accidents. In accident situations where human behaviour is an important factor, it is often possible to modify behaviour in order to decrease the likelihood that the accident will occur, as well as to reduce the probable consequences of the accident' (Strasser *et al.*, 1981, P.82).

Efforts to modify behaviour through attitude change have been found to be too simplistic to solve the farm safety problem (Glasscock, 1997; Elkind, 1993; Murphy, 1981). However, investing time and effort in understanding the human factor in safety is essential in order to improve workplace safety (Dunne, 2001). Human behaviour in terms of accident prevention depends on the attitudes and beliefs that people bring to a given situation. The choice of safe or unsafe actions is always present and therefore people develop attitudes, which in turn determine their responses. Once formed, action and decision making with respect to the object of the attitude are consistent with the attitude. Therefore the existence of attitudes is identified through observing the behaviour of people (Strasser *et al*., 1981). However, attitude is rarely the only determinant of behaviour. Motivation can also have a significant impact on behaviour (Strasser *et al*., 1981; Wadud *et al*., 1998). In addition, other forces such as social and physical conditions can also impact on safety behaviour. The impact and strength of these conditions may be adequate to overcome a safe attitude (Strasser *et al.*, 1981). In addition, Strasser identified two other levels of behavioural control that have an impact on safety, habits and values. While an attitude may possibly result from a single experience, habits are automatic responses to functions in life, which exist without direct involvement of conscious thought. According to Elkind (1993) the mundane repetitiveness of performing certain farm tasks over many years may affect farmers' concentration on the tasks. The habitual nature of some farm tasks result over time in farmers completing tasks almost automatically, without giving them adequate thought or attention. However, further examination by Reis and Elkind (1997) suggests that more experienced farmers may be more accustomed to the injury risk associated with performing risky tasks. In actual fact, they may be more likely to aim to control or avoid certain aspects of tasks, which are risky. Values are seen as enduring principles upon which people build their lives. While safety is not a value, other values have an important impact on safety e.g. family and friends.

In addition initial socialisation into a workplace has a bearing on perceptions, attitudes and commitment to safety as well as safety behaviour. Van Mannen & Schein, 1979, P.211 define socialisation as *'the process by which an individual acquires the social knowledge and skills necessary to assume an organisational role'* (Cited by Mullen, 2004). Safety socialisation involves conversations with colleagues, observing co-worker behaviour and the rewards or punishments relating to certain behaviour. Individuals that experience positive socialisation influences are more likely to have positive safety attitudes and perform work safely (Mullen, 2004). Mullen, 2004 found that socialisation which took place before a person joined an organisation has an effect on their behaviour after they have become socialised into the workplace. In other words, socialisation in one environment has an effect on future work environments. Essentially, people learn from experience and thus people 'learn to take risks'. When a situation arises in which a person has prior experience, this experience will help to determine and focus the response. Over time as experiences are repeated, a readiness to respond to a particular stimulus in a certain way is developed (Strasser *et al*., 1981). In terms of occupational injuries, since unsafe behaviour is very often not followed by a negative outcome, people learn to behave unsafely and to take risks (Dunne, 2001). In other words, risky behaviour which has been pursued to save time for example, is rewarded if injury does not occur. However, Mullen, 2004 argues that very often workers in an organisation pursue unsafe behaviour to avoid negative outcomes, such as harassment from co-workers. While previously it was thought that workers engaged in unsafe behaviour because they did not understand the risks, research now suggests that workers understand the risks associated with their behaviour and continue to engage in unsafe practices (Mullen, 2004).

Since negative consequences so infrequently follow risky behaviour, it is necessary to engineer workplaces so that risky behaviour is not rewarded, that is it does result in negative consequences. In this regard, several principles of learning have been employed in safety management systems. Dunne (2001) discusses the main principles of learning as they apply to safety;

7) **Punishment and negative reinforcement**
   This should follow risk taking in order to ensure that the consequences are meaningful to the person involved. However, punishment is only effective when it is immediate, inescapable and severe (Cole, 2002).
8) **Consistency and consequences**
   Ensuring that consequences of risky behaviour always follow and that they follow immediately.
9) **Imitation effects**
   Respecting the power of safety promotion, superiors should always be safety role models for subordinates.
10) **Discrimination learning and the stimulus control of behaviour**
   Improvement in safety performance can only take place if all members of an organisation are consistent in the implementation of safety regulations.
11) **Positive reinforcement**
   Working safely should be promoted by consistently positively reinforcing safe behaviour. Maintaining constant compliance with safety behaviours requires repeated positive reinforcement (Cole, 2002).
12) **Extinction**

When safe behaviour is no longer being reinforced, a process of unlearning occurs. In effect safe behaviour becomes extinct. To avoid this situation the above principles need to be implemented in order to promote safe working.

These principles are fundamental to the success of health and safety management systems and are widely used. Essentially these principles are based on the premise that *'people learn practices from experience'*. *'The most basic psychological principle of learning is that behaviour is governed by its consequences. We don't get hurt, cut or burnt. We don't fall (even though we may wobble). Nobody comments on our unsafe behaviour. Our risk taking does not have a negative consequence – so we take a chance again the next time'* (Dunne, P.39, 2001). However, the application of these principles in production agriculture is constrained by the fact that the farmer, in general, works alone and is both operator and manager. It is reasonable to assume that nobody does comment on farmers unsafe behaviour. Thus, in the vast majority of cases, farmers only face consequences of their unsafe behaviour when an accident or injury occurs.

3.9 Farmer safety behaviour

Farmer's perceptions of their ability to perform general health behaviours were found to be correlated to their perception of their ability to perform farm health and safety behaviours. Farmers who consider themselves able to perform health behaviours perceive more benefits and fewer barriers to practicing protective farm safety behaviours. In addition, they view themselves as less vulnerable to farm injury and anticipate less severe consequences. Those who place more value on their overall health in turn place more value on practicing proper farm health and safety practices. This suggests that an optimistic bias exists among farmers in which they feel unrealistically optimistic about their invulnerability to harm (Hodne *et al.*, 1999).

Green (1999) identifies factors at three levels, micro, meso and macro that make farmers in general exposed to health and safety risks. At the micro level factors internal to the farmer such as knowledge of hazards and recommended protective actions are translated into beliefs that are specific to each performance of a task. Thus each time a particular work activity is carried out, the farmer intuitively assesses his personal risk and considers the costs involved in using protective measures in relation to their ability to reduce his risk. Based on analysis, he/she decides which, if any, protective actions he/she will engage in. In addition to knowledge, the authors feel beliefs are shaped by close calls, health impairments which are affected by the farmers work and that physical capacity declines with age which in turn increases perceived susceptibility. At the meso, the immediate social and physical environment level, the farmers beliefs are influenced by others beliefs and practices. The presence of children or spouses will heighten the farmers perception of susceptibility. Also the belief that other farmers follow protective practices will reduce the perceived barriers to engaging in those practices. In addition, attributes of the farmers working environment also contribute to the perceived barriers to protective action. For example, the awkwardness and discomfort of certain protective equipment combined with time, financial and workload pressures. As farmers are their own bosses, this may prove an additional barrier to safety. The occupational culture of farming also affects the individual beliefs of farmers. The macro level or the broader environment, which includes policies, markets and societal values has also been found to shape the farmers working environment (Green, 1999). Farmers who were personally concerned about contracting farm work-related ill health problems (i.e. perceived susceptibility), felt that those problems could be avoided (i.e. perceived benefits), and identified fewer barriers to taking preventative action (i.e. perceived barriers) were most likely to take the necessary precautions to reduce their risks (Wadud *et al.*, 1989). Similarly, Murphy (1992) asserted that when people do not believe that they have control over certain behaviours, they are not disposed to voluntarily changing those behaviours. In addition, they will not pay attention to programs aimed at promoting such voluntary behaviour changes. Moreover a high degree of safety consciousness competes with other, frequently stronger, factors such as lack of holiday relief, time and money. In this regard risky but time-saving behaviours are often rewarded as they seldom result in injury (Jansson and Eriksson, 1990).

3.10 Injury control

Traditionally the agricultural industry, farm organisations and farm safety professionals have employed educational methods to address farm safety issues (Murphy, 1992). However, these efforts were seldom evaluated and therefore provided no means to differentiate between effective and ineffective interventions. As a result the effectiveness and applicability of previous education efforts are largely unknown (Aherin *et al.,* 1992). Both the industrial safety and health and public health fields have developed particular approaches to injury prevention, into which, psychological concepts and principles are deeply intertwined (Murphy, 1992). The Industrial Safety and Health approach to accident prevention grew from workplace experiences of workers in specific industries or occupations. The approach relied heavily on economic incentives to reduce accident losses (Aherin, 1992). In recent years, these approaches and research from other health and safety fields is being applied to farm health and safety. In addition behavioural change and persuasion research is an area, which has potential to provide empirical methods for identifying effective injury control intervention systems (Aherin, 1992). Three fundamental schools of thought on injury intervention are discussed below.

3.10.1 The Three-E Method

The Three-E method, otherwise known as the common sense approach was the principal industrial accident prevention strategy until the middle of the last centaury. This method was developed in or around 1961 by the then president of the Kansas Safety Council, Julian H. Harvey (Aherin *et al.*, 1992). This method rests on the premise that accidents can be prevented through the use of three instruments, Engineering, Education and Enforcement. While the method had success in industrial settings, this success was not achieved in agriculture. According to Murphy, 1992 the successful implementation of the Three E method in industrial settings was due to the control present in the workplace. The lack of workplace control in farming results in engineering technologies being disabled or altered by farmers. This method overwhelmingly relies on the control of worker behaviour in order to achieve success. The appropriateness of this intervention approach to farming in Ireland is questionable as the majority of farms are owner operated and thus worker control is absent.

3.10.2 The Human Factors Engineering Method (HFE)

Human Factors Engineering (HFE) is concerned with matching machine operation with the abilities and limitations of human operators. In doing this it acknowledges that humans are often unreliable, unpredictable and poor risk preceptors, therefore this approach does not rely on man to adapt to the product or process in question (Murphy, 1992). It is the application of the broader field of Human Factors. The study of Human Factors focuses on cognitive errors of workers, concentrating on subconscious factors, which result in accidents rather than conscious decision to pursue an unsafe action (Garavan, 1997). Human Factors Engineering is comprised of two fields, engineering and psychology. While engineers are the practitioners in HFE, psychology dominates the research field in HFE (Murphy, 1992). Systems are a central concept in HFE (Sanders and McCormack, 1987). In HFE a system is a logical arrangement of components that interact to perform a certain task in a given environment. HFE is sometimes referred to as the study of operator-machine and operator-environment systems with the main emphasis on the operator-machine system and the environment in which it takes place (Aherin, 1992). The application of Human Factors Engineering, like many industrial safety approaches, relies on control and supervision in the workplace. Thus in occupations where a self-employed person predominantly works alone, such as farming, HFE is generally not a reliable accident control approach.

3.10.3 The Public Health Approach

The Public Health Approach to accident and injury prevention has been developed from a concern for understanding and preventing diseases and for controlling the spread of disease throughout communities. The science of epidemiology is employed in order to understand, prevent and control occupational injury and ill health (Murphy, 1992). Various injury prevention or safety promotion measures are available to those concerned with reducing injury rates. In terms of occupational safety, many methods can be employed depending on the nature of the organisation or sector.

Sweden has long recognised its problem with farm accidents and has strived to prevent the occurrence of accidents through a farmers occupational health program. The Farmers Health Service was established over twenty years ago and benefited from government subsidies and contributions from the Federation of Swedish Farmers (LRF). The Farmers Health Service conducts research and provides occupational health services to farmers and others involved in ‘green areas’ through regional health centres. The service provides farm visits by safety engineers, which is seen as extremely important to advance change in environments and habits and also provides health checkups every second year and distributes information to those affiliated. Through their research activities the Farmers Health Organisation develops information materials, which are available to farmers in pamphlets, at meetings but most effectively during checkups and farm visits. Research findings are also used to lobby manufacturers and dealers of farm machinery in order to improve the work environment. Farmers who are affiliated to the service have fewer accidents and consume less general health care than others. The service has found that to be successful in this type of prevention program it is important to reach farmers through their organisations. Also the availability of technical staff who specialise in helping farmers construct safe workplaces is vital. Where the occupational health structures are not in place to provide this type of service, the Swedish experience suggests that with proper training there is an opportunity for primary health care workers to do so (Höglund, 1999).

3.11 Interventions

There is a significant amount of literature relating to farm safety interventions and as was highlighted earlier very little of this research has been evaluated. However, much of the literature provides research-based guidance on planning interventions. Scharf *et al.,* 1998, on reviewing farm safety interventions, provided a template of intervention protocols. They found four themes that were common among a number of reviewed farm safety interventions, which are discussed below. These are:

5. Active participation of the farmers;
6. Farm economics;
7. Safe-work practices and productivity;
8. Community participation.

Rural health care workers require an understanding of the occupational and environmental roots of farmer health problems, which in turn would enable them to recommend preventative measures (Donham *et al.,* 1982). Similarly, Walsh, 2000 found evidence in the United Kingdom that the National Health Service (NHS) is not meeting the health needs of the farming community. Walsh concurs that health care workers need to understand farming and provide a service that is tailored to farmers.

However, Thu *et al.,* 1990 highlighted the need for farmer input in designing new farm health and safety programs to ensure practicality, applicability and acceptance.

Kidd *et al.,* 1998 found that farmers and farm workers do not recognise the direct and indirect costs associated with work-related injury and consequently are not making safety decisions on an accurate basis. It is proposed that an intervention that visually illustrates the realities of work and highlights both the direct and indirect costs associated with work related injury enables farmers to see that safety is inexpensive and that farm expansion, labour requirements, and commodity choices all have safety implications. Dunne, 2001, asserts that the view of those who have no interest in working more safely is that safety is too costly and bothersome to merit time and money investment. They do not recognise all the costs associated with injury and believe that their insurance will cover any costs they may face.

Jaspersen *et al.,* 1999 detail the pilot Certified Safe Farm program in Nebraska which consisted of on-farm safety assessments and occupational health screening with an education program. This program attracted participant farmers with the incentive of a reduction in their health insurance premiums. The program was based on health and safety programs widely used in other industries. It consisted of voluntary participation in farm health and safety education, occupational health services, and on-farm safety assessment. The results of the program identified important safety problems on the farms while also finding current health problems and risk factors for future health problems. Chapman *et al.,* 2003, conducted and evaluated an intervention among dairy farmers in Wisconsin that coupled safety and profitability. The intervention sought to increase voluntary adoption of three production practices that were safer and more profitable than typical practices: barn lights, bag silos and a mixing site for calf feed. The program availed of print media, public events and resource people to disseminate the information to the farmers. The study found that the farmers appeared to be voluntarily responding to the intervention.

The Theory of Planned Behaviour adds sophistication to farm injury interventions by basing them on the actual beliefs and intentions of the target population. It allows for more specific targeting of interventions to a particular group for specific hazards. The model provides greater information on attitude, subjective norm and perceived control of the target group and the effect of these on a persons' intention to perform a safety behaviour (Petrea, 2001). Dunne, 2001 also puts forward the initiative of actively involving employees when developing safety policies, procedures and practices at work. This method ensures that people are seen as a resource within the organisation. The same could be said for the farming industry; the insights of people at all levels in the industry are relevant to safety and should be drawn on. This will serve to illustrate to farmers that they are a resource in the industry and that safety involves everybody, not just inspectors and safety advisors.

Safety campaigns generally aim to raise awareness about an issue, inform about an issue or to change attitudes and ultimately behaviour regarding an issue (Dunne, 2001). Safety education had its beginnings with the industrial health and safety movement. Originally, there were two aims to safety education. The first was to train people to engage in safety behaviour which affects people in direct and observable ways everyday. An example of this would be putting on a seat belt in a car. The second purpose however, was to act as a basis for devising the engineering / safeguarding and supervision / enforcement strategies. In essence this purpose aimed to aid industry and the general public in understanding all the possible accident prevention options. While the first purpose was common among workers, the second was by its nature the realm of health and safety professionals (Murphy, 1992). Safety education has long since come under criticism from professionals in industry. According to Heinrich (1941) employees may be talked to, read articles and view pictures about safety frequently and still fail to apply the messages within to themselves. In addition, he felt that safety education efforts, which were general in nature and aimed at mass audiences were somewhat limited as they failed to highlight the specifics of how safety applied to individual workers at the exact time they needed it. He believed that controlled work environments that had close relations between supervisors and workers were most favourable to safety education. Farm health and safety education is typically general and is delivered through a mass appeal approach. An example of this is 'always disengage the PTO and turn of the tractor before cleaning out a machine'. This presents good advice to all farmers, thus the mass appeal approach and it is applicable to a variety of situations encountered on a farm, and therefore it is general. However, it does not take account of the reality of situations that exist on farms at the precise time a safety decision must be taken. A variety of factors such as tired workers, cold workers, untrained workers, irritated workers, crops continually blocking the machine due to poor weather or disease and so forth, impact on safety decisions. *'In the face of such realities, routine safety or health instructions have little chance of effecting behaviour'* (Murphy, 1992, P.140). Dunne, 2001 also questions the degree to which educational campaigns influence attitudes and behaviours. Messages may be disregarded because the target group do not think they are relevant to them, they don't believe in the effectiveness of the content, they may have a fatalistic attitude to accidents or they become defensive and simply stop processing the information.

'*We will never, ever engage people in health if we pursue them with fundamentalist answers, regulations, warnings and prohibitions'* (Fugelli, 2003, P.12). Improving the effectiveness of injury prevention or education campaigns increases the likelihood that the message will reach the target group. Campaigns should be targeted rather than broadly based and subsequently the content and issues should be designed with this target group in mind. It is more constructive to provide information on how to work safely rather than issuing warnings about hazards or behaviours. If the content is presented positively and links safety to attractive aspects of the job, it is more effective. In addition, concrete and personal information rather than statistical data will appeal to the audiences' imagination, while focussing on more frequent events will increase the awareness of workplace hazards (Dunne, 2001). Dunne emphasises that as people we are all open to education and we inherently seek a better understanding of our environment.

Little evidence exists to direct the design and implementation of farm safety interventions. The techniques of the fundamental schools of thinking on occupational accident and injury prevention are not all relevant to farming owing to the absence of workplace supervisors. However, research has identified factors, which diminish the effectiveness of interventions. Participation in safety courses has not been shown to reduce injury risk in North American agriculture (Layde *et al*., 1993; Lewis *et al*., 1998). Tools that improve the effectiveness of interventions have been identified by occupational psychology and should be employed in intervention programs.

3.12 Conceptual framework

From the literature review, it is possible to derive a conceptual framework to direct the ensuing research study. In the context of work place health and safety, the complexity of the working environment is fundamental to the study of workplace accidents and subsequent injury. The literature review identified both person and environment characteristics in characteristics of farming, factors associated with injury risk and indeed in injury characteristics. Further, key characteristics of both the person and the environment that impact on health and safety on farms are identified (figure 4.1).

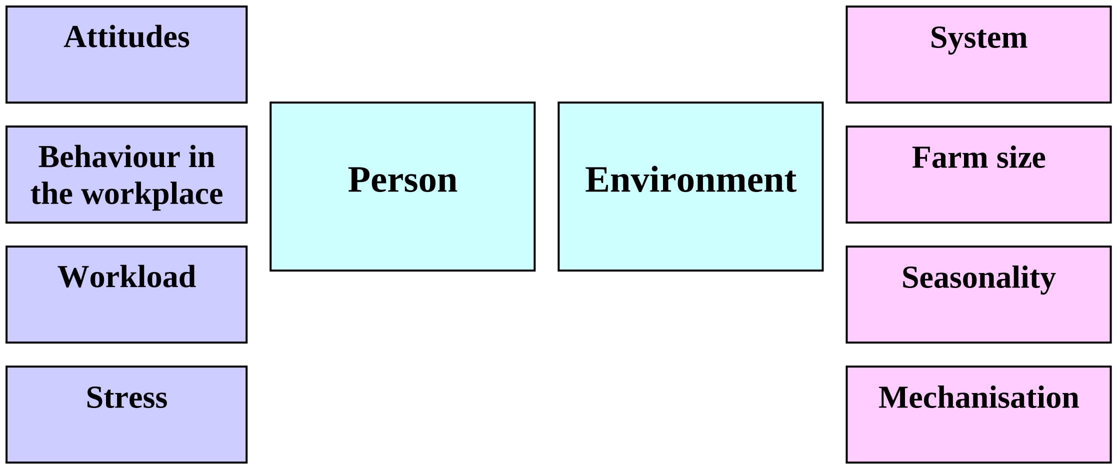


Figure 3.2: Person and environment characteristics impacting on health and safety on farms

The person and the environment are, however, integrated components – each exerting an influence on the other. Strasser *et al.*, 1981, described the interrelationship between man and the working environment. From the literature review, a dichotomous model is proposed which identifies the relationship between the components of health and safety on farms.

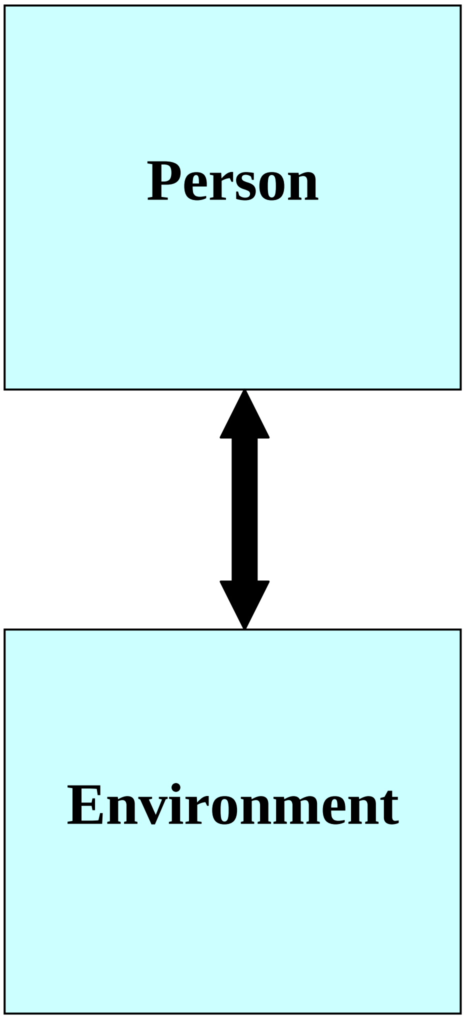


Figure 3.3: Conceptual framework for the study of health and safety on Irish farms.

Figure 3.3 illustrates that the interaction of the person within the working environment is central to health and safety in the workplace. This relationship is fundamental to the genesis of accidents, and the resulting injuries, in the workplace. While an understanding of both the environmental and person components, which ultimately impact positively or negatively on farm health and safety, is necessary, an understanding of the interaction between these components is critical to understanding health and safety on Irish farms.

The literature on farm health and safety places significant emphasis on understanding accident occurrence and injury outcomes. The importance of understanding behaviour and attitudes of farmers to health and safety was carried strongly by the literature. However, it provides limited understanding of risk and risk perception at farm level. In addition, the theory does not explore the impact of injury on the wider farm management and farm operations. Further, the literature tells little of how health and safety is managed on farms or how it is incorporated into day-to-day activities, both in thinking and practice. The literature review did identify and discussed the terminology, theories and models which underpin our understanding of health and safety both in farming and more broadly.

From the literature, it is clear that understanding person and environment factors are fundamental to the study of health and safety on farms. In relation to both, it is necessary to identify the characteristics which impact on farm health and safety. The literature review identified the necessity to record farm injuries in detail in order to design and plan intervention strategies and inform policy makers. In addition, it is now deemed fundamental to identify and explore the factors associated with injury risk on farms. There is a need to examine the place of health and safety in farm management and how this impacts on accident occurrence.

CHAPTER 4
THE SURVEY OF HEALTH AND SAFETY ON IRISH FARMS

One of the specific objectives of this study was to examine the degree to which health and safety impacts on the day-to-day management of farms in Ireland. An examination of the incidence of injuries and farm work related ill-health problems is necessary in order to estimate the extent of the problem and to examine the trends that occur over time. In addition, prevention efforts, to be successful, require accurate data relating to the injured person and the injury itself.

The conceptual framework proposes that the working environment and person factors are fundamental to workplace health and safety. It asserts that the interaction between environmental and person factors is critical in accident occurrence and subsequently injury to persons or property. Hence, The Survey of Health and Safety on Irish Farms has been constructed to provide an understanding of the incidence of injury and the attitudes and activities of farmers to health and safety on the farm. The survey was designed with the person and the environment as keystones.

In addition to examining farm work related injury levels, understanding farmers' perception of health and safety and their behaviour towards occupational hazards and risk is vital in order to create safe work places (Chapter 3). In addition it is necessary to determine the level of understanding farmers have of their legal requirements with regard to health and safety on the farm and the information, training and support requirements of farmers necessary to comply with this legislation.

4.1 Objective

The purpose of this chapter is to examine the current health and safety situation on Irish farms. The under-reporting of occupational injuries in farming to the HSA, results in unreliable statistics. Under reporting constrains opportunities to take appropriate measures and determine priorities (Barancik *et al*., 1983). While Teagasc have conducted two previous studies which examined the level, cause and consequences of accidents on Irish farms only interim results have been available since the 1997 study. The specific objectives of this chapter are to;

(vi) To determine the extent of occupational injuries on Irish farms;

(vii) To determine the extent of farm work related ill-health problems on Irish farms;

(viii) To examine the perceptions of farmers relating to health and safety on their farms;

(ix) To examine the safety related behaviours of farmers;

(x) To identify the needs of farmers in relation to farm health and safety.

4.2 Methodology

To meet one of the major objectives of this study, which was to ‘determine the extent of injury and farm related ill health on Irish farms’ a quantative study titled ‘The survey of Health and Safety on Irish Farms’ was undertaken. This exploratory study aimed to fulfil the objectives as set out above and provide a greater understanding of health and safety on Irish farms.

Based on the objectives outlined above a comprehensive questionnaire was developed and was attached to the February 2002 supplement of the National Farm Survey (NFS) (Appendix 1). The design of the questionnaire was based on those used previously by Teagasc in the ‘Survey of Health and Safety’ 1992 and 1997. Each of these studies took a retrospective approach to determining incidence of injury. Injuries that occurred in the five years prior to the date of recording were sought from participants. In the current study it was deemed necessary to employ the same basic approach and use the same reference time frame to allow for comparisons with the previous studies. Use of a similar questionnaire allowed for the examination of trends across the three survey periods. The Teagasc National Health and Safety Specialist, the Teagasc Safety and Labour Organisation Specialist and a researcher from the Health and Safety Authority were consulted on the design of the questionnaire. The questionnaire was then tested on a number of farmers and a number of minor changes were made. While the questionnaire was quite extensive, it was somewhat restricted in scope as the length was determined by the National Farm Survey. Thus, it was not possible to explore all elements in as much detail as was desired.

The questionnaire consisted of five sections:

f) Accidents on the farm;
g) Physical health of farm workers;
h) Safety Attitudes;
i) Safety behaviours;
j) Preventative actions.

While predominately made up of closed questions, a number of open questions were included in instances where it was deemed important to understand the full range of opinion held by the farming population.

The components of farm health and safety presented in the conceptual framework were fundamental to the design of the questionnaire. The questionnaire sought information relating to both person and environment components and specifically the factors of each which are implicit in farm accidents and the resultant injury.

In designing the survey it was necessary to choose whether to use elements of the questionnaire previously administered by Teagasc or to design an entirely new study grounded in the literature reviewed. The benefit of incorporating elements of the Teagasc questionnaire, which was the strategy adopted, allowed for comparisons to be made across three survey periods. It was necessary to examine whether the study should focus only on farmers that sustained farm work related injuries or whether it should include both injury and non injury farms. The latter scenario was pursued. The former scenario would have employed a surveillance methodology based in either hospital emergency departments or GP surgeries or a combination of both. This type of study would have required significant collaboration with medical professionals. It would have involved training of hospital or surgery recorders and ultimately would have relied on the staff in high pressure and time-poor environments to identify and record information from appropriate cases. This approach would have delivered detailed and accurate information on the accident event, pre-event and post-event. However, it would only have captured the most serious injury events and it would have had a strong medical focus. In addition, the reliance on staff to remember and to have the required time to administer the questionnaires meant that not all cases presented would be included in the study.

From the literature review attitude presented as being significantly associated with farm health and safety. Different measures of attitude were discussed; however, these were not incorporated into the Survey of Health and Safety on Irish Farms. The attitude measurements presented are drawn from the field of psychology and are specific in their design and administration. It was decided that it was beyond the scope of this study to employ attitude measurements as the necessary expertise was outside of the researcher's academic field. In addition, it was deemed important to ground the study, in so far as possible, in agriculture to provide an agricultural perspective on farm health and safety. Thus the survey included questions designed to give and indication of attitude without technically measuring and quantifying attitude.

4.2.1 National Farm Survey (NFS)

The primary function of the NFS is to collect and analyse information relating to farming activities. The objectives of the NFS are to:

e) Determine the financial situation on farms in the Republic of Ireland (ROI) by measuring the level of gross output, costs, income, investment and indebtedness across the spectrum of farming systems and sizes;
f) Measure the current levels of, and variation in, farm performance for use as standards for farm management purposes;
g) Provide a database for agricultural economic and rural development research, and;
h) Provide data to the EU Commission on Irish farm incomes.

(Connolly *et al*., 2003)

A farm accounts book is recorded for each year on a random sample of farms throughout the ROI. Stratified random sampling is used to select the sample. This ensures that all systems of farming are accurately represented. The weighting system is provided by the Central Statistics Office (CSO). Farms are weighted according to size and system. Of the 1167 farms that participated in the NFS in 2001, the supplementary questionnaire was completed for 1119. When CSO weightings were applied, the survey population represented 120,201 farmers nationally. The NFS is administered by a team of trained recorders and recording takes place on individual farms. Prior to the commencement of the survey, a training session was undertaken with the recorders to explain the background to the study and fully explain the questionnaire.

4.2.2 Definitions

For the purpose of this study the following definitions are employed:

Farm work related accident (accident): An event which occurs during the course of farming, excluding road traffic accidents, which has the potential to cause injury to persons or damage to property.

Farm work related injury: is an injury to a person, which has resulted from a farm accident.

Farm work hazard or hazard: is a situation in the farm environment with the potential to give rise to injury to persons, damage to property or the environment.

Farm work risk or risk: Likelihood of a specific farm hazard becoming an actuality and the degree of injury and or damage likely to result.

4.2.3 Statistical analysis

This data were analysed in conjunction with data collected by the NFS in 2002 relating to the farmers personal profile and farm characteristics. Analyses of the data were carried out using SPSS V.10. While data were recorded for 1119 farms, not all sections of questionnaires were fully completed with some questions not answered. For that reason, the number of respondents varies slightly across different sections. As the survey was conducted by a panel of recorders, it is not possible to determine if non-responses are predominately related to the recorder or respondent or indeed if they are a function of both. However, the excellent reliability of the National Farm Survey instrument assures that the data collected is of high quality. Analysis of the data took place at two levels, that of the entire population (n=1119) and the sub population that experienced an injury (n=110).

4.3 Results

This section examine the results of the quantitative analysis. The results are analysed on the basis of person and environment characteristics.

4.3.1 Incidence of injury

A farm work related injury was found to have occurred on 9.8% (n=110) of the sample farms and of these four farms experienced more than one injury. When the weighting was applied to the sample, the results indicated that an estimated 3,002 injuries occurred on Irish farms in the most recent survey year 2001 (Figure 4.1). This represents an injury rate of 21.5/1000 for Irish farmers (based on the actual population of 139,000 farmers). Fewer injuries were reported in each of the four years prior to 2001. Although fewer injuries may have occurred in those years, it is likely that recall errors may account for a significant proportion of this difference. Given that the average number of annual injuries in the five years prior to 1997 was 2,000 (McNamara & Reidy, 1997), it is unlikely that such a significant drop would be seen in 1997.

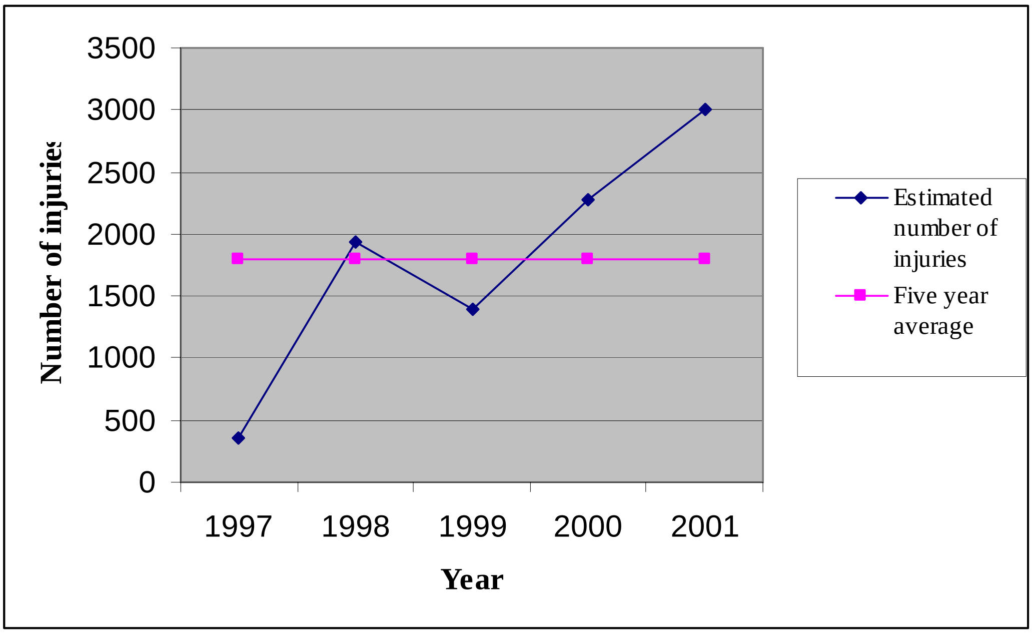


Figure 4.1: Estimated number of farm work related injuries per year

The estimated average number of injuries per year in the five-year period between 1997 and 2001 was 1,792. When compared to two previous five-year averages (McNamara & Reidy, 1992; McNamara & Reidy, 1997) the 2001 data shows some improvement over the 1997 data. However the rate of decline in farm injuries appears to have slowed down (Figure 4.2).

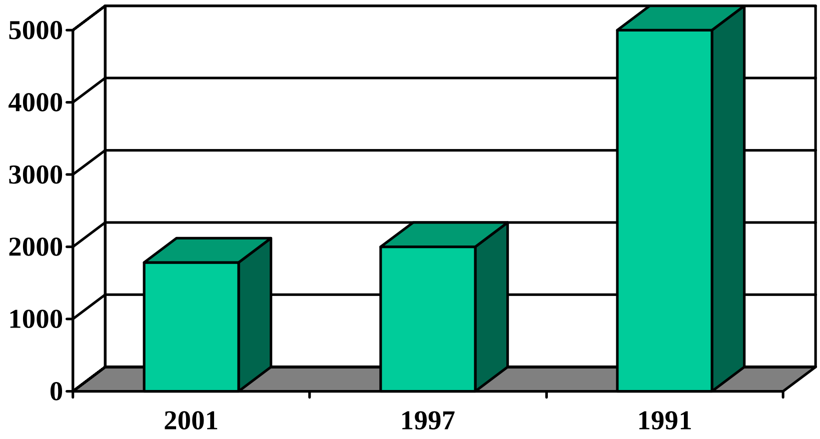


Figure 4.2: Average number of farm accidents per five-year period

The results show that ill health problems, which were attributed to farm work, existed on 11.5% of the farms surveyed; six farms reported having more than one incidence of farm work related ill health problems.

4.3.2 Environment characteristics of injury

4.3.2.1 System of farming

Table 4.1 shows the distribution of farms that reported an injury analysed according to system of farming. The farming systems are classified by the NFS based on enterprise gross margin. Dairy and other represents farms engaged in dairy farming in conjunction with one or more other enterprises. ‘Cattle other’ refers to beef systems other than suckler cow farming. Almost 30% of the reported injuries occurred on dairy farms while this system accounts for 30.8% of the farm population. While accounting for 8% of the entire population of farms, tillage farms accounted for 15.5% of the injuries. The highest proportion of injuries was reported by dairy farmers, followed by dairy and other.

Table 4.1: Frequency of injuries according to system of farming compared to distribution of farms by system

System of farming	Injury farms 1997* (%)	Injury farms 2001 (%) (n=110)	All farms 2001 (n=1119)
Dairy	35	29.1	30.8
Dairy and Other	15.1	20.9	16.5
Mainly Tillage	11.4	15.5	8
Suckler Cows	9.7	14.5	20.1
Cattle Other	13.6	10.9	13.3
Mainly Sheep	15.2	9.1	11.3
Total	100	100	100

***Source: The Survey of Health and Safety on Irish Farms (1997)**

A decrease in the injury level between 1997 and 2001 was reported by dairy farms, sheep farms and 'cattle other'. All other systems experienced an increase in injury with a substantial increase apparent in both suckler cow and dairy and other farming. Thus the findings correspond to those discussed in section 3.5.2 which assert that having large livestock on the farm is significantly associated with farm work related injury.

An examination of the relationship between system of farming and accident occurrence (Table 4.2, Cross Tabulation Analysis) suggests that Irish tillage farms and those categorised as dairy and other experience more injuries than those involved in other production systems. Using the chisq statistic (chisq=13.080, df=5, significance=. 023) this association was found to be significant at the .05 level.

Table 4.2: Relationship between injury occurrence and farming system

Injury Occurrence	System						
	Dairy	**Dairy & Other**	**Suckler Cows**	**Cattle Other**	**Mainly Sheep**	**Mainly Tillage**	**Total**
Yes	32 9.3%	23 12.4%	16 7.1%	12 8.1%	10 7.9%	17 19.1%	110 9.8%
No	313 90.7%	162 87.6%	209 92.9%	137 92.1%	116 92.1%	72 80.9%	1009 90.2%
Total	345 100%	185 100%	225 100%	149 100%	126 100%	89 100%	1119 100%

(Chisq=13.080, df=5, Significance=.023)

When the farming systems were recoded into four main categories, dairying, cattle, sheep and tillage the relationship between system and injury became more significant. The results indicate that Irish tillage farms experience a higher incidence of injury than those engaged in other systems, while those engaged in dairying sustain more injuries that either cattle or sheep farmers. Using the chisq statistic (chisq=11.636, df=3, significance=.009) this association was found to be significant at the .01 level (Table 4.3).

Table 4.3: Relationship between injury occurrence and farming system.

Injury occurrence	Dairying	Cattle	Sheep	Tillage	Total
Yes	55 10.4%	28 7.5%	10 7.9%	17 19.1%	110 9.8%
No	475 89.6%	364 92.5%	116 92.1%	72 80.9%	1009 90.2%
Total	530 100	374 100	126 100	89 100	1119 100

(Chisq=11.636, df=3, significance=.009)

Table 4.4 presents the distribution of injuries for each of the farming systems on a seasonal basis. The majority of injuries on all farms took place in autumn (33%), while 27.5% occurred in summer. Winter saw fewest injuries on all farms, which reflects the lower level of activity on farms compared to other times of the year. Seasonal variation in injury levels occurs when farming systems are analysed. On dairy and sheep farms the highest proportion of injuries occurred during the summer. Autumn appears to be a critical injury time period on suckler cow and dairy and other farms. This is generally 'turn in' period on the majority of cattle farms and cattle would require increased handling before being housed. At this time cattle would experience some level of stress and there would be a higher level of contact between the farmer and animals than in the previous months. Not surprisingly the injury level peaked on tillage farms during the harvest period. The cattle other category saw the highest level of injuries during the spring.

There is seasonal variation in injury levels within each of the Irish farming systems. Similar to the findings of previous research, section 3.4.5, the injury rate was highest in autumn and summer, which are the busiest periods in Irish farming.

Table 4.4: Distribution of injuries per farming system according to season

Season	All Injuries 2001 (%) (n=110)	System					
		Dairying (%)	Dairy & other (%)	Suckler Cows (%)	Cattle Other (%)	Mainly Sheep (%)	Mainly Tillage (%)
Winter	15.6	15.6	21.7	6.3	16.7	2.2	11.8
Spring	23.9	25	26.1	18.8	33.3	11.1	23.5
Summer	27.5	37.5	8.7	25	25	44.4	29.4
Autumn	33	21.9	43.5	50	25	22.2	35.3
Total	100	100	100	100	100	100	100

4.3.2.2 Size of farm (Utilisable Agricultural Area)

When examining the association between Utilisable Agricultural Area (UAA) and injury occurrence, the results show a clear relationship between farm size and injury occurrence (Table 4.5). As farm size increases so to does injury occurrence. Therefore the trend appears to be that those working on large farms experience a higher level of injury. Using the chisq statistic (chisq=7.497, significance=. 024) this association was found to be significant at the .05 level. This corresponds to the evidence from prior research which found the greater the farm size, the higher the injury risk.

Table 4.5: Relationship between accident occurrence and UAA

Accident Occur	***Utilisable Agricultural Area***			**Total**
	<20ha	**20-40ha**	**>40ha**	
Yes	11 7.3%	27 7.2%	72 12.1%	110 9.8%
No	140 92.7%	347 92.8%	522 87.9%	1009 90.2%
Total	151 100%	374 100%	594 100%	1119 100%

(Chisq=7.497, df=2, Significance=. 024)

4.3.2.3 Season and time of day injury occurred

The seasonal breakdown of the injuries according to system of farming has already been explored (Table 4.4). However, further analysis examines the seasonality of injuries according to accident type (Table 4.6) and indicates that certain agents of injuries may be related to seasonal activities and thus result in more injuries during specific seasons. A high proportion of livestock injuries occurred across all seasons, while machinery injuries were found to be highest during summer and autumn. Trips and falls accounted for the highest proportion of injuries during the summer period. Both summer and winter reflected high levels of injuries resulting from accidents with gates and doors.

In addition, table 4.7 shows injury type according to the season in which they occurred. Livestock injuries peaked in autumn with a smaller peak in spring. These are typically intensive periods on livestock farms in Ireland. In addition, there is a greater degree of animal handling at these periods, turn out and turn in, than at other times of the year. Trip and fall injuries peaked during spring and summer and declined towards autumn. Machinery injuries peaked sharply in the autumn. While the majority of other farmyard accidents occurred during the autumn, a significant amount was found to have occurred during the summer. While seasonality undoubtedly has an effect on injury occurrence, the peak periods for injuries in the farming calendar are not consistent across research (3.3.3). This possibly reflects the differences in the type of systems and characteristics of those systems according to country and indeed state in the case of America.

Table 4.6: Distribution of seasonal injuries categorised according to injury type

Injury Type	All Injuries 2001 (%) (n=110)	Season Winter (%)	Spring (%)	Summer (%)	Autumn (%)
Livestock	25.5	29.4	30.8	16.7	27.8
Machinery	20	11.8	15.3	20	25
Trips and Falls	21.8	23.5	26.9	23.3	16.7
Chainsaw/wood	6.4	11.8	7.7	3.3	5.6
Other farmyard	6.4	0	3.8	6.7	11.1
Tools and Implements	3.6	0	3.8	6.7	2.8
Gates and Doors	7.3	11.8	7.7	13.3	0
Other	9.1	11.8	3.8	10	11.1
Total	100	100	100	100	100

Table 4.7: Distribution of accident type according to the season in which they occurred

Season	Accident Type							
	Livestock (%)	Trips & Falls (%)	Machinery (%)	Chainsaw/Wood (%)	Other Farmyard (%)	Tools & Implements (%)	Gates & Doors (%)	Other (%)
Winter	17.9	16.7	9.5	28.6	0	0	25	20
Spring	28.6	29.2	19	28.6	14.3	25	25	30
Summer	17.9	29.2	28.6	14.3	28.6	50	50	0
Autumn	35.7	25	42.9	28.6	57.1	25	0	60
Total	100	100	100	100	100	100	100	100

Regarding time of day when injuries occurred, the results show that the highest proportion (30%) of all injuries occurred between 9am-12noon, which corresponds, to the findings from elsewhere (section 3.4.5). On both dairy and tillage farms the injury level was found to peak between 9am-12noon. Most injuries on sheep farms and dairy and other farms were sustained between 3-6pm while on both categories of cattle farm the highest proportion of injuries occurred between 12noon-3pm (Appendix 2). Table 4.8 illustrates the time of injury according to system of farming. The majority of injuries in both of the morning categories occurred on dairy farms. This reflects periods of high activity on a daily basis due to milking. In both of the afternoon periods, high proportions of injury took place on dairy and cattle farms.

Table 4.8: Distribution of time of injury according to system of farming

System of Farming	Time of day 6-9am (%) (n=10)	9am-12noon (%) (n=33)	12noon-3pm (%) (n=26)	3-6pm (%) (n=28)	6-9pm (%) (n=8)	9pm-6am (%) (n=5)
Dairying	50	33.3	19.2	21.4	50	20
Dairy & Cattle	20	15.2	26.9	28.6	0	20
Suckler Cows	0	12.1	26.9	7.1	25	20
Cattle Other	10	9.1	15.4	10.7	0	20
Mainly Sheep	0	12.1	0	21.4	0	0
Mainly Tillage	20	18.2	11.5	10.7	25	20
Total	100	100	100	100	100	100

4.3.2.4 Location of accident

Table 4.9 shows the distribution of injuries per farming system according to the accident location. Similar to previous Irish findings (3.4.6), the highest proportion of all accidents took place in the farmyard and this was true in the case of each farming system with the exception of sheep farming where the highest proportion of injuries were sustained in fields. Almost 38% of injuries on suckler farms occurred in the field and a similar proportion of injuries on tillage farms occurred in fields. In both of these systems, a significant level of the farm activity takes place in fields. The highest proportion of injuries that occurred in the farmyard was on dairy farms while just over 23% occurred on dairy and cattle farms (Table 4.10). In addition half of the accidents in farm buildings occurred on dairy farms. Both suckler and tillage farms each accounted for one fifth of injuries that occurred in fields.

As indicated in the literature, the farmyard and the field are the most significant locations for accident occurrence. However, variation in accident type was found according to accident location. The most significant accident types for farmyard injuries were found to be Trips and falls, livestock and machinery respectively (Appendix 3). Livestock accounted for the highest proportion of accidents in fields.

Table 4.9: Distribution of injuries per farming system according to accident location

Accident Location	All Accidents (n=110) (%)	System of Farming					
		Dairying (n=32) (%)	Dairy and Other (n=23) (%)	Suckler Cows (n=16) (%)	Cattle & Other (n=12) (%)	Mainly Sheep (n=10) (%)	Mainly Tillage (n=17) (%)
Farmyard	47.7	46.9	52.2	43.8	66.7	30	43.8
Field	24.8	12.5	21.7	37.5	16.7	40	37.5
Farm Buildings	18.3	31.3	17.4	12.5	0	20	12.5
Public Road	7.3	9.4	8.7	6.3	8.3	10	0
Farm Road	1.8	0	0	0	8.3	0	6.3
Total	100	100	100	100	100	100	100

Table 4.10: Distribution of injuries per accident location according to farming system

	Accident Location				
Farming System	**Farmyard (n=52) (%)**	**Field (n=27) (%)**	**Farm Buildings (n=20) (%)**	**Public Road (n=8) (%)**	**Farm Road (n=2) (%)**
Dairying	28.8	14.8	50	37.5	0
Dairy & Cattle	23.1	18.5	20	25	0
Suckler Cows	13.5	22.2	10	12.5	0
Cattle & Other	15.4	7.4	0	12.5	50
Mainly Sheep	5.8	14.8	10	12.5	0
Mainly Tillage	13.5	22.2	10	0	50
Total	100	100	100	100	100

4.3.2.5 Type of accident

The injuries have been classified according to the type of accident from which they resulted (Table 4.11). Over one quarter of injuries resulted from livestock accidents while 20% resulted from machinery accidents. A further 21.8% of the injuries arose from accidents classified as trips and falls. When compared to the results of the Survey of Health and Safety on Irish Farms (1997) it appears that machinery accidents have decreased while both livestock and other farmyard accidents have increased. In addition accidents categorised as trips and falls have increased since 1997.

Table 4.11: Distribution of types of accidents

Accident Type	All Injuries 2001 (%) (n=110)	All Injuries 1997* (%)
Livestock	25.5	22.9
Machinery	20	34.9
Trips and Falls	21.8	18.1
Chainsaw/wood	6.4	8.6
Other farmyard	6.4	6.8
Tools and Implements	3.6	0
Gates and Doors	7.3	0
Other	9.1	8.7
Total	100	100

*Source: Survey of Health and Safety on Irish Farms, 1997

An examination of the distribution of accident types according to system of farming shows that over one third of all livestock accidents occurred on dairy farms while a further quarter occurred on dairy and other farms (Table 4.12). The highest proportion (36.4%) of machinery accidents took place on mainly tillage farms, which by their nature are machinery intensive. The highest levels of trip and fall accidents occurred on dairy farms followed by dairy and other. The highest proportion of the three predominant accident types, trips and falls, livestock and machinery took place in the farmyard. However, a significant proportion of livestock accidents also occurred in fields (Appendix 4).

Within each category of accident type, the majority of accidents were found to have occurred on farms of greater than forty hectares (Appendix 5).

Table 4.12: Distribution of accident types according to system of farming

	Accident Types							
	Livestock (n=28) (%)	Machinery (n=22) (%)	Trips & Falls (n=24) (%)	Chainsaw/wood (n=7) (%)	Other farmyard (n=7) (%)	Tools & Implements (n=4) (%)	Gates & Doors (n=8) (%)	Other (n=10) (%)
Dairying	35.7	9.1	29.2	14.3	42.9	50	25	50
Dairy & Other	25	9.1	20.8	42.9	42.9	25	25	0
Suckler Cows	17.9	13.6	16.7	14.3	0	0	25	10
Cattle & Other	3.6	22.7	8.3	28.6	0	0	12.5	10
Mainly Sheep	10.7	9.1	12.5	0	0	25	0	10
Mainly Tillage	7.1	36.4	12.5	0	14.3	0	12.5	20
Total	100	100	100	100	100	100	100	100

4.3.3 Person characteristics of injury

4.3.3.1 Injured person

In almost three-quarters of the injury cases recorded (74.3%), the farmer was the injured person, while farm labourers accounted for 8.3% of the injuries. In addition 7.3% of the reported injuries were sustained by the farmers' son. The remainder of those injured were family members (Appendix 6). Similarly, the farmer was the affected person in the majority (84%) of reported ill health cases (Appendix 7).

Almost 92% of those injured were male. However, the median age of females injured on farms was ten years older than that of men, forty-two years versus fifty-four years. The age of the injured person was recoded in accordance with the age categories used by the CSO to characterise farm holders. However, in order to reflect injuries sustained by children the first CSO category <35 years was split into <16 years and 17-34 years. According to the HSA a child is a person who is less than 16 years old or the school leaving age which ever is higher. Table 4.13 illustrates the age of those injured in farm work related accidents. Of those injured 27.3% were aged between 17-34, while 18.2% were aged between 45-54. Almost 11% of those injured were over 65 years old while 4.5% were less than 16 years old and thus classified as children. In over 6% of the injury cases the age of the injured person was not disclosed. With the exception of the less than sixteen years old category the farmer accounted for the majority of injuries in all age groups (Appendix 8).

Table 4.13: Distribution of age of injured person at the time of injury

Age category	(n=110) (%)
1-16	4.5
17-34	27.3
35-44	17.3
45-54	18.2
55-64	15.5
>=65	10.9
No Age given	6.4
Total	100

The distribution of injuries per age group according to medical outcome of the injury illustrated a high level of fatality among the under sixteen's while fatality also occurred in the two older age categories. No other significant trends in medical outcome were apparent from the data (Appendix 9).

4.3.3.2 Medical outcome

Over 80% of the farm work related injuries reported required a hospital visit. Almost one third of the reported injuries resulted in medical attention as an outpatient in a hospital while almost 22% required medical treatment in hospital. A further 19% of the injuries required surgery (Table 4.14).

Table 4.14: Distribution of medical outcome of farm work related injuries

Medical Outcome	Frequency (n=110) (%)
Outpatients	32.7
Medical (In hospital)	21.8
Surgery	19.1
GP only	12.7
Observation (In hospital)	4.5
Fatality	4.5
None	4.5
Total	100

Further examination of the medical outcome of injuries according to age of the injured person shows that over one third of those who required surgery were in the 17-34 age categories. Over one third of those that required medical treatment in hospital and 27.8% of those who required outpatient treatment in hospital were also in this category. Although the numbers involved are low, 40% of the fatalities were in the youngest age group while 60% were over 55 years old (Appendix 10). When the outcomes of the ill health cases were examined, chronic back pain accounted for almost 50% of the reported cases. Dust related allergies accounted for 23% and farmers lung for over 12% (Figure 4.3).

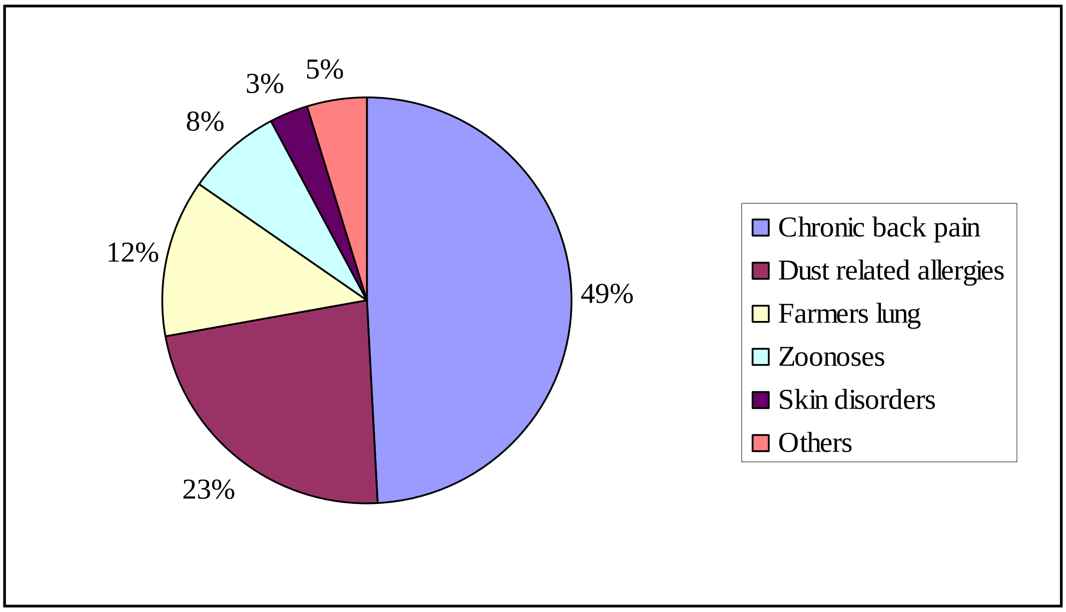


Figure 4.3: Type of farm work related ill health problems sustained on Irish farms

Of those who suffered from a farm related ill health 45.4% ranked the severity as being moderate, 29.2% ranked it as severe while 25.4% ranked it as mild. Over 70% of the respondents reported that their ill health problem was recurrent while almost 30% felt it was persistent. In 77% of the ill health cases the respondent said a measure was taken to eliminate the ill health risk.

When asked what part of the body was injured in the accident 121 responses were given, therefore, some of those involved in an accident sustained more than one injury. The extremities (i.e. legs and arms) accounted for over one quarter of the injuries. In addition, head injuries accounted for over 10% of the injuries sustained (Table 4.15).

Table 4.15: Distribution of responses to part of the body injured

Body part injured	**Frequency (n=121) (%)**
Hand, fingers, lower arm	25.9
Knee, lower leg, ankle	19.8
Shoulder, arm, elbow	14.9
Head (excluding eyes)	10.7
Back, spine	7.4
Eyes	5
Foot	4.1
Chest, ribs	4.1
Hip, thigh, pelvis	3.3
Neck	3.3
Internal	1.7
Total	100

An examination of the distribution of types of accident according to the part of the body injured shows that livestock accidents result principally in leg, arm and head injuries and chest/rib to a lesser extent. These injuries would be consistent with the principal types of accidents which livestock were involved in; kicks, attacks and crushing. The high proportion of head injuries, which resulted from livestock accidents is an alarming result. Machinery accidents result in a high level of hand and lower arm injuries and upper arm and shoulder injuries to a somewhat lesser degree. However, half of the trip and fall accidents were found to result in lower leg injuries (Appendix 11).

Fractures and broken bones accounted for over 30% of the principal injuries resulting from farm work related accidents while over one fifth reported their principal injury to be an open wound (Table 4.16). Fractures and broken bones are predominantly the principal injuries experienced by those involved in livestock accidents. Both fractures and open wounds are significant outcomes from machinery injuries while for trips and falls, fractures and broken bones and sprains are the main injury outcomes (Appendix 12)

Table 4.16: Distribution of principal injuries

Principal Injury	Frequency (n=104) (%)
Fracture / Broken Bone	30.8
Open wound	23.1
Bruising / contusion	9.6
Crushing	6.7
Muscle / Ligament	5.8
Other	5.8
Sprains	4.8
Eye damage	4.8
Internal injuries	2.9
Back / Head injuries	2.9
Fatality	1.9
Burns	1
Total	100

4.3.3.3 Injury related activities

It is evident from the results that the farm activities associated with the highest injury level are working with animals and working with machinery. However, one in ten injuries occurred while undertaking farm maintenance (Table 4.17).

Table 4.17: Distribution of injuries according to the activity underway

Activity underway	Frequency (%) (n=107)
Working with animals	46.7
Working with machinery	24.3
Farm maintenance	9.3
Tidying and cleaning the farm yard	4.7
Wood/tree cutting	4.7
Handling bales	2.8
Other	7.5
Total	100

Of the injuries that occurred while working with animals, cows accounted for the highest proportion followed by bullocks. Injuries involving bulls accounted for 10% of the animal related injuries, which was less than those accounted for by sheep. The nature and severity of injury associated with bull accidents is widely appreciated by the farming community and has been highlighted by both the media and safety campaigns. However, the results suggest that farmers do not afford other animals the same degree of caution as they do the bull. Dairy farmers have a high level of contact with cows; this level of exposure would explain the high injury level in this category (Table 4.18).

Table 4.18: Type of animal involved in injury

Type of animal	Frequency (%) (n=50)
Cows	34
Bullocks	24
Sheep	16
Bull	10
Horse	8
Weanlings	6
Sucklers	2
Total	**100**

Of the injuries that occurred while working with animals, over half resulted from being knocked over or attacked by an animal. A further 28.6% were due to animal kicks while over 10% resulted from animal crushing (Table 4.19).

Table 4.19: Specific cause of animal injuries

Cause of injury	Frequency (%) n=28
Knocked over / attacked	53.6
Animal kick	28.6
Crushing	10.7
Catching animal	3.6
Fall from horse	3.6
Total	100

4.3.3.4 Lost work days

While the majority of those injured were not admitted to hospital, over 18% spent less than two weeks in hospital while almost 6% spent more than two weeks in hospital. (Table 4.20)

Table 4.20: Distribution of injuries according to hospital stay

Number of days in hospital	Frequency (%) n=110
Not admitted	59.1
1 day	13.6
2-14 days	18.2
>14 days	5.5
Total	100

The results indicate that an estimated average of 6,000 hospital days were accounted for annually by farm work related injuries over the six-year period. This is fewer than the level found by Teagasc in both 1992 and 1997, 8,000 and 14,000 respectively. This calculation is based on the annual average for the five year period which was subject to recall issues. However, an estimated 9,500 hospital days were accounted for by farm work related injuries in 2001, which is an increase on that found in 1997.

In addition, an examination of the lost workdays experienced by those injured shows that over one quarter of those injured lost up to one week from work while almost 13% lost up to two weeks of work. Over 18% of those injured lost over 90 days due to their injury (Table 4.21).

Table 4.21: Distribution of injuries according to lost workdays

	Frequency (%) n=110
No lost days	18.2
1-7 days	26.4
8-14	12.7
15-21	8.2
22-30	5.5
31-89	10.9
<=90	18.2
Total	100

Over 67% of those that were injured resumed work while their injury was still causing difficulty. In addition almost 50% of those injured felt that they did not fully recover from the injuries they sustained due to the accident.

In almost 72% of the accident cases it was necessary for some one to take over the work of the injured person and on some farms more than one person was required. Where additional labour was required family members were cited in 63.8% of the responses of which 22.3% pertained to the spouse. In addition 24.5% of the responses indicated that hired labour was required. In the majority of cases (57.1%), those who responded said the additional labour was required for less than one month; however, in 27% of cases the additional labour was required for two-three months while in almost 16% of cases the labour was required for more than three months.

Over one third of the farms that reported an injury felt that there was an economic loss to the farm resulting from the accident. Of those who reported an economic loss, half ranked the loss as mild, 30.6% ranked it as moderate while 19.4% ranked the loss as severe.

The results indicate that injuries have a significant impact on farm labour, which inevitably must impact on efficiency and subsequentially profitability. Anecdotal evidence suggests that the labour deficiency on farms where an injury has occurred, if filled by family members very often requires family members to take time off from their own jobs or education to work on the farm.

4.3.4 Attitudes and activities toward health and safety on the farm

4.3.4.1 Perceptions of health and safety on Irish farms

When asked to classify the dangers associated with farm work over 63% of the respondents classified it as dangerous, while 26.1% felt it was safe. Almost 10% of the respondents felt that farming is very dangerous. However, when asked to classify their own farm from a safety perspective, over three-quarters of the respondents felt their farm was safe while 18% felt it was dangerous. Almost 4% of the respondents reported their farm to be very safe (Figure 4.4).

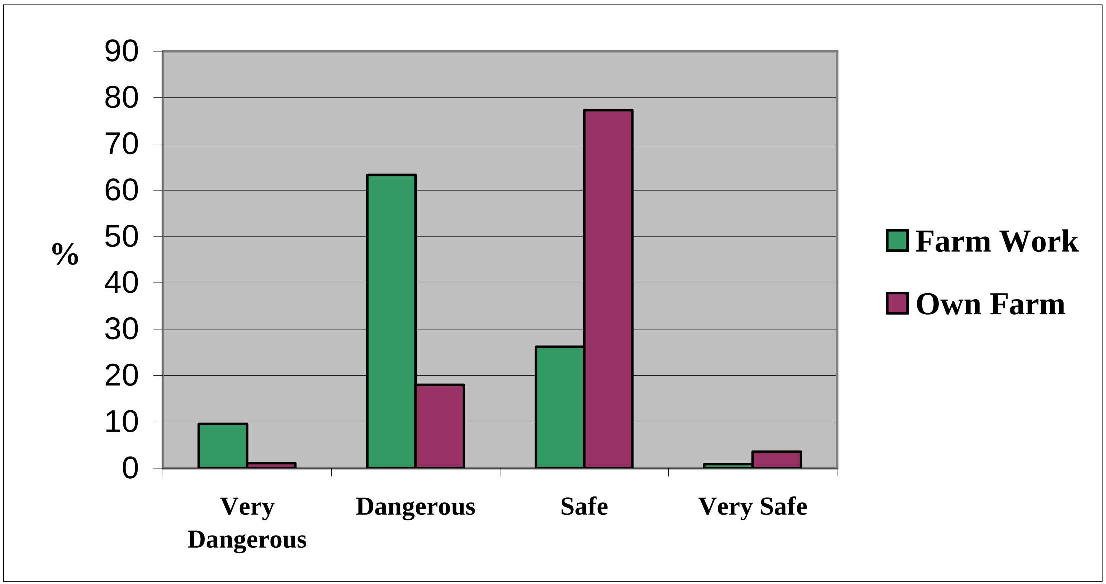


Figure 4.4: Distribution of perceptions of safety in farming

When the association between accident occurrence and the classification of the safety of the farm is examined a trend appears. Over 16% of those that classified their own farm as dangerous experienced an accident while 8.3% of those that classified their own farm as safe experienced an accident. Therefore it is likely that those who consider their farm dangerous do so because they have experienced a farm accident (Chisq=12.809, significance=. 000) this association was found to be significant (Table 4.22).

Table 4.22: Association between accident occurrence and the classification of the safety of the farm

Accident occurrence	Classification of own farm		Total
	Dangerous	Safe	
Yes	35 16.4%	75 8.3%	110 9.9%
No	178 83.6%	828 91.7%	1006 90.1%
Total	213 100%	903 100%	1116 100%

(Chisq=12.809, df=1, Significance=. 000)

In describing their own attitude to farm safety over two thirds of the respondents described themselves as concerned, while 28.1% said they were becoming more concerned about farm safety. Over 4% said they were unconcerned about farm safety (Table 4.23).

Table 4.23: Distribution of attitudes to safety on the farm (N=1116)

Attitude to safety on the farm	Frequency (%)
Unconcerned	4.5
Becoming more concerned	28.2
Concerned	67.3
Total	100

4.3.4.2 Health and safety legislation

While over 65% of the respondents understand what a safety statement is and the purpose it serves, less than half of the respondents were aware of their legal obligation, under the Health Safety and Welfare at Work Act 1989, to have a Safety Statement prepared for their own farm. Since enactment of the new legislation, after the survey was administered, the Safety Statement is no longer a legal requirement. Further, only 9.7% of respondents had prepared a safety statement for their farm. Almost 12% of the respondents were not aware of their legal obligation to conduct their farming activities in a manner, which does not put people at risk. The vast majority of respondents had heard of the Health and Safety Authority, however, almost half of the respondents said they would not welcome safety inspectors onto their farm (Table 4.24).

Table 4.24: Awareness of and compliance with health and safety legislation

	Yes (%)	No (%)	Total (%)
Understanding of safety statement (n=1113)	65.3	34.7	100
Aware of legal obligation to have a safety statement (n=1102)	46.6	53.4	100
Has safety statement been prepared (n=1119)	9.7	90.3	100
Awareness of legal obligations (n=1108)	88.3	11.7	100
Awareness of HSA (n=1116)	90.8	9.2	100
Incorporated safety into farm in last 5 years (n=1091)	58.9	41.1	100

4.3.4.3 Safety planning

Carrying out safety checks on machinery before use, may not require a great deal of time, but can alert the operator to potential hazards or problems that may cause disruption when the machine is in use and the operator under pressure. However, the results indicate that machinery checks are not always carried out before use on Irish farms. Indeed only 36% of the respondents said they always carry out safety checks on machinery before use while a further 43.9% said sometimes carry out checks. Moreover, when planning operations on the farm not all farmers account for safety. Over 50% of the respondents in this sample said they always account for safety when planning operations while 37.7% said they account for safety sometimes. Some farmers reported that they never account for safety when planning operations (Appendix 13).

Almost 85% of the respondents said that they did not perceive noise as a problem on the farm and 43.6% of the respondents said that they never use ear protection while working on the farm. In addition, over 50% of the respondents said they never supply ear protection to workers on the farm. Although 73% of the respondents feel safety signs are effective in minimising accidents on the farm, less than 20% of the respondents actually use safety signs on their own farm (Appendix 14).

4.3.4.4 Information and training needs of farmers

The results indicate a major health and safety training deficit among Irish farmers with little over 13% of the respondents having completed some form of health and safety training. Half of the survey respondents indicated that they need more information on health and safety issues. However, only 5% of the respondents had looked for information on health and safety in the previous twelve months. When asked to specify the information sought on health and safety, Teagasc literature accounted for over 26% of the responses, while information on chemicals accounted for almost 16%. Almost 11% of the responses related to electrical information and a similar proportion cited general safety issues and the safety statement (Appendix 15). The majority, 64% of the respondents, cited Teagasc as the source they would look to for farm health and safety information (Figure 4.5).

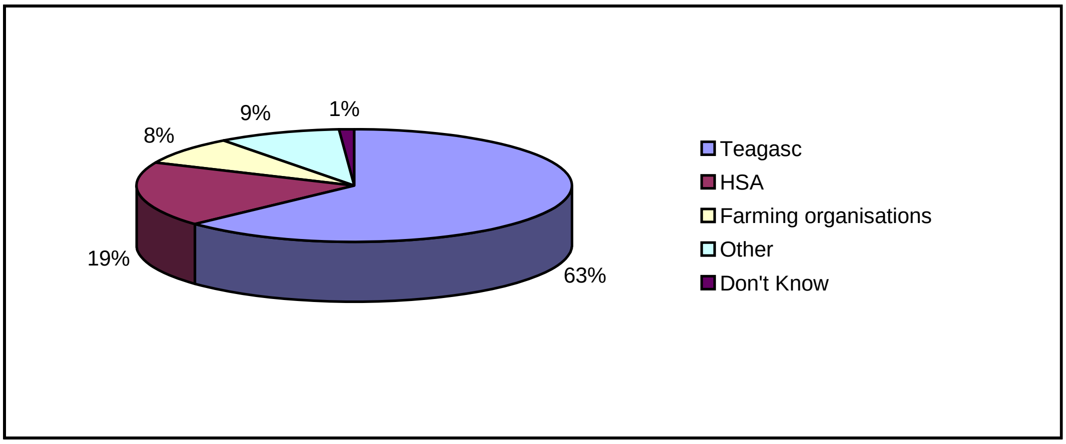


Figure 4.5: Sources of Information Sought on Health and Safety

The principal barrier to improving health and safety on their farm cited by farmers in the survey was the cost associated with safety improvements and income pressures (38% of responses). Farmers' indifference to safety accounted for over 16% of the responses while lack of safety awareness accounted for almost 14% of responses. Lack of time was cited and accounted for almost 13% of the responses, while the pressure of work accounted for almost 8% of responses. (Table 4.25)

Table 4.25: Distribution of responses to barriers to working safely

Responses	Frequency N=1360 (%)
Cost of safety & income pressures	38.4
Indifference to safety	16
Lack of safety awareness	13.8
Lack of time	12.9
Pressure of work	7.6
Lack of advice, information & training	2.3
Labour pressures	2.8
Laziness	1.8
Familiarity with work	1.2
Poor safety planning	1.0
Manufacturers lack of thought	.7
Information agencies problem	.4
Other	1
Total	100

4.3.5 Environment Factors

4.3.5.1 Incorporating safety into the farm

Almost 59% of the respondents said they had incorporated safety into their farm in the past five years. Of the changes incorporated over one quarter related to improvements in the safety of slurry facilities while 23% of the responses indicated that PTO shafts had been covered and safety guards had been applied to machines. Almost 12% of the responses referred to improvements in electrical installations while just less than 10% stated that fencing on the farm had been improved for safety reasons (Table 4.26).

Table 4.26: Distribution of responses provided for specific safety changes (n=1326)

Responses	% of responses
Improving safety of slurry storage	26
Covered PTO / Fitted safety guards	23.1
Improved electrical installations	11.8
Improved fencing	9.7
Improved cattle handling facilities	6
Adopted safer working practices	4.5
Improvements to farm yard	4
Improved safety of farm buildings	3.9
Improved safety of tractors and machinery	3.6
Made waterways and water tanks safe	3.5
Erected farm safety signs	1.4
Other	2.3
Total	100

4.3.5.2 Perception of farm hazards

Almost three quarters of the respondents perceived slurry gases to be very dangerous (Appendix 16). The majority of the respondents reported that they created an awareness of farm hazards among employees, their family and visitors to the farm. Over 85% of the respondents said that they made a planned effort to reduce risk at times of heightened activity, such as silage making, on the farm. However, only 45.2% of the respondents said getting the job done was never more important than taking safety precautions. Over one quarter felt that getting the job done was sometimes more important than taking safety precautions while a further quarter said it was rarely more important than taking safety precautions. Although in the minority, 4% of the respondents said that getting the job done was always more important than taking safety precautions.

Over three quarters of the respondents classified their farm as tidy while almost 6% classified it as very tidy. While few respondents felt that their farm was very untidy, 15.8% classified their farm as untidy (Appendix 17). The respondents perceived that accidents most frequently occurred with machinery and tractors while 15% felt livestock was the agent most frequently involved in farm accidents. Almost 11% of those that responded felt that trips and falls were the most frequently occurring accidents. There appears to be an overwhelming appreciation for machinery and tractor accidents, which may go some way towards explaining the decrease, by almost 15%, in the level of these accidents.

4.3.5.3 Management of health and safety on the farm

The hazard posed by a PTO shaft which is not properly guarded is well know among farmers and the importance of the guard cannot but be appreciated by Irish farmers given the coverage of this topic by all sections of the Irish Media. All PTO shafts were reported to be properly guarded on over 71% of the respondent farms. Yet on almost 29% of farms there were PTO shafts (one of the potentially most dangerous pieces of equipment on almost all Irish farms) that were unguarded. Lights on tractors were checked before each winter on over 81% of the respondent farms. While almost half of the respondents have the brakes on tractors checked once a year, 15% reported they never have the brakes on their tractor checked.

Chemical safety is paramount on the farm, and virtually all farms have cause to use agricultural chemicals to some degree. When handling agricultural chemicals over one third of the respondents do not wear any protective clothing. Further, over two thirds of the respondents did not have a locked storage area for chemicals on the farm; however, the vast majority (93.8%) of respondents consult the manufacturers' instructions when using chemicals on the farm (Table 4.28).

Table 4.28: Safety while working with agricultural chemicals

	Yes (%)	No (%)	Total
Wear protective clothing with chemicals (n=1094)	64.3	35.7	100
Locked storage area for chemicals (n=1100)	32.6	67.4	100
Consult chemical instructions (n=1099)	93.8	6.2	100

Almost four out every ten respondent farms had children less than fourteen years old present on the farm. It was reported that children are not allowed to play in the farmyard on almost three quarters of the farms in the sample, thus, over one third of farms permit children to play in the farmyard. In addition, 31.1% of the respondents indicated that children were not restricted from certain areas of the farm (Appendix 18). While the majority of children never have access to machinery 16.5% of the respondents reported that they sometimes had access to machinery while almost 5% said they always had access to machinery. Similarly, while the majority of children less than fourteen years old were not permitted to drive tractors on the farm 7.3% reported that they were sometimes allowed. On a small minority of farms it was reported that children were always permitted to drive tractors (Appendix 19).

Over 66% of the survey participants offered suggestions as to how safety could be improved on their farms. Of the respondents almost 14% suggested seeking training and advice on health and safety, which suggests that these farmers appreciate the role of the farmer in improving farm health and safety. The remainder of the responses relate to environmental modifications. Over 13% felt improving the safety of slurry storage and handling would improve health and safety on their farm. Over 11% of the respondents suggested covering PTO shafts, while 9.3% suggested making electrical installations safe and a further 9.1% suggested improving fencing and gates (Table 4.29).

Table 4.29: Suggestion to improve farm safety on own farm

Suggestions	Frequency (%) n=744
Seek advice & training	13.7
Improve safety of slurry storage/handling	13.4
Cover PTO shafts	11.3
Make farm electrics safe	9.3
Improve fencing / gates	9.1
Improve livestock handling facilities	8.3
Tidy / repair farm yard	7.4
Improve safety of machinery	7
Other	6.5
Repair buildings / silage pit	5.9
Be more safety conscious	4.2
Cover tanks / pits / water ways	1.6
Restrict access by children / public	1.2
Compile a safety statement	.9
Care handling stacked bales	.1
Total	100

When asked to rank the three main safety issues that give most cause for concern on the farm; livestock, machinery and power tools and slurry were found to be the top three concerns, respectively. Of the 26% of responses related to handling livestock 30% ranked it as the main safety issue causing concern on the farm and 32% ranked it second. Machinery and power tools accounted for 19% of the responses and of those over 26% ranked it as the main safety issue causing concern on the farm. Slurry and manure accounted for over 17% of the responses (Table 4.30). The same question in the SHSIF, 1997 illustrated that tractors and machinery were the principal agents for concern on the farm while few farmers were concerned about livestock on the farm.

Table 4 .30: Main safety issues causing concern on the farm (n=2341)

	Responses (%)	Rank 1 (%)	Rank 2 (%)	Rank 3 (%)
Handling livestock	26.2	30.1	31.9	10
Machinery & power tools	19	26.6	14	12.1
Slurry / Manure	17.3	13.4	17	24.9
PTO shafts	8	10.2	7.9	4.1
Other	7.3	5	6.8	12.2
Electricity	4.9	2.6	5.3	8.5
Children & members of the public on farm	4.5	3.5	4.5	6.4
Handling & storage bales	3.5	2.1	3.6	6.2
Using public roads	3.2	2.8	3.7	3.4
Tidiness of the farmyard	1.7	1.1	1.4	3.4
Working at heights	1.2	.7	1.1	2.3
Buildings in disrepair	1.1	.7	.6	2.6
Uncovered tanks & water ways	1	.1	1.2	2.4
Doors & gates	.7	.6	.7	.9
Working under pressure	.4	.4	.2	.6
Total	100	100	100	100

4.4 Discussion

Although agriculture accounts for on average 40% of all work place fatalities in Ireland, to date few studies have examined the extent of injury on Irish farms and the attitudes and activities of farmers in this respect. This national study significantly adds to the understanding of health and safety on Irish farms. However, the retrospective approach employed in this study is not without limitations, the most significant of which is recall bias. The reliability of the yearly accident levels are questionable due to the significant difference that occurs between the earliest study year and the most recent year. In addition, the injuries were not validated through medical records and in turn the data relies solely on the memory of the farmer. The increasing incidence of injuries over the study period indicates the presence of recall bias. Subsequently, it is difficult to make meaningful comparisons across the five-year period. This indicates that there may be a need for more regular and systematic collection of data relating to farm injury in Ireland. According to Jansson and Svanström (1989), medical data are most reliable when the reference period is up to three months. With periods of between four and twelve months underestimation occurs.

The absolute number of injuries reported by farms in the current study period was greater than that found by McNamara & Reidy (1997). Given that the farm population is in decline (Phelan and Frawley, 2002), a worrying trend emerges. As the number of farms in Ireland decrease, the percentage of farms experiencing an accident has in fact increased. On examination of the overall trend in farm injury, based on the five-year average data, the rate of decline in injury observed between the 1992 and 1997 studies was significantly higher than that which has been observed between 1997 and 2003. It is possible that the decrease in injury observed between the earlier studies have lulled farmers and the wider industry into a false sense of security. Dunne (2000) highlights the error in focusing too much on injury and fatality statistics, as these do not provide a true reflection of occupational accident risk. There may be cause to focus more on the level of risk present in the working environment of Irish farms in addition to recording and monitoring fatality and injury statistics.

The analysis of farm characteristics suggest that the system of farming engaged in and the size of the farm are significantly associated with injury occurrence. Farms with dairy enterprises accounted for the majority of injuries reported. However, bivariate analysis (analysing injuries in proportion to the population) found that tillage farms experience a higher incidence of injury than any other farming systems in Ireland. In addition, similar to the findings of other research having large livestock on the farm appears to be significantly associated with farm work-related injury (Sprince *et al.,* 2003; Stallones, 1990; Rautiainen, 2004). Tillage farms in Ireland are heavily dependent on machinery. Machinery is a significant hazard on farms (section 3.3.2). It is likely that the intensity of machinery use in Irish tillage farming results in a greater exposure to machinery hazards than other systems of farming. Greater accident levels were found to occur on tillage farms during autumn and summer when activity levels peak and machinery usage is high. The finding that tillage and dairy farms experienced a higher proportion of injury is broadly consistent with the findings of McNamara and Reidy, 1997. Similar to findings from other research, farm size was significantly associated with injury occurrence in this study (Section 3.5.1). Indeed, the theory that larger farms have higher annual production and thus present a higher exposure to risk as put forward by Zhou and Roseman (1994) may account for higher injury level on tillage farms.

The impact of seasonality on injury occurrence appears from the results to be complex. Not only does seasonality impact on injury occurrence in the individual farm systems, but there also appears to be a seasonal effect on accident type. Jansson (1987) found that the accident rate on farms was higher at busy periods of the farming year. The results of this study give further weight to this finding. The majority of tillage accidents were reported in autumn and summer, which are undoubtedly the busiest times on Irish tillage farms. It is reasonable to assume that the high injury level on dairy farms in summer is related to the high level of activity given that the total labour input on dairy farms was found to have peaked in May (O'Brien, 2004). However, Leahy, 2003, found that labour input on suckler cow farms peaked in spring-time yet the highest proportion of injuries occurred during autumn on suckler farms. The injury peak at this time may be related to the 'turn in' of the animals after the summer period, during which time the suckler herd will have required little handling by the farmer. An examination of the literature on seasonality and injury (section 3.4.5) shows that there appears to be no consistent pattern emerging from the research in relation to the peak seasons for injury occurrence or indeed type of injury experienced. It may indeed be that as Purchwitz and Field (1990) found, accidents vary by state in the USA according to the month of the year and thus would certainly vary across countries. From the results, it is apparent that injury occurrence while influenced by season is more closely associated with the level of activity underway at particular times of the year on the farm. The time of injury occurrence is broadly similar to that reported by McNamara and Reidy (1997), however, there was some increase in early morning injury (6-9am). Similar to the findings of the research reviewed (Section 3.4.5), the majority of injuries in this study occurred in the late morning to mid afternoon. The general consensus from the literature is that the majority of injuries occur in farmyards and fields (Section 3.4.6) and the results of this research concur. The results illustrate that the accident location varies according to farming system. System of farming emerges as an important determinant of the environmental consequences of farming. Seasonality, time of day and location of accident occurrence are all factors of the system of farming.

It is a global phenomenon that women of all ages are not injured to the same extent as men, with the exception of those post retirement (Diderichsen *et al.*, 1999). Similarly in this study, the vast majority of those injured were male, however, a greater level of female injury was reported than in SHSIF 1997 (McNamara & Reidy, 1997). Given that females had a higher mean age of injury than males, there is evidence to suggest that the injury profile differs between men and women on Irish farms. In this study, all of those injured were members of the immediate or extended farm family. The farmer is at the highest risk of injury.

No age group was exempt from injury in this study, however, the young and old present as particular concerns. The highest proportion of injuries were sustained by the 17-34 year old age group, yet according to (CSO, 2002), this group accounted for the smallest proportion of Irish farmers in 2001. Based on these findings, it is reasonable to suggest that these young farmers did not experience positive safety socialisation into farming. Those over 65 years old accounted for one in ten of the injuries reported in this study. According to Murphy, 1992, failing eyesight, arthritis, loss of hearing and slower reaction times are some of the age related problems influencing the safety and health of older workers. Further, there are defining characteristics of each age group which influence health and safety. Consequently intervention and education efforts to be successful must be tailored and targeted. Broad spectrum general interventions allow too much capacity for people to reject the message as immaterial to themselves (Dunne, 2001). A campaign that is targeted to a specific group is more likely to attract their attention.

Similar to the findings of McNamara & Reidy (1997), almost half of the injured persons required a hospital stay. While the estimated injury level has decreased, the hospital stay data would suggest that there are a greater proportion of more serious accidents than were previously experienced. There are significant economic and emotional pressures placed on farm families due to hospitalisation, (Finnegan *et al*., 2005), which have not been examined in this study. In addition, hospitalisation due to injury has consequences beyond the farm gate. Most notably there is an impact on the health services which is funded by the tax payer. Losses are also incurred due to loss of productivity in the economy associated with absenteeism from work by the injured person and possibly family members. Thus prevention of farm injuries is not merely an issue for the agriculture sector it also forms part of a wider debate on the global burden of injury. When a worker becomes a consumer, even temporarily, this change places a double burden on the economic system (Knapp, 1966).

The part of the body injured and type of injury were broadly similar to that reported by McNamara & Reidy, 1997. As farm work by its nature is very physical, passive injury prevention may be required to go further in protecting the body from injury. In addition, manual handling technological solutions must be embraced and applied by more farmers in order to reduce the incidence and severity of chronic back pain and other muscloskeletal problems associated with manual handling.

Working with animals has presented as the activity yielding most injuries and within this a wide variety of activities were reported. When compared to the results found by McNamara & Reidy (1997) it would appear that twice as many accidents occur now while working with animals than did previously. Injuries involving bulls and bullocks have decreased between the two survey periods, while those involving cows have increased. No differentiation was made between suckler and dairy cows in the reported data. However, according to data from the Department of Agriculture & Food (2004), there has been an increase in the national suckler cow herd since 1995 while the dairy cow herd is steadily declining. It is likely that the increase in suckler cow farming during the study period may be related to the increased incidence of injury with cows. However the decline in injuries with bulls cannot be explained in the same way as the number of breeding bulls on Irish farms has been steadily increasing over the years. It may however, be a response by farmers to Irish campaigns relating to safe handling of bulls.

While the majority of farmers in the study classified farming as dangerous, they classified their own farm as safe. This suggests that farmers are aware of the hazards associated with farming and can identify them on other farms; however they do not recognise the hazards present on their own farm. Similar conflicts were observed by Elkind, 1993. The results suggest that farmers who consider their farm to be dangerous do so because they have had an accident. It is likely that the farmers in the study evaluated 'danger' according to whether or not an accident had occurred. The emphasis on injury and fatality statistics result in farmers classifying the dangers associated with their occupation based on accident levels rather than according to workplace risk. *'Focussing exclusively on either accidents, reportable accidents or fatal accidents, or some combination of these three statistics, is not a true reflection of the real state of affairs as regards occupational accident risk'* (Dunne, 2001, P.16).

At present it seems that farmers do not have the correct tools to adequately assess risk on their own farms. Farmers are not unconcerned with farm health and safety, in fact the majority of respondents in this study said they were concerned yet their concern does not correspond to action on the farm. Thu *et al*., 1990, found that farmers were as concerned about personal safety and health on the farm as they were about other farming issues. However, according to Murphy, 1992, what farmers actually do is more indicative of their beliefs or values than what they may indicate in a questionnaire. The results of both the person factors and environment factors which are to follow indicate that farmers' actual beliefs and values in relation to farm safety may be dissimilar to what they have stated.

The fact that less than 10% of farmers had a safety statement prepared for their farm may in itself be a statement of their values and beliefs in this regard. However, more than half of the respondents were not aware of their legal obligation to have a safety statement which indicates that serious issues exist in relation to information exchange between the relevant agencies involved in farm health and safety and farmers. Further, the results suggest a level of hostility towards HSA inspectors, as half of the respondents would not welcome safety inspectors onto their farms.

The majority of safety improvements undertaken on farms in the study period related to farm waste storage facilities, safety guards on machinery and electrical installations on the farm. While not in the same order, these improvements accounted for the top three responses to the same question posed by McNamara and Reidy, 1997. Few farmers have been found to have undertaken any form of health and safety training. According to Dunne (2001) good training gives full and accurate information on aspects of these situations which are safety critical. People build up models or schema on the job at hand based on training and experience. People will pay more attention to the elements that training and experience determine as important to the job. While many of the respondents felt they required more information on health and safety, few had actually sought information in the previous year. However, farmers for the most part would look to Teagasc for information on health and safety.

There is a perception among Irish farmers that safety costs money. Irish farmers currently operate in a price cost squeeze environment which is clearly demonstrated by the decrease in the terms of trade index 2005 by 4.5% (CSO, 2006). All farmers are looking for cost efficiencies within the system in which they operate. If safety is perceived by farmers to have an economic cost and more specifically improving the safety of farm activities requires finance, it may not be pursued by farmers. In addition farmer's indifference to safety and lack of safety awareness were cited by many farmers. It is clear from the above results that an indifference to safety does exist among certain farmers. Perhaps this indifference is related to the emphasis placed on injury and harm in the workplace rather than risk. If farmers equate safety with injury occurrence then the absence of injury on the farm may result in an indifference to safety.

An assessment of the environment factors fundamental to farm health and safety confirmed that farmers' beliefs and values, as represented by their actions, differed significantly from what they said above. Many farmers did not have PTO shafts properly guarded or lights on tractors checked before the winter. Many do not wear the protective clothing when handling chemicals and locked chemical stores are not a feature of many farms. Safety is not portrayed through the results as an important factor in planning farm activities in Ireland. While most farms make an effort to reduce risk at times of heightened activity, getting the job done on the farm is often more important than taking safety precautions on many farms. There is a potential gain from risk taking should loss not occur (Dunne, 2000), which in farming may be completing a task quicker, avoiding oncoming adverse weather or getting work completed in the given time period.

Although the majority of respondents considered their farm to be tidy, the high proportion of trip and fall injuries occurring in the farmyard suggest that general housekeeping and tidiness may be an issue on many farms. While safety signs are considered effective, they are rarely used. Noise is not perceived to be a hazard by Irish farmers despite the fact that farmers as an occupational group suffer from noise induced hearing loss to a greater extent than other occupational groups (May, 1990). In addition, noise has the potential to interfere with speech communication, audible warning signals and the normal sounds of machinery as well as concentration and affecting sleep (Murphy, 1992).

Handling livestock, machinery and power tools, slurry and PTO shafts on the farm were reported to be the main safety issues causing concern on the farm. The fact that handling livestock was the concern most voiced indicates that on the ground, there is awareness among farmers of the hazards associated with livestock. Yet the majority of farmers feel that machinery and tractors are most frequently involved in farm accidents. This may be an example of the availability bias at play (Dunne, 2001; Murphy, 1992). Many machinery accidents result in very serious injuries, often fatalities and these are widely reported in the media and also discussed among the farming community. For this reason, farmers can call these accidents to mind more easily than accidents which received less attention and had less devastating effects. Consequently, they are likely to estimate the occurrence of such accidents as higher than their actual statistical incidence. This may result in farmers being less vigilant while working with livestock or being less aware of the possibility of sustaining a serious injury through a trip or fall accident. Again, this illustrates the importance of reporting and analysing the level of risk present on farms rather than the fatality or injury levels associated with farm work.

On some farms children continue to engage in hazardous activities and many are allowed access to all areas of the farm. Because the farm and family home are often one and the same; children are injured both at work and at play on the farm (Murphy, 1992). In Ireland as with other countries, children are very much involved in farm activities and are often a valuable labour source on the farm. Children's involvement in the family farm has traditionally been very important as a business and way of life was being passed on from generation to generation. However, the speed and sophistication of contemporary farm activities often places children that engage in farm activities in situations which they do not have the skills to deal with. According to Dunne, 2001, people will not respond to exhortations about dangers if they do not believe that they are at risk. Given the culture in which farmers grew up, it is possible that many value the opportunities which growing up on a farm affords to children. If the experience of children being involved in a farms activity has been positive and has not resulted in negative outcomes, it is conceivable that the family will not identify with warnings regarding child safety as they do not believe that they are in any danger.

CHAPTER 5

THE REALITY OF HEALTH AND SAFETY ON IRISH FARMS: CASE STUDIES FROM THREE RISK GROUPS

5.1 Introduction

Although the results from the Survey of Health and Safety on Irish farms provide an indication of farmers' safety activities, they do not provide an insight into the interaction between the farmer, the physical working environment and technology present on the farm. '*Accidents involve complicated interactions between characteristics of the individual and his environment. Many processes occurring simultaneously and with differing temporal patterns coincide at the time of impact to determine the nature and consequences of an accident*' (Glasscock *et al.*, 1997).

Similarly Dunne, 2000, P.3 believes that accidents are not just chance occurrences, they arise from particular circumstances '*that are created by the interaction between the technology being used, the attitudes, beliefs and motivations of the people working there, and the policy and practices of the organisation, whether these were formally developed or allowed to just evolve over time*' .

This chapter seeks to examine the interactions between farmer characteristics and the farm environment and technology. While the results from the Survey of Health and Safety on Irish farms provided historic accident data and the findings of self-described attitudes and activities of farmers, they could not offer an insight into the interplay that exists between a farmer and his/her environment. Case study analysis was undertaken in order to provide a perspective on the contemporary reality of Health and Safety on Irish farms. This study is not designed to be representative but rather reflective of health and safety on Irish farms. Case study research provides significant detailed information in a holistic investigation of the situation (Casley and Lury, 1986).

5.2 Objectives

The objectives of the case study research were to:

- Examine the interaction between the person, the physical working environment and technology factors present on the farm;

- Examine the extent to which other factors indirectly impact on health and safety on the farm.

Neither the literature review nor the findings of the Survey of Health and Safety on Irish Farms reflected the reality of health and safety on farms. While they did provide information on farmer behaviour and indications of attitude, these were self-reported and not independently observed. In addition, the information was generic in nature and did not relate to specific scenarios which farmers are confronted with daily.

Thus far, the findings have been based wholly on the farmers' perception and while this is fundamental and vital information it provides only one perspective on farm health and safety. The survey did not challenge farmers to really consider health and safety in all of their daily activities and routines. Further, thus far the study has placed the farmer to the fore and has not adequately examined health and safety on the farm. To do this it is necessary to go to the farm, to examine the farmers' perspective within the farm environment and to challenge this where necessary in light of the reality of the farm. Based on a farm "walk-through" in Denmark with the Agricultural Engineer Gunnar Smidth simply auditing the farm environment has been determined wholly inadequate. If auditing is the correct word, then it is necessary to audit not only the physical environment and technology present but also the protocols and behaviours brought to bear in all scenarios relating to the environment and technology.

5.3 Methodology

A multiple case study design was chosen, the single case study design might be weakened by that fact that you will have put 'all your eggs in one basket' (Yin, 2003). A true reflection of the relationship between environmental, technological and person factors and their impact on health and safety on the farm requires examining several permutations of size and system. A methodology was required for selecting farms from the survey data which would be used to identify the case study farms. The Survey of Health and Safety on Irish Farms highlighted the importance of measuring risk in the farm environment and the need to focus on risk as opposed to accident and injury. It was on this basis that it was decided to conduct the case study analysis according to the level of risk in the environment. Initially cluster analysis was used to identify if groups of farms with similar characteristics existed within the survey population. However the results from this exercise were inconclusive.

5.3.1 Farm Injury Risk Index

A Farm Injury Risk Index (FIRI) was constructed for the purpose of selecting case study farms. The literature review identified a number of factors associated with injury risk on farms. The FIRI was devised using a combination of variables that were shown to have a significant relationship on the occurrence of farm work-related injuries in the bivariate analysis. A weighted index was constructed to account for the difference in the significance of the relationship between the individual variables and farm work-related injury. The variables selected for inclusion in the index were Farm Size (Chisq=12.420, df=2, Significance=. 002); System of Farming (Chisq=14.773, df=5, Significance=. 011); Hired Labour Use (Chisq=4.563, df=1, Significance=. 033); Region (Chisq=15.214, df=6, Significance=. 019). In addition to the above variables, Safety Statement preparation was also included in the index due to the importance placed on it in workplace injury reduction in Ireland. '*Preparing and implementing a Safety Statement for your farm will significantly reduce the likelihood of an accident occurring*' (HSA, 2001, P.44).

Each variable was allocated a score between zero and twenty, based on the significance of its relationship to farm work-related injury. The scale of the index was selected logically, as the index comprised twenty components. Based on the variable score, the components of each variable were then allocated a score again based on their significance. Using the strength of relationships identified through bivariate analysis and expert opinion, variables were ranked in a hierarchical fashion with those having greatest impact listed first. This process was repeated until all variables were ranked. Based on a scale of zero to twenty each variable was allocated a score. Each sub category was then allocated a score, which was a sub component of the score allocated to that variable. Applying the scoring system outlined, the highest possible score attainable was 59, this score would represent a farm greater than 100ha that is engaged in tillage and employs hired labour. The farm would be situated in region 2 and would not have a Safety Statement prepared. In other words this farm has the highest concentration of identified risk factors that were found to be associated with accidents. The lowest possible score was 17, this score would represent a farm less than 40ha that is engaged in cattle rearing and does not employ hired labour on the farm. The farm would be situated in region 7 and would have a Safety Statement prepared (lowest category).

Once developed, the index was applied to all 1127 farms in The Survey of Health and Safety on Irish Farms. The farms were then categorised into three groups that of high risk, medium risk and low risk, each comprising one third of the population. The index was validated by examining the risk scores of the farms, which experienced a farm work-related injury. The results showed that 20.9% of the farms that experienced an injury were categorised as low risk, while 29.1% of those that experienced an injury were categorised medium risk and 50% were categorised as high risk farms (Table 5.1).

Table 5.1: Percentage of farms experiencing an injury in each risk category

Risk Category	**Percent of farms experiencing an injury**
Low risk	20.9
Medium Risk	29.1
High Risk	50.0
Total	100.0

5.3.2 Farm selection

Based on the risk score assigned to each farm that participated in the survey, sample farms were randomly selected from the data set. In total nine farms were selected for case studies, three from each of the risk categories. In selecting the sample farms, care was taken to ensure that they were representative of typical Irish farms in terms of scale, system and region. As the National Farm Survey is confidential the case study farms could not be selected from this population. The profile of the nine sample farms were used to identify the case study farms.

The nine sample profiles selected were provided to Teagasc in order to identify farms that matched the criteria. Farms with matching farm size, system, labour requirements and region specifications were identified by Teagasc advisors. A letter was distributed to advisors in the relevant regions describing the study and what was involved (Appendix 20). The advisor identified farms which matched the case criteria and the initial contact was made with farmers through their local advisor. Subsequently, the researcher contacted each farmer to seek their consent to participate in the study. Suitable on-farm appointments were agreed. All farmers that were contacted were willing to participate in the research, however, the researcher experienced difficulties on one farm in engaging the farmer on Health and Safety issues. Subsequently, a replacement farm was sought. Where the farmer approved, relevant photos were taken depicting both positive and negative safety issues in the farmyard, as they arose. All of the case study interviews were recorded and later transcribed.

Prior to conducting the case study research, a pilot study was undertaken on a large tillage farm which had a beef enterprise in region 2. A farm walk through was carried out at which the researcher, the farmer, his Teagasc advisor and the Teagasc Labour and Organisation specialist were present. The farm walk through validated the proposed case study methodology and also ensured that the researcher had a sufficient understanding of the mechanics and hazards of machinery in this particular type of farm operation.

5.3.3 Data collection

A guide for the case study assessment was developed using expert opinion and the Health and Safety Authority, Farm Safety Handbook (Health and Safety Authority, 2001). The guide was used as a frame of reference for directing the farm walk through on each farm (Appendix 21). Each of the case studies was recorded using a dictaphone with the farmers permission. In addition, photographs were taken with the farmers' permission and the reason for the photo explained. Detailed field notes were also compiled by the researcher during the visit.

5.3.5 Case study analysis

Each of the case study interviews were initially transcribed and read to ensure that all relevant information was captured. Follow up phone calls were made following this phase. Subsequently the information was analysed on a case basis on a flip chart and common themes were identified. Both the transcriptions and the field notes were used for this process. Subsequently, the themes were extracted and analysed further to provide the case study findings. Again this analysis was carried out using flip charts. In documenting the results the transcripts were examined and 'ver batum' quotes were used extensively to add to the understanding of the results.

5.4 Results

The results of the case study research follow. The high risk category results are presented first, followed by the medium risk and finally the low risk. The names of all persons detailed in the results have been changed to conceal their identity.

5.4.1 High Risk Category: Case Study 1

Martin has been farming full time since 1995/1996. He farms 800 acres of tillage with his father in Co. Kildare. He completed the Green Certificate at Gurteen Agricultural College followed by a HNC in crop husbandry in Scotland. In addition he has completed an advanced certificate in crop husbandry at Teagasc Oakpark and has also taken a spraying course with Teagasc.

Both Martin and his Father are full time employed and the farm employs two seasonal labourers, a student, who is hired for three months, and a labourer who returns each year for four months. The main farmyard is situated along side the family home and directly opposite, across the main road, there is a smaller yard with grain and straw storage. In addition, there are two more yards, which are located between two and five miles away from the main yard. The farm is not in the Rural Environmental Protection Scheme (REPS). There are no children living on the farm, however, on occasional Sundays there are children visiting the farm. These children are all over ten years old and are not permitted unsupervised access to the yard. Anything that is perceived as dangerous for children; spare wheels, chemicals are locked away and visiting children are unable to access them.

Both Martin and his father have completed safety statements. They have had a number of HSA inspections and have always implemented change where recommended. Martin feels strongly that those advising on and inspecting farm safety set a good example to farmers. If farming themselves, they should employ the safety standards which they expect of farmers. The local Teagasc advisor is very safety conscious and actively encouraged them to complete a safety statement. They included their employees in the process and show it to new employees. In addition, a first aid box is provided in the farm yard.

Martin feels that in general he is in a rush while he is at work; however, a lot of that pressure is self-inflicted. In terms of stress he describes himself as extremely focused, driven and single-minded on things '*I want it done now and done well*'. Although he is driven he does find it easy to switch off from work. The weather is a major source of stress for Martin in relation to his job. In addition he finds farmers can be very small minded and there is an underlying competitiveness among neighbouring farmers. This is another source of stress in his day which can have a greater impact depending on other unrelated factors. As a young farmer he finds it can also be stressful working with his parents and trying to assert change on the farm.

In terms of work organisation, Martin and his father do engage in planning. However, they do not sit down and regimentally plan their work. Martin feels the weather dictates different things, although they know what needs to be done there is always uncertainty as to whether the weather will permit them to do it. As a result of this he feels that some days '*you more or less make up your day as you go along*'. Martin has a fairly steady annual workload with occasional peaks during the year with the exception of the harvest period. Between August 15th and September 15th is his peak period which he describes as, *'absolute mental time'*. He feels that his life is a lot more organised outside of the harvest period and he can make it more regular.

During the off period on the farm all the service and repair work is carried out on machinery and buildings, '*everything is gone through with a fine tooth comb if you* *can, but it far from means that you will have a trouble less harvest*'. Any problems that arise with a machine during the year are written down in a log book and each one is dealt with individually. All of the basic machinery maintenance work is carried out on the farm and a mechanic deals with any major problems. Sometimes the situation arises that a machine is not repaired until quite near to the time it is required, due to unavailability of spare parts. Martin finds this quite stressful and says it often results in things being overlooked.

To have left nothing unturned is the most important consideration to Martin when planning activities on the farm. He also feels that it is very important that he has paced his work throughout the year so that there are no periods of panic and unduely heavy workload.

Martin describes safety as a vital element of his working day, *'I would see it as being vital, in every aspect. Obviously it increases when you get busier and when you have more people coming to work on the farm with you'*. He finds that safety is quite simple when it is just himself and his dad; one of the employees has been working on the farm for a number of seasons and he knows what is expected of him with regard to safety. However, the student is new each year and is taught 'what's what' with regard to safety, often just simple things such as not standing behind a grain tail board while opening it. Martin feels this process of going through safety with the student each year gives him a chance to rethink safety issues. He believes that farming is not an inherently dangerous occupation; *'I think it depends on your attitude and your focus. Whether you keep stuff maintained as in regards to safety shields or you know if you are conscious of it yourself all the time'*. He describes his father as being very conscious of safety, which he feels, is a result of age and experience. People in the locality would identify his father as being very safety conscious.

Martin feels that a lot of farm accidents happen when people are very busy or when workloads increase. One of the biggest factors in relation to farm accidents is pushing something to a limit either your body or a machine. He feels that farm accidents are somewhat preventable. However, the nature of farming means that there is always a risk factor. The risk of having an occupational accident is greater for a farmer than it is for a person who works at a desk job.

The farmyard was found to be extremely tidy and well maintained. Everything on this farm has a place and nothing is left in the farmyard. Several machines including a hedge cutter, a loader and a grain trailer were parked in the yard. Photo one illustrates the level of organisation on this farm. All of the sheds in the yard have locked doors, which are opened on a need only basis. All electrical installations on the farm are compliant with the required standards. A separate farm entrance was put in this year for safety reasons, the old entrance passed directly outside the back door of the dwelling house onto a narrow side road which turns immediately onto a busy main road. The farm is situated on a bend on the main road. As the road was becoming busier and faster combined with the poor visibility due to the bend, accessing the road from the farmyard and vice versa became extremely hazardous.

Photo 5.1: Main farm yard

This picture represents the standard of organisation and house keeping that is in place on this farm. With the exception of a straw trailer, nothing is stored in the farm yard. The yard is regularly swept and power washed and all of the farm structures are well maintained.

On commencement of the farm walk through, one of the farm employees was found power washing the yard. General tidiness in the farmyard is deemed vital, *'you can ask the lads about it they never have a brush out of their hands, they will always be* *power hosing'*. The yard opposite the main farmyard was also extremely tidy despite there being some water lying adjacent to the field verge, following heavy rain; *'And you're actually seeing it on a mucky day, usually it wouldn't usually be as mucky out here now'*. This yard is locked at night and when unattended.

The farm has a very spacious workshop, which was very organised and tidy. Martin feels that organisation is essential in the workshop, when something needs to be repaired it is easier to do if the workshop is organised. He recently bought a new hydraulic jack system for removing and replacing tyres on tractors and machinery. This allows for tyres to be changed with ease and safety. The vast majority of farmers do not have a hydraulic jack system; however, Martin feels that many more will invest in these systems in the future.

The chemical store is situated in an old stone building in the farmyard. It has a locked sliding steel door with a dangerous chemicals warning sign fixed to the door. The chemical store is well organised and clean. There is no running water in the store; however, there is a tap outside the door (photo 2). There are rarely any chemical spillages on the farm and Martin says it is difficult for this to happen. All the empty chemical containers are rinsed out after use and burnt on the farm. The spray is purchased as it is needed on a per hectare basis and spray is rarely held over from one season to the next. The sprayer is filled from a gravity tank which allows for ease and speed of filling. Gloves are always worn while spraying however a mask is not worn. There is air conditioning in the tractor however they are not conscious of closing all the windows while spraying *' If we wanted a window open we'd spray away there happily with a window, not maybe a major back window open but a side window for a bit of air into the cab or whatever'*. Although the cab filters are such that spray cannot enter the cab an open window on a windy day may result in spray in the cab *'If you had a window open or something on a windy day you might get a blast of it but it hasn't really been any harm to us. But it's not ideal either'*. There is a tank for clean water on the sprayer and in the event of a blockage in the nossel, there is always something in the cab to free the blockage.

Photo 5.2: Locked chemical store with warning sign

The chemical store is another example of adherence to safety standards on this farm. The store, like all other buildings is well organised. The store is always kept locked. It is clear that chemicals are perceived to be a major hazard on this farm.

The hedge cutter which was parked in the farm yard is well maintained. All lights and indicators were in proper working order, a ‘flashy beacon’ on the roof of the cab is used which cutting on public roads. The PTO cover was intact and well maintained, Martin is generally conscious about keeping PTO shafts covered. ‘W*e try not get them broken in the first place. So it’s the original one that often sees a machine out. That’s an eleven-year-old machine and it’s the original PTO. To be fair to it, it doesn’t move much. It’s not like an implement that lifts and moves so there’s not much wearing on that*’. Warning signs are rarely used while working on the road unless he is working on a very bad bend. When you encounter a cyclist or a walker it is important to stop and lift the mower and look after their safety. Also operator safety is an issue as material can often fly up and hit the cab. In the event of a blockage in the head of the hedge cutter, normally the PTO is switched off and the tractor also switched off and then the blockage is manually cleared. However, often just lifting the mower and reversing back will clear the mower.

There are seven trailers on the farm and all except one have trailer braking. This trailer is used seasonally for drawing straw internally between fields and the farm yard. It is rarely used on the road. Martin feels brakes are not as important on a straw trailer as they are on a grain trailer as the load is a lot lighter. All of the trailers have lights and indicators. Last year a student working on the farm overturned a trailer on a roundabout due to lack of experience. *'He was just too flippant and even though Dad had got up with him that morning at seven o'clock and told him take it easy, don't rush and respect the weight of the load pushing him he just came to a roundabout fast and couldn't take the bend and just turned over. Nobody was injured fortunately but you know, you be thinking farming is not even worth that amount of hassle, you know'.*

The loader was also parked in the yard and was awaiting repair. The bucket on the loader would not stay back and drooped forward quite quickly when used. The loader is used for moving grain and also for accessing heights on the farm. They do not use a safety frame when lifting someone up to heights; they rely on the handle at the back of the grain bucket for support. When working at a height on the farm, helmets are not worn and there are none present on the farm, *'Well, if you fall, you're head won't be the only thing that'll you will hurt. Now ok you're head could be kind of smashed but the amount of time we're up on heights or lifted up on something is rare'.* He explains that they see themselves as half way towards having the need for safety helmets as their loader only reaches seven metres, *'but you're half way to getting to a point where you should wear a safety helmet, even though you don't need one, only five days of the year maybe'.*

There are two combine harvesters on the farm, one of which is quite new and is kept in the main farm yard, they other is older and is kept on an out farm. Although driving the combine harvester on the road is a major safety concern, Martin finds it is quite easy to drive when you are used to it. All of the lights and indicators are working on both machines; there is a small well at the side of the driver door on the main combine to allow for a grain sample to be taken safely. When accessing the well there are no moving parts exposed however, it is quite warm. The new combine has cab filters, which Martin relies on, *'if you have any problem with the air conditioning you would probably open the door and run'.* He describes how his father has a persistent cough, which he feels could not really be described as a health problem. This cough is attributed to dust exposure from working in a combine harvester over many years.

In order to clear blockages from the header of the combine everything is switched off and it is manually cleared. When somebody enters the main body of the machine to clear a blockage they put the keys into their pocket. In this way they can work inside the machine knowing that there is no possibility that the machine could be started.

Although there are no children present on the farm, experience from others has taught Martin that a farm is not an appropriate environment for children. In the locality he sees children playing in farmyards when trailers are being reversed, for example. He feels that although having children on a tractor with the operator is better than having them running around the yard, tractors with seats for children are not the answer. He highlighted the case of his uncle who got his hand caught in the slurry tanker while trying to free a blockage after his young son accidentally engaged the sluice lever in the cab.

Dust masks hang in all the grain storage sheds, however, it is up to each employee if they chose to wear them. According to Martin half of the time you would not need a mask as you would perhaps only be brushing loose grain for ten minutes at a time which would not generate a lot of dust.

There are two grain dryers on the farm, one stationary dryer in the yard opposite the main farmyard and a portable dryer which works from the main yard or an out yard. The dryer is not manned all the time, however, it is checked every twenty minutes by somebody. As fire is the primary hazard associated with the dryer there are extinguishers positioned in the yard. In twenty years of drying there has never been a fire on the farm. Generally the dryer would start at 6.00 a.m. and finish at 12.00 at night; it rarely works through the night. When checking the dryer close attention is paid to the bearings to ensure that there is no wear and also the main bearing to ensure it is not dropping grease, which can be a fire hazard. The grain dryer produces a lot of noise in the yard, the researcher found that in order to continue the conversation it was necessary to shout. Ear muffs are not worn while working with the grain dryer and

Martin does not consider the machine noisy; however, he says it does get noisy towards the end of the day. He feels that ear protection disconnects you from your environment *'somebody could come in behind you with a load of grain and you wouldn't know they were there and you could just walk out almost toward them'*. Often if a machine is starting to give problems you will hear the problem, such as slipping belts before you will see it; wearing ear protection would eliminate even the noises which the operator should be listening for.

A new grain shed was constructed beside the stationary grain dryer this year. The shed will provide storage for both wet grain and dried grain. This cuts out a lot of the labour involved in the drying process, as the grain does not have to be hauled to the site. The contractors have yet to come back to fit the shed doors. It was hoped that this would have been done before the harvest due to the level of noise and dust present in the environment resulting from drying, *'But, the contractors that are coming, we asked them to come sooner when we weren't drying. We told them we would be working now and there would be a noise factor and a dust factor. So from that point of view, they've come too late'*.

There are several straw storage sheds on the farm. As the sheds are being filled rat poison is put down to avoid problems later on in the year, *'Obviously from a health and safety point of view, well from a health point of view, the rat poison is, we see it as being very important anyway'*. There is generally never a problem with rats on the farm with the exception of sheds that have been rented where sufficient control measures were not in place. This is seen as a priority for straw storage on the farm because of the disease hazard.

In general terms Martin finds the Personal Protective Equipment recommended for farm use practical, *'the main ones I would see as being very useful are obviously ear goggles, welding masks, overalls, you know working with chainsaws, the proper equipment and even the chainsaw. You know even the safety helmet for working on heights is very simple and not in your way'*.

There are five tractors on the farm, three of which are less than seven years old, one is eleven years old and one is twenty years old. All tractors are maintained in very good condition with lights and indicators working. The twenty-year-old tractor is used for hauling, turning and drawing straw, 'It *has its place here still, just about!' 'If you didn't have it you'd really miss it. It the cheapest tractor on the farm so why sell it'*. Passengers are seldom carried on tractors and students working on the farm are not allowed to carry passengers.

5.4.2 High Risk Category: Case Study 2

Sean farms 240 acres in Co. Wexford along with his two sons. He has been farming fulltime since 1970. He has no formal agricultural training and has not taken any agricultural courses. The farm is not in the Rural Environmental Protection Scheme. He is engaged in dairying and cattle farming and also has some tillage. There are 140 dairy cows on the farm and approximately 100 weanlings, 100 yearlings and 100 one to two year olds and one stock bull.

The farm is situated on a very quiet side road. The main farmyard is adjacent to the family dwelling house although it is separated by a wall. There are both separate farm and house entrances. There is also another yard approximately a mile away from the house. There are no young children living on the farm, however, a three-year-old grandson often visits and likes to go to the farmyard. Sean prefers to see children in the yard up on a tractor where they can be seen rather than on the ground. The workload on the farm is quite variable but in general Sean feels he has a steady workload. The weather influences the workload as they try to capitalise on the good weather. Due to the seasonal nature of the farm, activities are roughly planned for when the opportunity presents, *'The job comes up, you know the job is there and the day suits you and you just go and do it then. Unless something is broken that has to be fixed'*. In general, maintenance of machinery is done as soon as a problem is encountered and seasonal machinery would be serviced before it is used. However, he highlights that in general machinery breaks down when you are using it, therefore maintenance cannot always be scheduled.

Both Sean and his wife feel that safety is a big consideration on their farm. According to his wife, 'Y*ou would be trying to have things as good as possible. It wouldn't be perfect all the time'*. Sean feels that although he is conscious of safety he would not go out in fear of things on the farm *'I wouldn't be stopped from doing something just in case something might happen, you know'*. They would not consider that farming is a dangerous occupation and asked would I feel afraid to go out in my car as more people get killed in cars than on farms. Sean feels that most farm accidents are preventable, however, he feels that '*Accidents happen and they happen so quickly, that's why they are accidents*'. Sean describes himself as not stressed. He feels that stress is caused by problems and that a problem by its nature is only something that you cannot solve.

Having had a serious accident with a chainsaw, he feels that a lot of accidents are the result of taking short cuts. In relation to his own accident, he feels that although the chainsaw may not have been perfect the accident was a direct result of his behaviour, *'If the health and safety had come in they would have faulted the chainsaw. But the chainsaw had nothing at all to do with it. What happened to me was what I did and it wouldn't make any difference if you had twenty of the best chainsaws in the world. It wouldn't make one bit of difference, when you don't do it right'*.

The farm buildings are a combination of the original stone buildings and new structures. The main farmyard was comprised of an open slurry tank, silage and maize silage pit and sheds at the lower end, machinery storage at the upper end and the dairy facilities and cattle crush situated in between. The yard was reasonably tidy, however, in the upper yard there were some tyres standing against the wall while there was a tyre stack in the lower yard. There was also some machinery stored in the upper yard and some empty barrels and oil drums along side the diesel tank.

There is a steep slope from the lower yard into the silage and maize pits, although they experience very little frost this has been hazardous in the past and resulted in Sean slipping and breaking his hip. An overhead electricity cable crosses the yard where the silage is brought in, however, it is not a concern on the farm as they feel it is a covered wire and the machinery are not high enough to contact it. Generally contractors and lorry drivers coming onto the farm are very conscious of overhead wires. This year the contractor involved in harvesting the corn was concerned with an overhead wire in a field, which was within two inches of his new combine. Sean is hesitant to bury the overhead electricity cables on the farm as they are not definitely marked and they might be safer where they are, where people can actually see them.

It is often necessary to access the shed roofs on the farm to carry out maintenance work. Generally heights are accessed using a ladder at the lowest end of the roof; however, a helmet is never worn. Sean is very conscious of Perspex sheeting on shed roofs, often, hired painters spray the entire roof including the Perspex. He feels that there should be a safety net or grate below them as you can very simply step back onto them while working on a roof, '*In my opinion, you'd be up there doing something, washing a shed or painting. Sure it's just one step back when you are doing something; there should be a mesh on them'.* Sean recalls three accidents with Perspex sheeting; two of them were local men who are now in wheelchairs. Although he finds roofs quite slippery he does not use a roof ladder. He would be very conscious while up on a roof and as he has gotten older he has become wary about very high roofs.

The cow shed divides the upper and lower yards and it is opposite the milking parlour. All the dairy cows and bullocks are over wintered in the shed. Automatic scrapers clean the shed and there is a slurry storage tank below the shed. Generally the cubicle cleaning and maintenance is done during milking time when there are fewer animals to work around. Sean estimates that there is approximately one hour of work in the cattle shed each day. Feeding in the shed is done with a diet feeder. The shed has good lighting and the electrical fittings were all waterproof. Cows and calves are kept in a shed in the lower yard before and after calving. There is a restraining gate in the shed for calving cows.

There is an open slurry tank at the bottom of the farmyard which has a high concrete wall to the front of the tank. This gives the impression the tank is very well secured. However, on closer inspection it is clear that construction of the walls has not been finished. One of the sidewalls has a large access point which is blocked of with unsecured gates while the other side is quite exposed with only barbed wire across the access. '*It's not perfect now, we have work to do on it, it was never really finished off. Actually a cow went into it on us last year*'. The cow accessed the tank at a point where the wire was knocked down and had not been repaired. The tank is about five feet deep and Sean recognises that with young children present on the farm the current safety structures are inadequate. '*It needs to be a bit more secure, we have never really thought what exactly we should do but there is some kind of security rail needed on it'*. Although Sean would prefer to have an underground ground tank he is restricted by the existing farm infrastructure. '*It's good enough, I'd sooner have it under the house to be honest about it, because you have less rain water in the tank but* *that's the way it is. It's amazing this was a green field when we started here. It's amazing how you get things so wrong. Things have changed. We have put down as much concrete as our father's had before us*'.

Generally the cattle are removed from the cubicle shed when Sean is agitating slurry. However, on very windy days they may be left in and the doors all opened, as it involves great difficulty to let the entire stock out for a day. Sean feels that people are not as conscious of removing stock while agitating slurry as they used to be. He recalls people who have killed stock and incidents where farmers were killed, '*And people have killed stock and people themselves have got killed. You know your man Tierney up there in Galway, Noel Tierney, he was the one that I remember, his son got killed and he just barely got ou*t'. There are outdoor manhole access points for emptying the slurry tank, which has a safety grate below. In the past a contractor that agitated the slurry had a poor safety record; he often wore loose clothing and stood over an unguarded PTO shaft. Sean was always conscious to be present and tried to keep him away from the PTO shaft. Generally when the tank is being emptied the safety grate will be replaced when unattended.

The milking parlour was built in the early seventies and has been remodified several times since. Most recently, two years ago the floor of the pit was raised to allow for comfort while milking and protective bars were erected between the operator and the cow. There is safe access into the pit through well-sloped steps. Although there is a lot more that could be done with the parlour, the costs of remodification are high. Already in recent years automatic cluster removers and new feeders were installed at a cost of €14,000. Sean finds the parlour comfortable to work in. Generally two people are working in the yard during milking time; therefore if help is required in the parlour there is someone nearby. The dairy is well organised and tidy. All chemicals are stored in a steel cupboard which is generally kept closed but not locked; Sean admits it probably should be. Although gloves are generally worn while milking, Sean admits that he may be careless with chemicals, '*Maybe I'd be careless with chemicals but I've never got caught with them you know*'. Both motors in the dairy were well guarded and the PTO shaft driving the milking machine was also properly guarded.

There are four tractors on the farm that are dated 2004, 2000, 1997 and one that is over twenty-five years old, which does not have a cab or roll over protective structure. The old tractor is not maintained in road worthy condition; however, it does travel on the road a few times a year to an out yard. The tractor is kept for scraping the yard and is seen as a vital piece of machinery. The remaining three tractors are all maintained in good working order and all lights and indicators are working. The basic servicing of the tractors and machinery is carried out on the farm.

Sean is acutely conscious of the dangers associated with poorly guarded PTO shafts after the death of a young neighbour. He feels that guards should definitely be in place on machines where the operator is working around the PTO shaft. However, the PTO shaft on the slurry spreader is broken and has not yet been fixed; yet it continues to be used. The PTO shafts on most other machines are well guarded. He feels that this is not as important on machines such as the harrow, where the guard is broken, as you should not be working at the PTO when the machine is operating. Sean agrees that guards should be compulsory however, the quality of the guards is not consistent and they are often too expensive '*There's one very good guard. They should be compulsory but they should be sold at a proper price you know, they definitely should be compulsory. The lads that are selling them shouldn't be allowed to clean up on them*'. If a problem arose with a machine while operating, whether the PTO would be taken out of gear before alighting from the tractor would depend on what needed to be done.

A major safety concern on the farm is cleaning out the diet feeder, which requires that somebody enter the machine and physically clean it out. Although care is required to avoid contact with blades while inside the feeder, the main concern is that somebody else would start the tractor. There is no safety practice in place on the farm to avoid the machine being started during cleaning; they rely on the fact that the others will be aware the machine is being cleaned.

The hedge cutter also has an uncovered PTO shaft; however, there is one safety guard for the back window of the tractor to protect against flying objects. The fertiliser spreader has a well guarded PTO shaft. The spreader takes half tonne bags and the front loader is used to empty bags into the spreader. In addition there is a shear grab and a loader, which are both rested at ground level when not in use.

Sean's son does most of the spraying on the farm. Chemicals are generally bought as they are needed and stored in a locked shed behind the dwelling house. There is no clean water tank on the sprayer. His son has not done a spraying course, however, he always wears a mask and has gloves in the cab of the tractor, '*he would have a mask with him, other than that he wouldn't have any special clothes you know*'. He feels that the recommended coveralls are not necessary, '*what would fall on your clothes is not going to change nothing in my opinion*'. While respecting that coveralls are recommended he says '*but clothes wise, that is the recommended clothes and you're supposed to have them and they say you know, well, some of that research is done very well and more of it is done to sell clothes!*' However, he does see contract sprayers wearing protective clothing and can identify one neighbour who has been very ill as a result of exposure to chemical sprays. Spraying conditions are very important on the farm, spraying is rarely carried out in windy conditions and if it is Sean can generally feel the effects. Of all the precautions he could take while spraying, wind conditions definitely have to be correct. All chemical containers are washed out and sent to the dump, however Sean feels that these and oil drums could be reused by manufacturers and distributors. Waste disposal is a major issue, which is often not addressed allowing 'litter' to build up in the yard.

Generally there are two stock bulls on the farm; however, there was only one at the time of the researchers visit. There is no bull pen on the farm and the bull is housed in the cattle shed. The bull is ringed but does not have a chain and there is no bull pole on the farm. The bull is generally moved along with the dairy herd and in that sense is easy to manage. Typically only one person and the dogs move the herd. Sean is always conscious that a bull is a bull and you have to maintain distance, '*you always have to remember that. That doesn't necessarily save you either you know. But you do, that lad here is very quiet but we've had lads now that weren't quiet. But they're the best lads, for performance*'. The cattle crush is positioned outside the dairy for easy handling of the herd. There are other cattle grazed on the out farm which also has a cattle crush. Sean and his wife use a temporary fence to round up cattle when there is no help. They use wire attached to reels to gather the animals and this has proved very effective both in fields and while moving animals on roads.

5.4.3 High Risk Category: Case Study 3

David farms 300 acres in Cork. He is engaged in mixed farming with dairying, beef production, sheep and tillage. He has been farming full-time for twenty years and went to agricultural college in Pallaskenry. There is one full time employee working on the farm and David's wife also works on the farm. They do not participate in the Rural Environmental Protection Scheme. There are two children present on the farm aged thirteen and fourteen. The farm is situated on a busy road; there are separate entrances to the farmyard and the house. However, the back yard of the house runs into the farmyard. The farmyard is large and spacious and is kept very tidy (Photo 5.3).

The workload on the farm is steady all year, however, as David takes a lot of time off he feels that this contributes to periods of greater pressure, *'I have a steady workload I suppose all the year round, but I would possibly have different periods where I would be under pressure alright. I do take a lot of time out from the farm so that probably contributes to some of the workloads and pressures'*.

On a day-to-day basis however, he finds they are not in a rush on the farm. This may be due to having an additional full time employee; nevertheless, he feels one person could not work the farm alone. Although he does not have a written plan, David feels that they are always working to a plan. David and his neighbours co-operate together informally on a number of tasks to ease the labour pressure on their respective farms. David describes himself as *'not a stressed person'*. Although he often works 17 or 18 hour days when required, he relaxes and takes time off when he can. He considers himself good to plan and as a result he feels he can deal with unforeseen circumstances.

Photo 5.3: View across the yard to the dairy and old cattle crush

This is the view from the farm entrance into the farm yard; beyond the pillar in the left foreground the farmyard meets the back yard of the house. The yard is large and spacious and has a good system of gates for moving the cows to and from the milking parlour. Apart from the material stored at the wall in front of the parlour, the yard is tidy.

For David, safety is always an important element of his work and he would consider safety most of the time, *'I suppose we probably do take chances but at the same time we'd always be conscious of safety'*. David sees safety at work as being able to work in an environment where accidents don't occur; he does not believe farming is inherently dangerous. At times it does strike him that he could be injured on his farm, *'I mean there's always the times that it would strike you, but it's no more dangerous I think than any other profession, There's dangers everywhere you go'*. He feels that all accidents are preventable if you abide by the letter of the law. Farmers are now working too hard or too many hours under too much pressure, *'I suppose at the end of the day farming has got so much more technical now over the years, like every job has to be done today not tomorrow or the day after. People seem to be working a lot faster; the speed of operations now compared to twenty years ago is a lot faster. That probably causes a lot of accidents'*. David agrees that these changes in agricultural work have an effect on older people and children on the farm, *'I suppose I would have* *seen it probably when the children were very small, that was probably the one time safety would be focused in your mind. You know the odd time there was a few close shaves I suppose and from that point of view I suppose we copped ourselves on a small bit at times'*.

David feels that the consequences of not working safely have an impact on your future behaviour. Every year they are working more safely on the farm, *'Now maybe there are probably still 1001 things outside that could be a lot better but at the same time there would have been a lot of issues that we would have dealt with over the past 10 or 15 years that would have made the place a safer environment'*. He feels it is important to look at safety on the farm and make changes where necessary. He has responded to near misses that occurred on the farm, *'Like I can remember nearly having a close accident years ago and that I think was one of the things too. I was making up pens for sheep with gates, and the young lad was down in the shed with me and he just put his hand on a gate and it toppled over back on top of him. So that sort of focuses the mind pretty quick then and ever since if ever there is a gate loose thrown against a wall, something would be put on it or it would be tied'*. He feels they are probably lucky they have not had any accidents as most farms have had accidents at some stage.

Safety is a big consideration when contractors are working on the farm, '*We would be putting signs up on the road all the time before a contractor would come in. We would basically watch, we'd make sure there would be nobody around the yard'*. At this stage the children are present in the yard while contractors are working; however, this was not permitted when they were younger. Rather than have them in danger in the yard, they would generally be put up on a tractor.

David feels it is important that his children can be a part of the farm and being at home on the farm all the time the children are safety conscious. *'Too many kids haven't got those opportunities any more. In the unfortunate way as farming got more intensive people got too busy and they didn't have time to have children around, farmers wives were out working and the children weren't out on the farm as much and I suppose we're luckier than most we have a man here as well who is good with the children that at least we could all keep and eye to them'*. Owing to the fact that the farm is adjacent to the family home, David feels the children cannot be kept away from it. Being out in the farmyard gives them the opportunity to spend more time with their father. As small children, they were out in the yard as much as possible; yet never working with cattle. Davids wife said they were always well supervised and often tied into the tractor with their father while he was working. They always felt safer with them in the tractor rather than in the yard where tractors were operating.

The children are at a disadvantage in that they never have birthday parties or visiting friends as David feels the environment is too dangerous for visiting children. Had children's parties taken place he feels all activity on the farm would had to have ceased for a day. His wife adds that when you mix children problems often arise where one child engages in a risky activity to show off to the others.

Growing up on the farm the children have learned a lot about it and they enjoy farming and he would not change their involvement, *'I don't think I would have, I would change it. I suppose it's easy to say that when we didn't have any accident, things ran smoothly but at the same time I think it's nice for the children to be involved'*. At this stage the children are quite involved in the farm and work there every Saturday. David felt this year that both children were competent to drive tractors under supervision and they were involved in drawing bales during the summer. The children look after all the sheep on the farm and during springtime they feed all the calves. They are generally involved in moving cattle and sheep. David talks to his children about safety on the farm, especially in relation to cattle.

The milking parlour was built over twenty years ago and has been developed to a small extent over the years. David considers his parlour to be 'fairly safe' to operate. Within the parlour and dairy and indeed throughout the farmyard industrial type electrical installations are in place. The wiring in the milking parlour was upgraded a few times since the parlour was built and all installations are totally wash proof. The milking machine is housed separately and the belt on the motor is guarded. The pit is a comfortable size and was made extra deep to accommodate for David's height, *'I decided I wasn't going to be bending too much'*. However in doing so it has proved a discomfort for David's wife who is much shorter than David. The effect is not severe as David milks approximately 80% of the time.

A new machinery shed was built six years ago to house all the machinery on the farm. The workshop is located to the front of the machinery shed. The workshop was very tidy and highly organised, however, according to David it is usually tidier, *'Well at the moment it's not tidy now, I'd prefer if it was a lot tidier. But it's just you know, October seems to be the time of the year when you tidy everything up. And during the summer months, things get out of place a bit'*. The machinery shed has been important to the farm since it was constructed, '*it is a machinery shed and it's a store probably for some, a lot of bits and pieces. But, it is locked most of the time and I would be very good to lock it. But it has been an important factor in the place over the last few years, but it's the first thing that you would see that everything is tidy here so that you can get at it when you want it'*. Equipment is always plugged out after use in the shed and stored away in its correct place. In that way nobody will get caught up in or trip over loose leads or equipment.

Photo 5.4: Machinery shed and cattle shed with cattle crush to the left

Cattle handling on the farm is made simple by the system of gates in the background which run between the cattle shed and the cattle crush which then runs into the holding yard from the milking parlour.

There are two tractors and an industrial loader on the farm. One of the tractors is reasonably new while the other is twenty years old. Both tractors are used on the road and lights and indicators are working on both. David sometimes carries passengers on the tractor. Mostly they would be in the cab however occasionally there may be passengers on the trailer. He would never carry a passenger on the drawbar; he describes this practice as *'lethal'*. David finds that as the modern tractor has a closed cab, this generally occurs on older tractors *'Handy tractors, you see the modern tractor you can't put a person up on the drawbar because they cab is closed in so they won't do it. But I mean any of the older tractors like you've an open cab and they're half in and half out of the cab. That's how they are on the drawbar'.*

There are three trailers present on the farm. A cattle box which is pulled by a jeep which has lights and trailer braking, a bale trailer and a small trailer which both have lights but not brakes. David often borrows trailers from a contractor, which would have lights and brakes.

David is very conscious about keeping PTO shafts guarded, although he feels it is important, it is a bigger issue for his employee, '*probably a bigger one for the man working with me. He would be very conscious about things like that. It would always have to be right or he wouldn't work on them, that's the way it is'*. He admits that there are times that a chain might break on a PTO shaft and it would be tied with wire until there was time to repair it. All of the PTO shafts on the farm are guarded.

The industrial loader is used for handling half tonne bags of fertiliser on the farm. Throughout the year there are often small bags of fertiliser used however they would be loaded onto a height and filled into the spreader, *'we wouldn't lift a bag of the ground at this stage'*.

David and his employee carry out the crop spraying on the farm. They are quite conscious when handling sprays and always wear a mask while mixing sprays. One of the tractors has a sealed cab and if using it for spraying a mask is not necessary however a mask is always worn if using the 20-year-old tractor. If a blockage is encountered in a nossel, they usually come back to the yard to clear it as there is no clean water on the sprayer. David never uses gloves while cleaning out the nossels as he finds them too cumbersome. The chemical store on the farm is always locked.

There is one animal shed on the farm which was constructed in three sections. The first part was built in 1973 and was added to in 1989 and then again two years ago. Two pens were erected in the shed this year for bulls and appeared very strong, *'All pens and gates that we would be making for the last few years would be a lot stronger now than they would have been'*. In addition, all openings in the slats have been changed to manhole slats in the last five years, there were previously twin slats covering the openings. All of the doors have been changed to sliding doors. One section of the shed is for the dairy herd while the cattle are housed in the other. Silage is fed in the shed using a shear grab.

The cattle crush is situated in the middle of the yard between the cattle shed and the milking parlour. There is also another cattle crush on an out farm. When moving cattle there is always more than two people present, unless when moving from one field to another. However, when moving cattle on the public road there is always a minimum of four present. David tries to minimise the amount of movement of cattle between the yard and the fields as the farm is fragmented. However, he does not try to do too much with the cattle when he gets them in to the yard as he feels this is not best practice and generally results in you rushing. *'Anything with animals, I'd be doing basically what they require rather than what I require'*. When dosing animals, he generally has a 'pour on' to hand in case an animal gets excited or awkward, which eliminates the need to restrain and further stress the animal and thus reduces the risk of injury.

All slurry storage on the farm is underground; there are no open pits. There is *'a sort of a dung stead'* behind the silage pit but there is no slurry in it. David spreads some of the slurry; while, a contractor spreads the majority. The manholes are replaced on the tank when agitating is complete and while spreading slurry it is only necessary to open an eight-inch section, which again is closed as soon as spreading is complete. The animals are always out of the shed while the slurry is being agitated irrespective of how windy the day is. There is a separate tank for silage effluent, which David perceives as the worst pollutant of all and is generally dirty around the yard.

David would get up on the shed roofs occasionally and generally uses the loader to access heights, '*If I do go up it's on the loader, it is safer than a roof ladde*r'. He is very conscious of the Perspex sheeting and has one shed with an asbestos roof, which he would never get onto. When building the shed with the asbestos roof, he said he was forced to use asbestos to qualify for grant aid and ten years later the department would not allow asbestos as a roof material. David is conscious of the effect of changes in regulations on farmers, *'The other part of it is that we had no choice but to put them on….They change policy and they don't think of the consequences'.*

There is a loft on the old farm buildings adjacent to the dwelling house. The railing on the steps came off about 10 years ago and has not been replaced. The loft is accessed approximately five or six times a year and is used as a domestic storage facility. David agrees he should do something about the steps, '*Something should be done about it by right because it's definitely a danger'.*

A major issue on the farm is feeding cattle in the shed. David feels that a farmer can become so accustomed to driving in and reversing out of the shed that they may not look behind when reversing. '*You get so used to going in and out of the shed, that you won't look back. It's just something that people would need to be aware of because I mean familiarity, there's no doubt you won't keep turning around the whole time. Oh you'll give a quick glance in the mirror or you might give a quick look around. But sure by the time you get out of the shed there might be someone else coming in around the corner of the door'*. He feels this is an issue on most farms that keep animals.

David feels that a lot of commercial farmers are more safety conscious than part time or smaller scale farmers. Commercial farmers want to make things easier for themselves, '*You know you go to a lot of the bigger farms and the yards are well set up, there's good space in them and things are in such as fashion as they are easily managed'*. He feels that bigger farms are more conscious of doing things correctly *'And if you're going to do it right then safety will always come into it. And I suppose a lot of busy farmers would be conscious of that as well'*. He feels there are easier ways of doing things and generally if people stopped and thought about things they would realise this. Although money is a factor that affects a lot of farmers David feels that safety is worth investing in. *'I suppose one big example would be lights now* *around the place. In springtime when I'm calving cows and sheep and that I would leave the lights on, well the main light up on the house there, would shine, would light half the farmyard. Basically when it's dark I can do anything around the yard, without a flashlight or anything'*.

Given the size and level of activity on the farm, there is not a lot of machinery; the majority of machinery work is done by contractors. All of the major activities such as silage, slurry spreading, harvesting and bailing are done by contractors.

5.4.4 Medium Risk Category: Case Study 4

John is a dairy and beef farmer in Co. Louth. He farms 85 acres and is full-time employed on the farm, his son works with him part-time. He has 40 dairy cows and roughly 40 0-1 year olds and 40 1-2 year olds. He has been farming for 45 years and in that time he has not taken any agricultural courses. James is not in the REP scheme.

The farm is situated on a quiet road about 250 metres away from the family home. The farmyard is a mixture of old and new farm buildings. There are no small children present on the farm and although his grandchildren visit, they would not be on the farm. John tries to keep his farm as safe as possible but admits that is not always as safe as it could be. He feels that individual farmers should see what is needed to be done on their own farms and respond accordingly. He feels that familiarity with activities and the environment has possibly made him a little laxed with regard to safety. Accidents that have happened locally have made him conscious of certain activities on the farm. *'There was one instance about 10 years ago, a chap over the road got killed with a loader on a tractor. He had the loader raised up at full height and a shear grab on it. And he went to do something, to put water into the radiator of the tractor. He went between the tractor and the loader and a pipe burst and it came down and killed him instantly. Busted him. So like I'd be always, if you came in or somebody came into the farm and went to do that put diesel into the tractor and attempted to go inside the loader I'd be always aware. I will always be aware of that for the rest of my life. It's such a thing that can happen'*.

John feels that farming can be hazardous but no more so than other occupations. He feels certain situations are extremely dangerous such as children present in the farmyard during silage making or slurry spreading. James feels that all accidents are preventable and more care could often be taken on farms, which isn't always taken.

John is not involved in any type of farm planning or planning of activities. *'Well there's not much planning; it's only a matter of keeping grass in front of cows in the summer, spring and summer time and during wintertime it's keep the silage in front of them. Yeh, no there's not, I couldn't put a plan on it as such now'*. He does not find it necessary to think ahead about safety at peak periods of activity such as silage making or slurry spreading.

In terms of stress John describes himself as a bit stressed when he wants something done, he would not be laid back. With regard to workload he feels he is not rushed, *'Once I get the milking done morning and evening now, I wouldn't be rushed, unless I was rushing at silage. That would be it, or say spreading slurry, if I want to get a field finished or a tank emptied, coming onto evening I'd be rushing here, rushing there'*. However in his average day he is not rushed.

The dairy and milking parlour are situated to the front of the yard in the original farm buildings. All of the electrical installations on the farm are wired to standard and industrial fittings are used. The milking parlour is an old tie stall parlour, in which four cows can be milked at a time. The cows enter the parlour and step into raised stalls. The operator works at the yard level and there is no physical structure separating the operator and the cow. John finds the parlour comfortable to work in. A new cubicle house was built ten years ago and for grant purposes the entire farmyard was rewired. The motor in the dairy is well guarded. The dairy is always locked at night. All veterinary medicines are stored either in the dairy or in a locked shed adjacent to the dairy, which also acts as a workshop. However there is no specific locked cabinet for them. The workshop was found to be very untidy and appeared to have no level of organisation, for example power tools were left lying around on the floor. It is generally only tidied once a year. John admits the shed workshop should be tidier; however he has not got around to doing it.

The cattle crush, although very well positioned in the yard, is old and does not appear strong, however John feels it is sufficient *'Now like the gates mightn't be the best but nothing gets through them anyway'*. There is a system of gates in the yard, which allows one person to manage cattle in the yard with ease. The yard itself was found to be somewhat untidy with tyres, broken implements and other materials standing against walls. A derelict dwelling house is situated inside the main entrance of the yard (photo 5).

Two main lights, light up the entire farmyard, however, there are also lights on each shed. John never has reason to access heights on the farm and does not carry out any maintenance work on shed roofs. There are two electrical wires running through the farm yard, one which brings electricity between sheds and one which brings electricity from the old dwelling house to a water pump. John feels that these are not a hazard as his own tractor and slurry tanker is the only machinery which passes under the wires. All silage machinery uses a back entrance into the yard.

Photo 5.5: Cattle crush and yard in front of dairy

This image shows the cattle crush in the foreground with the collection yard for the milking parlour in the background. The crush and gates are all quite old and show signs of damage. The crush has no skulling gate which is used for safely restraining animals. In addition, the yard is quite dirty and untidy. The milking parlour is in an old farm building and animals pass in and out through quite small doorways.

The cubicle house is situated behind the milking parlour and it has an outdoor slatted tank, which also gathers the effluent from the silage pit. Automatic scrapers clean out the shed onto the slats. There are two additional calf sheds which both have underground slurry storage. When agitating the slurry the cattle are all taken out of the shed and the doors are opened. Initially when John built the slatted tank he agitated the slurry with the cows in the sheds as he heard many other farmers did this. However, as a result of one of the dairy cows dying in the shed while the slurry was being agitated, he now empties the cattle from shed.

There is one tractor on the farm, a loader, a fertiliser spreader, a slurry tanker, a slurry agitator, a muck spreader and a topper. Not all PTO shafts were intact on machinery. John does not replace or fix PTO shafts when they get broken and they can often be left broken for long periods of time. On machinery which is operated from the back of the tractor, such as the slurry spreader, John would be conscious to have the PTO guarded if it was being used by somebody outside of the farm. However, if John or his son were using it, it would not be a major issue if the guard was broken.

A local mechanic does the service work on the tractor. The lights are in proper working order on the tractor, however there are no indicators and the U-Guard is also missing on the back of the tractor. John does not carry additional passengers on the tractor, except for his son. *'No, no, except for him like if we're going from some of the fields down, I'd sit on the drivers seat and he'd stand up behind me. But, no passengers, no'*. When John carries his son along with him on the tractor he stands on the drawbars outside of the cab.

A contractor is used to spread the fertiliser on the silage fields. John and his son spread the remainder of the fertiliser. They use the small bags of fertiliser and store them on the trailer until they are required. This allows for ease for handling as the bags can be poured into the spreader from the trailer.

There are two isolation sheds, which are used for calving cows or separating a sick animal. One is situated at the end of the dairy cow cubicle house for calving while the other is beside the calf sheds. Both isolation sheds have water, good lighting and hooks for tying up animals. John finds this essential for caesarean births. During calving season it is necessary to come down to the farmyard and check the cows several times during the night. Generally there are few calving problems on the farm and John tries to avoid using the vet for calving procedures due to expense. He generally uses the calving jack for calving cows, *'No, I think it's the safest way for the man and, for the person working with the cow and it's easier, I think it's actually easier for the cow, if you work it right. Like you can use a calving jack but you can damage the cow too but if you use it properly, there'll be no problem'*.

The silage is cut and drawn by a contractor. The silage pit is built in a shed and the effluent drains into a slatted tank. The pit walls are 9ft high, there are no sighting rails on the exposed walls. Generally there is no reason to go up onto the pit, *'I wouldn't have to go up on the pit. You wouldn't have to go up on the pit but sure you will go up, you know but there's no work really on the pit. In the shed yeh, you might just have to keep the edges of it when it gets up over the wall. The walls are about 9ft high and when it gets over them just to keep it tidied back and in'*.

5.4.5 Medium risk Category: Case Study 5

Michael and Joan farm 150 acres in County Galway. They are engaged in sheep and suckler farming. There are 100 ewes on the farm and they have a suckler quota of 26, although they generally keep a little over this. There is also one stock bull on the farm. Both Michael and Joan are full-time employed on the farm. Michael has been farming full-time for almost forty years and along with Joan has taken several Teagasc courses. They are involved in the Rural Environmental Protection Scheme. The farm is situated on a very busy road, which services both a local a co-op and a mine.

Michael and Joan feel that safety would be the most important part of their work. Joan has previously worked in a garage where safety was an important consideration; she feels this was a good learning experience. In addition her own father was very safety conscious and she feels that also influenced her behaviour *'And I mean Dad would have been, he had to have been very safety conscious over machinery, so I would have learned that very, very early. Yeh so I suppose you inherit it'*.

Michael and Joan have three daughters, the youngest of which is eleven. Safety was always a concern on the farm when the children were small, the yard is enclosed and the children were only permitted supervised access to the farm. Joan feels that young girls do not have the same interest in machinery and farming as young boys and are therefore easier to supervise on a farm. She is also acutely conscious of the risks associated with elderly people living and working on the farm as Michaels father who had Alzheimer's lived with them. Michael and Joan feel that a lot of farm accidents are preventable; however, they feel certain animal related accidents are not preventable due to the unpredictability of animal behaviour. Although they are very conscious of safety on the farm, Michael and Joan do not believe farming is inherently dangerous, they see it as a healthy occupation and if you are sensible about it, it will not be dangerous.

Michael and Joan do not prepare a written plan for farm activities; however, they feel that they are always planning ahead and organising activities. ' *you would plan, I mean you would do more planning for some months than you would for others but I'd say there isn't a month that you wouldn't have to plan. Some kind of plan, you'd have* *to. And like I mean, to a certain extent you have work to do anyway, you certainly have to plan'*. In advance of silage making signs are always erected on the road to warn motorists of crossing machinery.

Michael and Joan have a fairly steady workload; although they are busy, they do not feel they are rushed on a day-to-day basis. Springtime is the busiest time on the farm due to lambing and calving, *'I mean if you had problems with lambs now you know and say cows calving at the same time. We try to change it but a couple of years now we got caught with things happening; you know two lots of things. But it's tough enough going'*. In terms of stress they would not describe themselves as generally stressed, according to Michael *'We're stress free you could safely say!'* Joan feels that sometimes juggling the household and the farm can often be pressurised while Michael feels financial worries can be stressful. Although they are somewhat anxious about the changes that may be brought about by the Single Farm Payment, Joan feels *'It's more wondering than worry at this stage because we'll have to wait and see'*. Although they are clearly subjected to some level of stress, Joan does not feel they are subjected to stress like others *'But I mean real stress as in, not like some people'*.

There are gates separating the farmyard and the house and there are also separate entrances to both. The original stone farm buildings are situated in a yard directly behind the dwelling house, while the new farm buildings are situated behind these. The original stone sheds, which once housed animals, are now all used for storage. With the exception of an open garage, all the sheds have bolted doors. The workshop, although quite tidy had a lot of implements and material stored at ground level. All sharp implements were stored at a height. Apart from the shed that houses the electric fence control unit, none of the old buildings have electricity installed. Although the loft steps have a railing, they appear somewhat exposed and are very steep and slippy. The steps have also been a concern for Joan and when the children were small she blocked off the steps (photo 6).

Photo 5.6: Steps to the loft in the old yard

The original stone farm buildings are used for storage on the farm. These steps are very exposed and a pallet is used to guard the open drop at the top of the steps. The general untidiness of the steps adds to the hazard.

There are two tractors in use on the farm, one that is confined to the yard for scraping which does not have a roll over protective structure. The main tractor is in good working order and has both lights and indicators working. A mechanic carries out all of the service work on the tractors. Michael never carries passengers on the tractor, *'No, never, no. It's one thing I do not approve of.'* Joan feels it's too easy for something to go wrong and totally disagrees with young children being allowed on tractors.

Although there is very little machinery present on the farm, Michael is very conscious of having PTO shafts on the properly guarded. *'That's the first thing Teagasc would say to you now when you go in you know when you're doing any of these courses or anything. Have you your PTO's covered'.* Joan dreads PTO shafts and is very conscious of them *'they're deadly, they are deadly yokes and I absolutely dread them since the very first day, I was always conscious of them'.*

Contractors carry out both slurry spreading and silage making on the farm. The silage is harvested into big bales. Typically four tractors operate to draw bale silage to the farmyard and a one-way system is operated for safety and speed of operation. They are very conscious of other people working on the farm; Joan feels that to a certain extent they loose control of the operations when outside operators are involved. They find some young tractor drivers working for contractors drive very fast and according to Joan *'you can't talk to them'*.

The main farmyard was generally tidy, although in places quite overgrown with grass. The new farm buildings are constructed in a U shape with the cattle crush in the centre. The cattle crush though very well located in the yard is old and not strong, there was one horizontal bar missing. In recent years an additional gate was added primarily for calving cows. If a cow becomes agitated the side gate of the 'calving crush' is opened and cow can be confined in a holding yard (photo 6).

The slatted shed was built in front of the original cubicle house and there is free movement of the cows between both. There is also a passage into the cattle crush, which allows for effortless movement of cows between the yard and shed. Feeding takes place in the centre passage of the slatted shed. There is minimal contact with the animals and they are confined to the slatted shed during cleaning of the cubicle house. There are three cubicles adjacent to the sheep shed for separating cows and calves or ewes and lambs depending on the situation.

Photo 5.7: Cattle crush

The cattle crush is quite old and looks quite fragile. The restraining gate is old and appears quite weak. There is no catwalk in the yard which allows for ease of handling while also protecting the farmer's feet from injury. The crush appears poorly maintained

A mobile handling unit for sheep allows for safe and easy handling of sheep, *'Its stress free for them and for you'*. Since building the sheep shed, there is little difficulty handling the sheep. Both Michael and Joan agree that sheep are not difficult to handle. A redundant deep freeze in the sheep shed houses all the veterinary medicines. All electrical installations on the farm are in accordance with the required standards. Although there is an electricity cable crossing the farmyard, Michael and Joan feel it does not pose a hazard to machinery. Joan feels that all electricity cables should now be buried underground

Generally the bull is out wintered as Michael feels that housing or confining bulls makes them cross. Typically the bull remains with herd, however, if being separated from them; four or five people are required. Most of the farm has electric fences and Joan feels that this is a sufficient escape route in the event of a problem. They originally had a ring and a chain on the bull but these fell off and were not replaced. Michael finds the chain gets caught quite easily resulting in the bull injuring itself. There is a warning sign at the entrance to the field where the bull is kept, however, from experience Michael and Joan have found that the general public often ignore warning signs and access fields in which the bull is visibly present. Michael's neighbours assist him when moving or testing animals and he does the same for them.

There is no longer an open slurry storage pit on the farm, Joan stresses that although open slurry storage was not ideal it was the only option in the past. A contractor carries out slurry agitation and spreading during the summer when the shed is vacant. They are very conscious of having access points to slurry tanks covered at all times.

5.4.6 Medium Risk Category: Case Study 6

John and his brother farm 250 acres in Co. Westmeath. They are engaged in mixed enterprises and have 110 suckler cows, 250 ewes and 30 acres spring barley for use on the farm. They also grow 5 acres of potatoes for the local market. With the exception of grain harvesting they do all their own work and the farm is quite highly mechanised. Two seasonal workers are employed to harvest the potatoes, which are harvested by hand. John has been farming full-time for 17 years. He has completed the Certificate in Farming. The farm is in REPS. The farmyard is situated on a quiet road, close to the family dwelling house. There are never children present in the farmyard.

John feels that safety is a very important part of his job, *'Well I suppose you have to make it important every day you go out every day you get up. I mean you read about accidents and you think that will never happen to me. Its only when it happens to somebody you know or maybe you have a near miss yourself that you realise how vigilant you have to be and how important it is. Yeh it is very important'*. As a result John makes a conscious effort to incorporate safety into his daily activities. Safety is more important to John than when he started farming *'I suppose if you think back 17 or 16 years ago when I started farming it wasn't that important to me. But I've heard and seen so many accidents both locally and things that you read about that it is a big deal. It is extremely; I suppose it's vital. You have to take every precautionary step that you can'*. John feels that when a farmer he knows has an accident it sinks home that it could be him.

Although he feels a lot of accidents could be prevented through extra care and less rush, John feels this is not easy to do. He feels that due to the nature of farming farmers are always rushing. *'I mean now its kind of the world we're caught up in anyway, it's a bit of a rat race and farming is just as bad as any other occupation. People want more and more and we want our free time like everybody else, so we try to get through the day as fast as we can maybe to spend time with our girlfriends or wives or whatever in the evening. We don't want to be out all night or all evening so it is a bit of a rat race too to get through the day and to get through the work as fast* *as we can. I mean maybe you're working against the weather and there's rain coming in the evening time and you're trying to get you're job done'*.

John describes his workload as constant, *'there's something going on almost every month of the year'*. However because his brother is also full time employed on the farm they are never too severely pressurised and work would not be rushed. John feels stress definitely affects his work and describes himself as a 'worrier by nature'. *'I mean obviously when you are out and a machine breaks down or whatever and you're panicking to get it fixed up again before you can even get going, things like that do stress you out'*.

John works to a rough weekly plan, allowing for interruptions or changes in the schedule as he goes along. With cows calving and the weather constraint he has to be reasonably flexible. At times of peak activity on the farm such as silage making and slurry spreading safety is an issue, *'I wouldn't say it's in the back of your mind but it would be there all the time. And even more so in the past few years because we have been made more aware, even people like you have come around be it whoever, even simple things like doing a safety statement makes you look at things you've got to look out for'*. Although John tries to have his machinery maintained and organised for when it is needed, he feels things always happen that you can't anticipate.

John compiled a safety statement for the farm and found that the process drew his attention to different things on the farm that he did not previously think about. He would like to further pursue health and safety on his farm and feels there is a market for this in Irish agriculture. *'Now ok they do a little bit, when we are doing old training courses, on health and safety but like that's only the tip of the iceberg'*. He feels that most farmers are learning about health and safety by experience on their own farms. Whatever health and safety training younger farmers have received, John feels the older farmers have received none and very often these are the people who have accidents. With the exception of near misses, he finds that generally health and safety issues are not discussed among farmers. *'I don't know maybe it's something that we don't like to discuss, but no it doesn't actually come up for discussion'*. He is unclear about who he would turn to for advice on health and safety issues, perhaps his

Teagasc advisor *'he wouldn't be an expert on everything either, he's going by the books and it's not always practical on the farm'*. John feels that farms, which have been built in the last 10-15 years, generally comply with the recommended standards. However older farms require a large investment to achieve the recommended safety standards, 'if *you were to go back to an old farmer and started say on the electrical end of it that would cost thousands and thousands to get right'*. He feels improving the safety of the physical working environment can only be done gradually.

Machinery is an important part of John's farm and he exhibits a good understanding of all the safety issues associated with his own machinery. He feels that as a lot of machines require both high revs and high speeds to operate, the operator needs to be experienced. Grain harvesting is the only activity for which a contractor is used on the farm. There are three tractors on the farm, all which are new and in very good condition. The oldest is 1998 and there is a 2002 and a 2004. As the farm is fragmented the tractors are involved in a lot of roadwork, thus John ensures all lights and indicators are in proper working order and that tractors are in roadworthy condition. John himself does all the machinery service work. Although he has concerns about carrying passengers on the tractor, he admits he often does. *'But sometimes the reason first of all why you would have somebody, I suppose is because say you are going gathering up livestock or whatever, you need help with you. Maybe there wasn't a car or a jeep available for the passenger to drive so you'd have to bring him with you in the tractor'*. John feels that carrying a passenger in the cab proves to be an obstruction to the drivers view, however, there often is no alternative. He dreads seeing people standing on the drawbar of a trailer behind a tractor and feels having passengers in the cab is certainly safer. He appreciates the importance of knowing the limitations of the machinery and respecting that. *'So things like that, would happen no matter how experienced you are or no matter how good you think you are. I suppose you do have to realise that these things can happen'*.

John is very conscious of having PTO shafts guarded on the farm '*PTO shafts above all things going'*. He describes one of his neighbours' injuries resulting from entanglement in a PTO shaft and as a result he tries to ensure all PTO's are covered. *'I have replaced one or two now that have got broken or whatever. So I would be conscious of that, I just hate open PTO shafts'*.

Blockages are common in machines such as a silage harvester and John is always vigilant about disengaging the PTO shaft before clearing a blockage. *'Oh yeh, Jesus I wouldn't, like that tractor there, that's the one we'd be driving at harvest and that has a hand clutch which you literally pull up to stop the PTO turning. But I would actually go to the trouble of taking the PTO out of gear completely rather than relying on the hand clutch'.*

Transporting machinery, in particular harvesters and mowing machines that are wide, on the road is an issue for John because the farm is so fragmented. In addition hedge cutting on narrow roads requires vigilance and warning signs are always used. John handles half tonne bags of fertiliser with a loader, although less labour-some than 50kg bags he feels they do bring other problems. He highlights the importance of having the correct counterbalance and 'picking your spot' in terms of level ground for loading. Further the consequences of mistakes with these bags could be severe. Despite this John feels this advance has been hugely positive *'Like most farmers would have gone away from handling the 50kg bag. It's too labour some and most people have bad backs from lifting those yokes. I don't want to be one of them'.* He can identify local farmers with severe back problems which are perceived to have resulted for farming activities.

Although previously accepted as something that went with the job, John feels farmers are now more concerned about reducing the strain on their bodies and their health while increasing the speed of operations also. *'Everyone is looking for an easier option, but I suppose it's a faster option too for me'.*

Dust and noise are major concerns when working with the corn roller, which generally requires 2-3 hours work per week. Ear muffs and a dust mask are essential and always worn and the machine is positioned to allow a tonne of meal to be rolled at a time and thus minimising operator contact.

Heights are often accessed on the farm, be it to service the motor on top of the grain bin or to clean or paint shed roofs. Generally John uses the front loader on the tractor and stands in the bucket. Ladders, if used, are always secured as John himself experienced a fall from a ladder. The bottom section of the ladder fixed to the grain bin was removed to prevent access to the height. Although concerned about working on heights John does not have a roof ladder and although he has a helmet it is never worn *'I have one or two in there, they just don't look the part'*.

John feels that protective equipment is now becoming more acceptable among farmers. When spraying John always wears a mask and gloves. Although he recognises the merit of wearing coveralls while spraying, he feels they are impractical. *'Say take spraying potatoes for instance, you're trying to pick the driest, warmest, calmest day you can get and the last thing you want to do, I mean you're probably going to be in jeans or tee-shirt and not much more. You don't want to be clammed up in overalls'*. He also feels that these decisions are based on perceived risk '*I suppose the bottom line is that if it means you're going to live longer you'd do it rather than getting dosed with chemicals. I suppose then you have to look at the high risk, I mean I wouldn't consider some of the sprays that we use for potato blight as high-risk sprays. Maybe the likes of Gramoxone® or Roundup® or stuff like that, you'd be paying a bit more attention'***.**

As all of the tractors have air conditioning, windows are never opened while spraying. John has no specific means for cleaning blocked nossels and does not carry clean water while out spraying, '*depending on what I had. A bit of tissue in my pocket or whatever. I'm lucky in the sense that I have a choice of nossels so if it was a bad blockage or whatever I might flick it around to one of the other nossels until I got back to base or I had fresh water or whatever. But when you're in the middle of a field, you kind of turn to whatever you have*'. John is keen to take a spraying course and has inquired about courses in his area. All chemicals are stored in a cupboard in an old dwelling house in the yard, which is not locked, John is conscious that the chemical store is less than adequate and intends to have a proper locked store made.

There are two shear grabs on the farm for feeding silage, which Johns also uses for carrying bags of meal '*I have a tendency to carry bags of meal in the shear grab. I gave myself a nick on the hand once from the actual blade of the shear grab*'. Despite injuring himself, John continues with this practice to save time, '*it's the only practical* *way I have of carrying them. It's either make a second trip back with the meal or bring it the first time when you are going with the grab'.*

There are three trailers on the farm, two that are pulled behind tractors and a cattle trailer for the jeep. Neither of the tractor-trailers have lights or brakes, although lighting boards are put on if the trailer is going into the town. The trailers are old and it is not feasible to install trailer braking on them. John is very conscious of the cattle trailer behind the jeep, if the trailer is full it can often cause the jeep to destabilise.

The majority of slurry storage on the farm is in underground tanks however there is one open slurry pit. With the exception of one tank which requires moving slats all the access points are manholes. All cattle are released when agitating slurry and manholes are never left open when unattended. John sometimes has to access the shed when agitating slurry to observe if there is a problem, which he feels, is a risk. The open slurry tank is walled off on three sides and fenced on the remaining side, which is adjacent to a ditch.

Animal handling is a major concern on the farm, the cattle crush is very strong which John feels is essential when dealing with cows and calves. Generally there are two people present when handling animals, however, the situation does arise when John is alone, '*But I mean sometimes there'd be only yourself and you'll have to try and manage, you know on your own***'.** John has a very strong restraining gate in his cattle shed which he describes as '*a must have for anyone with sucklers'* (Photo 8). John had the gate made at a cost of €300 primarily for safety reasons but also for practicality, *'I suppose in that case like with the sucklers they go hand in hand, safety and practicality'*. It allows him to safely calve cows or work with a cow and calf, '*and even for simple jobs like getting a calf to suck or whatever when it's born, at least you're safe'*. John tends to do a lot with the cows when he gets them into the yard '*it's mostly limmosins we have and we can't get them in, so when you do get them in you tend to do a lot'*. Safety is also an issue when feeding weanling bulls in the field as they tend to be quite rowdy.

Photo 5.8: Restraining gate for suckler cows

John invested in this restraining gate for both safety and practicality. The gate allows for safe handling of a suckler cow during calving or indeed after calving if working with the cow and the calf. At €300, this was seen as a necessary and good investment.

There are two bulls on the farm, both of which are ringed; however, neither have a chain for reasons which John outlines *'I don't know I think it looks bad. I think it's cruel as well. They never had one on, any of the bulls we've ever had and we've had numerous bulls'*. John and his brother are generally both present when the bull is being handled. They have never experienced any problems with their bulls and they find them relatively easy to handle, however, they are always cautious and generally bring the jeep into the field when herding or stay close to an electric fence if the bull is present.

John and his brother make their own silage, generally nobody is on top of the silage pit, however, it may be necessary in order to trim the sides. The silage backs onto a field from the yard and there are no sighting rails on the walls which at times pose as a worry, *'it's something that could be done but, like all things that were built in the olden days there were no railings put on it then'*.

5.4.7 Small Risk Category: Case Study 7

Joe is a suckler farmer in Co. Roscommon. He farms 70 acres of mixed land, some good land, bog and he also has 20 acres of callow land which is fragmented from the main farm. Joe is a part-time farmer who works full-time in a chemical manufacturing plant '*I work part-time, I farm part-time and I work full-time'*. He keeps 24 suckler cows.

The farmyard is adjacent to the family dwelling house where Joe lives with his mother. Both the farm and house have separate entrances. Although he has been farming all his life, his father died at an early age, the farm was only transferred eight years ago. At this point he joined the REP scheme. There are no children living on the farm however, nieces and nephews do visit approximately six times a year, they are all under ten.

Safety is an important feature of Joe's job in the chemical plant. He has taken several safety courses specifically on manual handling and chemical handling which he feels impacts on his farm work. Joe views work safety as being able to do any job he has to without getting hurt. He is aware of the dangers associated with farming, *'You'd be aware of them or you'd like to think you are aware of them all anyway at this stage. You'd like to think you know most of them anyway If you're handling stock, you'd be careful or out shaking slurry you would be careful'*. However, he feels that there are dangers associated with many other things also.

Joe feels that close calls on the farm make him aware that accidents are possible *'Sometimes you might have one or two close calls now and again. Nearly every year you might have one but you would be aware especially on your own'*. Some accidents, especially those involving children are considered preventable *'it's preventable if you don't bring them I suppose'*, however, Joe feels that at a certain age children want to go on tractors and it is difficult for parents to say no.

Although safety is important to Joe he feels that it costs money *'Safety costs money as well you see, it does cost money'*. In addition Joe feels that investment depends on the physical environment of the farm when it is passed down. Certain aspects of the farm needed to be changed when Joe received it to enable him to farm alone, for example animal handling facilities.

As he is full time employed, planning activities on the farm is important. Although Joe does not prepare a written plan, he works to a rough plan. Working alone he is guaranteed that equipment is always in working order, if something breaks it is repaired immediately *'it'd never be left there so that you know when you go back next time it's going to work for you. You don't just leave it on the long finger'*. Weather is the most important factor in planning activities on the farm.

Joe feels he is not a stressful type of person at all. He describes his workload as steady *'I think as you get older you have a more steady workload, when you are younger it's different. I don't see the point of it anymore'*. His priority is always to his job as that is essentially what pays him.

The original stone farm buildings are situated beside the dwelling house. In recent years a slatted shed was built further down from the house beside the silage pit. There is a separate entrance to this yard, which is also used for accessing the upper yard. The farmyard was extremely tidy, it is important to Joe to be well organised and to be able to see where everything is, a tidy farmyard helps this *'Yeh, a place for everything and everything in its place'*. Joe feels that REPS has improved the tidiness of farmyards, whereas once people tended to allow material build up in yard now rubbish is dumped immediately and everything else is properly stored.

Photo 5.9: Upper yard *'A place for everything and everything in its place'*

The original stone buildings adjacent to the house are well maintained and the cattle crush is still in use. A system of gates in this yard allows one person work with cattle. The yard is and adjacent storage sheds are well organised and reflects Joes motto which titles the image.

Most of the sheds adjoined to the house are small and serve no purpose on the farm. The calving shed is situated opposite the cowshed where a restraining gate has been fitted. Although the gate is secured with a chain, it is not very strong *'It's a bit open looking but it gives you room to work at the back'*. Joe is very conscious of the suckler cows temperament at calving time as he feels they are not at all tolerant. Generally he does not intervene in calving unless absolutely essential. After calving he finds the cows are at their most dangerous *'there are more and more every year that you can't go near'*.

Opposite the calving shed, cows and calves are housed in a converted three bay slatted shed. The conversion allows for seven or eight pens for cows and calves depending on the requirements; however it has left extremely limited operator access and working area. Bedding requirements necessitate Joe to enter the pens with cows and claves. Although he is generally aware of cows especially when they have calved, escape mechanisms from the pens are unclear *'Escape is jump the gate basically, that* *is it'*. The gates in one pen, however, allow for isolating cows in the event of difficulties.

Although the shed is well lighted, the fittings are all domestic and do not comply with the required standards. The access point to the slurry tank is outside the shed, it is a four-section access. Joe feels that this type of access is very safe and as only one section is opened for spreading slurry. Cattle are not removed from the shed while slurry is being agitated; however, Joe prefers to have a breezy day to agitate.

There is a newer three bay doubled slatted shed in the lower yard where calved cows are housed. A pen surrounds the entire shed with a cattle crush along one side, this allows for one person to move animals with ease (photo 5.10). The silage effluent is collected in the slurry tank and thus this tank is emptied twice a year. Again the animals are not released during slurry agitation.

Photo 5.10: New shed with pen and crush

The lower yard is less organised and not as well surfaced as the other. The gates and runway surrounding the shed allow Joe to move cattle with ease from the shed into the crush on the right side of the shed. This is an example of how a simple engineering solution can provide both labour and safety solutions.

The bull is housed in the newer slatted shed for approximately twelve weeks of the year. Although once ringed, it wore off and has not been replaced as Joe did not feel there was a need to have it replaced. Joe feels the bull is actually quieter than the majority of his cows; nonetheless, he is careful with him and always conscious he is a bull. *'This lad must be seven or eight years old I suppose now at this stage, he has never caused any problems. But at the same time you can never be sure you know. He's definitely quieter and easier handled than a lot of the cows we have'*. Joe does not have a warning sign in the field with the bull but he is more conscious that he should have after receiving a book from the Health and Safety Authority.

One parcel of land is removed from the house and requires that the animals are walked 20 minutes along the road. In order to move the cattle Joe gets the help of neighbouring farmers *'It would take about five of us, it's about a twenty minute walk. You'd bring the people and leave them on the road and you'd go in front of them yourself and put someone behind them. You're not covered by insurance otherwise. When you have somebody in front of them and somebody behind them you're covered by insurance then'*.

There is very little machinery present on the farm, generally a contractor is used for silage making and slurry or alternatively the machinery is borrowed from a neighbour. Joe has a 1990 tractor, which is maintained in good condition with lights and indicators working. It is however missing the U-guard, which Joe is conscious of and intends to replace. A local mechanic carries out all the machinery service work. Passengers are generally not taken on the tractor for work purposes; however, when his nieces and nephews visit he takes them for rides on the tractor. He would not take children out on the tractor while he is working as he feels it is dangerous.

He has a JCB with silage grab for feeding in the sheds, which rarely leaves the farmyard. The JCB is also maintained in good condition and all lights and indicators are working. Again the children enjoy rides in the JCB *'If they want to go on the JCB, I just park, they like just working with the back actor. Park it in a pile of muck and let them swing away themselves'*.

When spraying Joe does not wear a mask, he feels it is sufficient that he keeps the windows of the tractor closed although the tractor does not have a sealed cab. Blockages in the nossels are cleared easily as the top can be removed and the dirt can be knocked out. Gloves are always worn when handling the nossels. There is no clean water storage tank on the sprayer, *'If you needed clean water out in the fields, you'd go to a cattle trough or whatever, you know, that would be your source'*. Although he keeps very little chemicals on the farm, there is a small shed specifically for chemical storage. With only a bolted door Joe feels that it would be a step forward to put a lock on the door.

There is also a transport box, a fertiliser spreader, sheer grab, muck spreader and a share in a topper, which is not kept on the farm. All of the machinery have original PTO shafts intact.

Silage is made by contractors and Joe would have very little to do at silage making apart from covering the pit. His main safety concerns about contractors working on the farm would be that a machine would pick up a foreign object in a field that would cause it damage. Although the silage pit is not very high, there are no sighting rails and the walls are quite low. There is never any need to be on top of the silage pit while it is being filled and Joe feels that people up on the pit get in the way.

Joe keeps very little tools on the farm as he does minimal machinery maintenance; therefore there is no farm workshop.

5.4.8 Low Risk Category: Case Study 8

Sam is a farmer in Co. Donegal who farms 78 acres, 17 of which are rented. Sam keeps on average 16 suckler cows and approximately 110 ewes and has one stock bull. He is full-time employed on the farm. Sam has been farming all his life, firstly at home with his own father and brother and then renting land of his own while also working. He has been farming his own land for almost twenty years. Sam's farm is not in REPS and he has never taken any agricultural courses.

Sam has quite severe back and hip problems which both required surgery. He walks with the aid of a walking stick and has *'pains nearly everywhere'*. Sam believes that his pains are related to Organo Phosphate exposure from dipping sheep over many years *'Years ago when we were dipping sheep, we were too careless, no gloves, no hat, no nothing. You learn by your mistakes'*. This condition has had a major impact on his ability to farm and he finds that it is a struggle to carry out many routine farm activities. There are no children living on the farm, however his grandsons visit occasionally. Sam's wife always supervises the youngest child while he is in the yard, while Sam describes the older boy as '*a wee bit wild of himself*' and is more difficult to supervise.

Sam views safety as an important part of his work and feels he is conscious of safety at all times. Safety is always a consideration for Sam when he is doing tractor work. He believes that farming is a dangerous occupation, *'Farming would be dangerous, there no doubt about it now. Tractors I mean of all things, you know yourself a tractor is nearly the most dangerous thing you could drive, worse than a car. But there are plenty of accidents with tractors you know'*. He feels that a lot of farm accidents are preventable and a lot of carelessness exists among farmers.

Although he does not strictly plan and does not have a written plan, Sam feels he is always planning ahead. Depending on the activities safety may or may not feature in Sam's activity plans. However safety is always considered when he is planning activities involving tractor use. Sam describes his workload as steady going *'Oh you could rush it, like and try and do more in the one day but if you were doing something you'd spread it over a couple of days you know. When you're working for yourself you're not worrying about the hours or time or anything'*. Sam describes himself as not really stressed; he feels that because he is his own boss he is not subjected to as much pressure.

The farmyard is situated directly behind the dwelling house, which has steep steps leading from the house up to the farmyard. There is no railing on the steps. There is an entrance to the house from the road and also an entrance to the farmyard, which also serves the house. The farmyard was somewhat untidy with a lot of materials such as wood, paling posts, rolls of old fertiliser bags and oil drums stored against walls and sides of buildings in the yard. Sam says the yard is usually not as untidy, however, with his bad health he has been unable to tidy up and move anything heavy. In addition things, which once were burned, have not been disposed of since the introduction of regulations preventing the burning of waste. This has posed problems for Sam. Sam feels that good lighting is very important particularly in spring during calving and lambing; however, there is only one outdoor light in the yard which Sam feels is sufficient. Sam never has reason to access heights on the farm.

There is very little machinery on the farm, Sam's tractor is dated to the 1970's, however, it is well maintained and the lights and indicators are working. Sam never carries passengers on his tractor *'I'd be afraid to keep somebody standing on the tractor in case they would come of it, and the trailer or whatever you have behind you come over on top of them you know. No, I never would take nobody on a tractor'*. There is also a block cutter, a cattle trailer, a fertiliser spreader and a mowing machine all of which were well maintained. The PTO shafts on the fertiliser spreader and the mowing machine were both properly guarded. Sam's son and his brother in law do most of the service and repair work of the machinery. There is a chainsaw on the farm; however, it is rarely used as Sam cannot operate it any longer. He never wore safety equipment when operating the chainsaw but recognises that specific protective equipment must now be worn.

There are two slatted sheds with underground tanks on the farm, one for cattle and one for sheep. There are two outside manhole access points to the tank on the cattle shed, which is covered with a heavy steal cover. There is a safety grate present below one of the steel covers and Sam intends to install one in the second manhole. In order to access the tank in the sheep shed, the slats have to be moved. There is no open slurry pit on the farm. During slurry agitation all animals are released from the sheds. Manhole covers are replaced at night when slurry is being spread *'So you just put on the slat down when you're finished then. It'd be evening or night, I never would leave them lying open now. It's too dangerous. You never know like, as I say there are no children here but you don't know how people will come wandering in at any stage. I don't know how insurance would go, we'll say even somebody wandered down from the road, some man drunk put it that way and wandered into a hole. I don't know how that would work'*. It usually takes only one day to empty each slurry tank.

Calving pens are erected in an older shed for calving suckler cows. There is no restraining gate for calving the cows; however, there are rarely problems at calving time. Sam tries to operate a closed herd; the animals are used to being handled and are generally all very quiet. All of the electrical installations were installed to the required standard.

A new grant aided silage pit was constructed in recent years. Previously up to eighteen acres of silage was built into a pit, which had no walls. Sam felt this was very dangerous and posed specific hazards when the pit was being rolled. There is never any need for anybody other than the contractor to be up on the pit while the silage is being built *'I would find like, if you've somebody rolling and somebody putting up silage as well, it's too dangerous to be up there for starters. Because it's very hard for the man that's driving the tractor to watch you, you know what I mean. You have to watch yourself or else stay down'*.

Sam uses small bags of fertiliser, which he loads into the spreader from the trailer. If the bags are stored at ground level one of his sons will lift them into the spreader for him.

Although Sam's wife often assists on the farm, they do not move cattle unless they have additional help. The stock bull is ringed but does not have a chain; Sam describes him as very quiet. Although there is a warning sign in the field with the bull, Sam feels if people want to enter the field they ignore the sign. Despite this he is always conscious that he is a bull and more so now due to his lack of mobility *'But* *saying that like, if I was going up to the field to him I'd take the Land Rover with me. I wouldn't chance walking through the field. I'm not fit enough to walk by'*.

The cattle are all grazed on lands surrounding the farmyard and thus moving cattle on the public road is not a major issue. The sheep are grazed on lands further away from the farmyard and are always transported in the cattle trailer. Animal handling in the cattle crush is minimised and usually a number of jobs are scheduled together. The cattle crush is well situated in the yard and is quite strong. For handling sheep and lambs in the crush, Sam stands old doors against the railings to prevent them from escaping. All veterinary chemical and agri chemicals are stored in an unlocked cupboard in an old loft in the farmyard *'Well they're in a wee cupboard, there'd never be no children in there so they're very safe where they are. If there were young children about the house you'd have to have them locked up. But here there's nobody, just the missus and me and I don't think we'll start drinking it at this stage!'*.

A sheep-dipping tank has recently been built in the farmyard and Sam and his son have the materials to make a cover for the tank. He no longer takes any chances when dipping sheep and always wears a rubber suit. Sam is confident that when the dipping tank is covered and the safety grate is installed in the manhole access to the slurry tank that all outstanding safety issues will be taken care of on the farm.

Sam's main safety concern on the farm relates to members of the public accessing his land. This is a particular problem during the month of June when the car rally passes by his farm. This attracts a significant amount of spectators that enter fields without permission. Often gates are opened and not closed resulting in cattle gaining access to the road. Sam now locks all gates on the farm; however, this does not prevent people accessing the land.

5.4.9 Low Risk Category: Case Study 9

Seamus farms 83 acres in Co. Tipperary and is engaged in dairy and beef farming. His farm is divided into two segments of seventy and thirteen acres. Seamus is full-time employed on the farm and his son works part-time on the farm. Seamus has been farming for fifty years and in that time he has not taken any agricultural courses and he is not a participant in REPS. Presently Seamus has 65 dairy cows, 16 in-calf heifers and 18 calves.

There are no small children present on the farm and his visiting grandchildren are very young and would never be present in the farmyard. Seamus feels that safety is certainly an important aspect of his work and he would be conscious of safety in his day-to-day activities. Seamus does not feel that farming should be considered a dangerous occupation, though he respects there are dangers associated with farming. Seamus feels that the best intention in the world will not eliminate all accidents, although most can be prevented, accidents will always happen.

Although not written down, Seamus always works according to a rough plan. Seamus's work is quite pressurised during February and March as this is calving time and also there is extra work involved in getting grazing ready for turnout. Although not generally a stressed person, Seamus does feel stress occasionally. He feels if things do not go according to what he has planned it can cause him to be stressed.

The farmyard is adjacent to the dwelling house with a wall and garden gate separating both. The yard is very tidy and very organised and free from any obstructions and Seamus is conscious about keeping the farmyard tidy (photo 5.11).

Photo 5.11: Farm yard

The farm yard is tidy and well organised. The trolley resting against shed wall is used for moving materials in an attempt to minimise manual handling.

There are both separate farm and house entrances. The farmyard combines both original stone farm buildings and newer sheds. The original farm sheds are now used as calving units and as storage sheds. There are two calving units which allow for four cows to calve at a time, there is one restraining gate. Opposite the calving units there are three pens, which are monitored by camera. Cows within two weeks of calving are moved down to this area from the cubicle house.

There are two storage sheds, which are used for tools, implements veterinary medicines and other materials. The veterinary medicines and chemicals are stored in a double door locker. Both sheds are well organised. All of the original sheds have heavy steel hanging doors, which are all bolted shut. The straw storage shed, pre-calving units and young calf sheds each have doors made from gates sheeted with corrugated iron. Although bolted and well secured these would certainly be a hazard in windy conditions. There are two additional calf sheds for older calves; one of which has an underground slurry tank. In order to access the slurry tank in this shed four slats are lifted, which are very heavy. *'They're very heavy. They're too heavy. They wouldn't go in at all now, as big as that. They're all a lot smaller'*.

The cubicle shed, which has automatic scrapers, opens out into a slatted feeding area. There is outside manhole access to the underground slurry tank. All of the slurry is stored below ground.

The dairy is well organised and very tidy. Seamus has a guard covering the motor and belts, which he feels is not as good as it should be. *'Now I've that done a long time ago myself. Michael now, he is twenty-two but when they were small they'd be coming down, you'd hate the thought of them coming in and going near belts or anything like that'*. The cubicle house, milking parlour and dairy all have industrial type electric fittings while the older sheds have domestic fittings.

There is very little machinery on the farm as Seamus hires a contractor to cut his silage and spread slurry. There is one 1978 tractor on the farm which is well maintained and has lights and indicators working, however, the u-guard is missing. Seamus never carries additional passengers on the tractor, as he does not have room in the cab. Seamus feels newer tractors are perhaps safer and more equipped for carrying passengers '*But more tractors now are maybe more safer. Now I was talking to a man the other day who was talking about the accident you mentioned a few minutes ago and he said he has a new John Deere tractor, well it's two year old and he said there were even a place on it to put up a car seat for a child on the tractor. And maybe other tractors have the same thing*'.

In addition Seamus has a silage grab, fertiliser spreader, mower and a sprayer all of which have properly guarded PTO shafts. He is very conscious of the hazards posed by exposed PTO shafts and he feels that PTO shafts are his biggest safety concern on the farm.

When spraying Seamus always wears a mask and gloves when he is handling chemicals. However spraying is not a big activity on the farm. Chemical containers are rinsed out and burned when empty.

Table 5.2: Summary of case study critical findings

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
Attempts to eliminate hazards	✓		✓			✓	✓		✓
Good organisation & Planning	✓	✓	✓		✓	✓	✓		✓
Effective management & maintenance of physical environment	✓		✓		✓		✓		✓
Safety socialisation a key feature	✓		✓		✓				
Management of workload & stress		✓	✓				✓	✓	
Good perception of risk	✓		✓		✓	✓	✓	✓	✓
Effective management of technology	✓	✓	✓			✓		✓	

5.5 Discussion

The structure of the case studies focused on examining the specific person factors of farmers and the physical working environment of the farm that have been identified in the literature as being central to accident occurrence. The following is a discussion on the findings from the case study research. Figure 6.1 illustrates the factors as identified in the research as having an impact on health and safety on the farm.

5.5.1 Person factors

The case study interviews provide a deep insight into the knowledge, perceptions and attitudes of the farmers relating to health and safety on their farms and the key factors that influenced attitude formation. Through discussions about their own farm yards, the equipment they use and the activities they engage in, the interviews exhibited the varying knowledge and interest that exits among these nine farmers in relation to the hazards associated with farming.

5.5.1.2 Attitudes

Section 4.1 highlighted the importance of understanding people's attitude to health and safety. The importance of safety as a part of farm work ranged from being an important feature to being vital. The level of discussion engaged in, in the interviews, reflected the level to which safety was examined and considered on the farm. Three of the cases engaged more fully on safety than the other cases (1, 3, 6). These were typically of a younger age and had large commercial farms. The three farms selected from the low-risk category (7, 8,9) did not engage in the same level of discussion as those from the other two categories. This possibly reflects the degree to which they are required to confront safety issues in their day-to-day work.

While three of the farmers viewed safety as vital or the most important part of their job (1,5,6), others felt it is a big consideration but conceded that things are not always perfect (2,4). The remaining farmers view safety as always being important (3,7,8,9). According to one large farmer, commercial farmers are more safety conscious than smaller or part-time farmers because they are more conscious that they have to do things correctly (3). In addition older farmers particularly were identified as lacking in health and safety training while they were viewed as the age group that often get injured (5). Two of the farms have prepared Safety Statements (1,6), both of these were large farms and had been visited by health and safety professionals. In one situation where both a father and son were working the farm together, both had prepared a safety statement (1).

5.5.1.2 Beliefs

The findings very much mirror what was established in chapter 4, that is while farmers are aware of the dangers associated with farming and can identify them on other farms they do not consider that their own farm is dangerous. This indicates that there is a cultural belief in farming that it is a healthy and safe occupation. There is an almost passive acceptance of hazards, risks, illness and injury on many farms (Murphy, 1992). Farming is more than an occupation, it is a lifestyle. Although all the interviewees recognised and alluded to specific dangers associated with farming, as an occupation they did not perceive it as dangerous. With the exception of one farmer (8), farming was not believed to be a dangerous occupation (1,2,3,9) or any more dangerous than other occupations (4,7). Comparisons were drawn between farming and other occupations and even car driving. According to one couple (5), farming is a good healthy occupation while another felt that it is really depends on the farmer's attitude (1).

Quite varied views were expressed on accident prevention in the interviews. Literature suggests that farmers who believe that they have limited ability to prevent injury and ill health problems do not see the immediate benefit in taking precautions and are in fact less likely to take precautions (Wadud *et al*., 1998). Two of the farmers felt that all accidents, not exclusively farm accidents, are preventable (3,4). The remaining farmers felt that most accidents could be prevented (1,2,5,6,7,8,9). However, two of these farmers held the belief that accidents will always happen, that's why they are called accidents (2,9). This implies that they believe that accidents are phenomena, which are out of the control of the person. Certain types of accidents were seen as being more preventable than others. Accidents involving children on tractors can be prevented if children are not taken on tractors (7). While it is unclear if all animal related accidents could be prevented due to the unpredictability of animal behaviour (5). The three young large commercial farmers believe that increased workloads, working hours and pressure are central to accident causation (1, 3, 6). In addition two of the farmers believe that the nature of farming, in terms of exposure to hazards, increases the risk of accidents occurring (1,6).

5.5.1.5 Perception of risk

Through the course of the interview, the discussions focused quite significantly on perception of risk. While one farmer in particular had an excellent sense of the risk present in his environment and associated with his behaviour at work, particular instances arose were he could not acknowledge the risk involved (1). The most striking examples of this were spraying with a tractor window open '*it wouldn't really be any harm to us*', and accessing heights from a loader without any head protection.

In many instances the farmers interviewed could recognise the risk present in their environment. However, by assessing the risk for themselves or having previously taken risks and not suffering the negative consequences, they were willing to take the risk. For example, Sean in case two admitted that he was careless with chemicals but he has never been caught. David (Case 3) is aware of the dangers of PTO shafts; however, it is more important to his employee that they all be covered. John (case 4) knows that unguarded PTO shafts on slurry spreaders are a risk, however, if it is just himself and his son working with them it is not such a big concern. Joe does not recognise that agitating the slurry with the cattle in the shed poses a risk to both the cattle and to himself and this practice is normal on his farm. According to Fischoff *et al.* (1978) as cited by Dunne (2000) research on risk perception illustrates that people accept higher risks for themselves when there is a voluntary aspect to becoming involved in the activity. Dunne (2000) asserts that this would suggest that farmers and the self-employed would be inclined to accept higher personal risks than employees working for somebody else. '*It appears that being in a position to choose to run the risk can make a given level of risk more acceptable to the person. This is because choice gives people a sense of having more control over the situation*' (P.68). This perception of having control is a significant influence on a person's assessment of the probability of an accident happening to them. There is evidence from the SHSIF to suggest that farmers assess the danger or risk in their workplace based on whether or not they have experienced an accident. According to Dunne, 2000, P.30, *'Awareness of risk is the crucial factor in improving safety at work'*.

5.5.1.6 Habit

Dunne (2000) discusses 'strong but wrong' responses which can be implemented before the person realises that the demands of a particular situation are different in a safety critical way. The case study analysis highlighted a good example of this. David (Case 3) described feeding cattle in a shed and reversing in and out while neglecting to look behind. Generally speaking, when driving a tractor the farmer is looking ahead and therefore the automatic but inappropriate response to driving the tractor backwards is to look forwards *'You get so used to going in and out that you won't look back'*. This was perceived to be a major issue on cattle farms as feeding is a routine task carried out relatively frequently.

5.5.1.5 Safety Influences

The positive influence of peers, family and advisors on safety attitudes and practice is apparent. Those farmers that had alluded to an influence on their safety thinking or practices from their family were conscious of safety on the farm. The farmer's occupation is often inherited, with the farmer following in the fathers footsteps. The majority of farmer training for dealing with safety is gained through experience and informal observation (Knapp, 1966). Undoubtedly family, especially parents have an influence on a person's attitude and belief construction particularly in the formative years. Practically all learning can occur through observing the behaviour and consequences of other people's actions (Bandura, 1977). Two of the farmers considered their father to be important influences on their attitude to health and safety on the farm (1, 5). Both described their fathers as being very safety conscious and as a result this has impacted on their motivation to work safely. In case 1 the farmer was conscious that local farmers also identified his father as being safety conscious (1). In addition, the positive influence of health and safety information and practices from off-farm jobs or previous jobs was highlighted (7, 5). For others the impact of 'near misses', accidents in the locality and accident reports in the media clearly had an impact on their attitude to particular activities (2,4,6,7). They spoke about becoming more aware of hazards associated with different activities as a result of an injury or near miss. Very strong reactions were expressed to accident situations *'I will always be aware of that for the rest of my life'*, *'I suppose we copped ourselves on a small bit nearly at times'*, *'I've heard and seen so many accidents both locally and things that you read about that it is a big deal'*. One farmer (Case 1) highlighted that his advisor was particularly safety conscious and had encouraged him to complete a safety statement.

5.5.1.6 Children

Traditional farm culture has incorporated children into farming activities out of economic necessity and the desire to instil a work ethic in children (Tevis and Fink, 1989 as referred to by Aherin *et al*., 1992). The issues relating to child safety on the farm highlighted the differing levels to which children are involved in farm work and also how children's involvement in farming is managed. While the exclusion of children from the farming environment would eliminate the possibility of injury it would also deprive those children of involvement in a way of life that is highly valued by many. '*The line between farming as a way of life and as an industry blur where children are concerned*' (Aherin *et al*., p.6, 1992).

Only two of the farms visited were homes to young children (3,5), while five farms spoke of visiting children having access to the farmyard (1,2,7,8,9). On the remaining two farms, children were never present (4,6). There was general acknowledgement from the farmers that children need to be supervised while in the farmyard. In addition the safety of children while machinery is operating in the yard was addressed, children are perceived to be safer in tractors where they can be seen rather than down in the yard. However, one farmer gives visiting children tractor rides and allows them to use the back actor of his JCB while it is in a stationary position (7). Thus, these children are learning to use machinery for entertainment and enjoyment.

On those farms that were homes to children the approach to safety was managed differently. While one farm had an enclosed yard at the house (5), the other case had a farmyard, which ran into the back yard of the house (3). The ethos on this farm is one of including the children in the farm as much as possible as it is their home, now both young teenagers; they are allowed to drive tractors under supervision (1). This farmer highlighted the value of growing up on a farm, which many children do not have the opportunity to experience. Yet, this farmer gives the sense that there is a conflict between children's involvement in farming and the associated risks. He illustrates, however, that it is possible to integrate children and farming if safety is a priority and supervision is central.

5.5.1.7 Workload

Farming as an occupation provides variable workloads which are greatly influenced by the seasons. Work overloads occur at busy periods on the farm when work is heavy and labour units are low, while work underloads occur while carrying out repetitive, boring tasks and when working alone (Aherin, 1992). Leahy (2003) reported on labour use on suckler farms which was found to be lowest in December at 8.32 hours. Therefore at its lowest, labour input on suckler farms is similar to that of the average for all in the workforce. The case study analysis highlighted the different perceptions that exist among farmers of their own workloads. Most of the interviewees described their workload as steady (2,3,4,5,8,9). Two farmers described their workload as generally steady, however, with periods of pressure (5,9). However for two farmers their workload was not steady, one describing his as rushed (1), while the other described his as constant (6). Both of these farmers appeared to be good managers, working to some form of plan and both described themselves as stressed.

The three younger, large commercial farmers highlighted the issue of increased workloads, working hours and pressure in relation to their effect on health and safety (1,3,6). One likened farming to any other occupation in terms of a ‘rat race’, where farmers want more regular working days yet still need to complete all their work (6). In addition the speed at which operations are now required to be conducted on a farm and pushing the limits of man or machine were discussed in relation to their perceived effect on farm safety (1, 3). In most of the cases the farmers spoke of periods of pressure, which in tillage farming, for example, can last months rather than days or weeks.

Two of these farmer, however, described working long hours to get a job finished (2,8). One of these said that although he often works excessively long days, he also takes a lot of time off from farming (2), while the other described perhaps having to work until 9p.m. at night to finish a job due to the pace at which his health required he worked (8). Despite long and in some cases excessively long working days, these farmers considered their workloads steady. One of these farmers was past retirement age, was in poor health and often found himself working excessively long days in order to complete certain jobs. Given that over 27% of farms in the ROI are owned by farmers over 65 years of age (CSO, 2002), the case study example may be true for many farmers in Ireland. The issues surrounding workload and working hours are discussed in section 3.5.3. Workload has been identified as a factor affecting farmer stress (Weigel, 1980; Aherin *et al.*, 1992) and thus it is included as a risk factor inherent to the farmer which impacts on farm safety.

5.5.1.8 Stress

Farming is a very stressful occupation (section 3.3.6) and it has been suggested that stress is an important factor in many farm accidents (Aherin *et al*., 1992). Three of the farmers described themselves as being stressed (1,4,6). In addition to this two farmers described how certain situations create stress (5, 9). In the course of the interviews several issues, which served to increase pressure and add to stress, were raised by the farmers. The pressure exerted by the weather was expressed by four farmers who felt the dependence on fine weather created pressure to complete tasks (1,2,6,7). In addition, some felt that during calving season other farm activities become pressurised (6,5). Furthermore case five expressed that farming activities, particularly in springtime, exert severe pressure on the household and result in the couple 'juggling' the farm and the home. While, case one spoke of stress relating to trying to assert change while also trying to deal with interferences from neighbouring farmers. The range of stressors presented indicate that while macro stressors impact on farmers, during the course of the working day the farmer is confronted with micro level stressors which impact on the farmer at a particular point in time.

5.5.2 Physical working environment of the farm

The examination of the working environment of the farm highlighted the varied levels of safety in place on the farms. In addition to assessing the actual working environment, how farmers interact with their environment was discussed. Detailed discussion surrounding specific routines provided an insight into the dynamic which exists between the farmer and the work environment. From the case study discussions it appeared that the degree to which safety was considered on the farm was relative to the size and level of activity on the farm. The weight placed on farm size as a factor in the Farm Safety Risk Index is certainly justified. The larger farms had a greater level of activity and were typically more highly mechanised and consequently presented a higher level of risk which required consideration.

While the farms from the high risk category were found to have considered safety to a greater degree, unsafe practices were found on all farms. It was quite common to find practices that a farmer would not engage in due to the negative consequences experienced on the farm or by a farmer locally. However, other hazardous practices were engaged in, the effects of which were not perceived to be as severe.

5.5.2.1 Farmyard situation

Typical of the Irish farm, on seven of the case study farms the family home was situated on the same site as the main farmyard (1,2,3,5,7,8,9). Although on most there was a physical division, a wall or gate, between the farmyard and the house, two farms had no such division (3,8). All of the farms visited had separate farm entrances. There was also a degree of farm fragmentation found, with both yards and land situated away from the farmyard (1,2,3,5,6,7). In the ROI there is a great deal of farm fragmentation which has been identified as having a significant association with labour use (Leahy, 2003). This resulted in moving both machinery and animals on roads, often several miles away. All of the farmyards had evolved from a small farmyard with original stone buildings. Before any further development took place, plans were restricted by what was originally in existence. As many farmyards were designed in the past, they were designed with the needs of the system at that time in mind. The changes in labour supply on Irish farms in recent year's means that the current labour input can not effectively operate within the design without modification (Ruane and Phelan, 2003). In farm safety terms, the farm yard was the location of the highest proportion of accidents for most systems of farming (SHSIF). However, the high-risk farms (1,2,3) were found to have larger, more spacious well-planned yards than the farms in the other two categories. The farms were found to reflect a level of investment in farm infrastructure, which was relative to the size of the farm, with larger farms appearing to have invested considerably more than smaller farms.

'Housekeeping' in the context of health and safety refers to the everyday system of keeping the work place clean and free from danger. While housekeeping may appear trivial and unimportant and thus is often neglected, it plays a central role in maintaining a safe work environment. Poor housekeeping frequently results in accidents which are easily avoided such as trips and falls (Garavan, 1997). General tidiness of the farmyard was possibly the most striking aspect on arrival to a farm. While housekeeping was deemed paramount on two of the high risk farms (1,3), a third fell somewhat short of this standard (2). In addition, one of the low-risk category farms was found to be very tidy (7). With the exception of one, the remainder of the farmyards were reasonably tidy; however, they were not entirely clutter free. Housekeeping should become part of all employees working day and in that way it is not forgotten and enabled to get out of control (Garavan, 1997). While there was considerable variation in the level of development of yards in terms of concrete, one was found to be quite underdeveloped (5). This was well depicted in the photos. One farm was found to be very untidy and the farmer himself acknowledged that he was no longer able to maintain the level of tidiness desired (8). Overhead electric cables were an issue on three of the farmyards (2,4,5). While one farmer felt these cables should be buried (5) another felt strongly about the dangers of underground electric cables (2).

5.5.2.2 Farm buildings

The majority of sheds found on farms were relatively new and maintained in good condition and were fitted with sliding doors. Some farm buildings appeared, both outside and inside, to be excellently maintained (1,2,3). Safety should be a consideration when designing livestock housing and handling facilities. When housed there is always contact between the stock person and the animals and thus confined spaces present high potential for serious injury (HSA, 2001). Old stone sheds still served a function on some farms as both storage facilities (9,8,5,7) and also as isolation units for calving cows , housing sick animals or housing the bull (4,7,8,9). These sheds were typically small; they had small hanging doors and had some form of restraining mechanism such as a gate or a hook to tie up an animal. The use of these sheds as bull housing and calving facilities appeared wholly inappropriate.

Regarding cattle housing, three farms had a cubicle house with electric scrapers (2,4,9), while in addition all farms had some slatted sheds. On two farms the operator area inside the shed was somewhat obstructed. Animal pens were constructed in the operator area of one slatted shed (7) while another used the area as a storage facility (5). On three of the farms domestic type electrical installations were used in older sheds (5,7,9).

On the farms that had cause to access heights (1,2,6,3) three used a loader for accessing heights (1,6,3) as they felt it was more secure than using a ladder. Helmets were not worn while accessing heights, however, one farmer had a helmet but did not wear it as *'they just don't look the part'* (6). In addition to discussing the hazards of asbestos roofs (3) and Perspex sheeting (2), solutions to the dangers of light sheets were offered.

Workshop

A high level of safety in terms of layout and fittings can be achieved in farm workshops, especially when located in new farm buildings. However, many workshops are in older converted sheds and essentially compromise buildings (HSA, 2001). This was reflected in the case study findings. Two of the farms had a workshop where tools and implements were stored and machinery maintenance took place (1,3). Both observation and discussion revealed that safety was a priority in both of these sheds. Two of the medium risk category farms had tool stores (4,5), one of which was relatively tidy although storage was mostly at ground level (5). The other however was extremely disorganised and untidy and the farmer spoke of 'meaning' to tidy it (4).

Milking parlours

Of the four dairy farms visited, three had herringbone milking parlours (2,3,9) two of which had been constructed over twenty years ago and modified since to accommodate the growing herd (2,3). In each case the pit appeared comfortable and the pit access was not steep. However the fourth farm had an old tie stall parlour, which had not received any modification (4). In each of the accompanying dairies all of the belts on motors were covered and in one case the milking machine and motors were housed in a separate locked house to the dairy (3). Two of the farms had a cabinet in the dairy for storing chemicals and daily veterinary medicines (2,3), while in the others they were stored on the floor. Two of the dairies were always locked at night (3,4). All of the dairies were found to be very tidy and well organised.

5.5.2.3 Cattle crush facilities

Good cattle handling facilities are required on all livestock farms. Farmers are required by law to ensure that their facilities are safe for use by themselves, vets, AI and other technicians, Department of Agriculture and Food officials and inspectors (HSA, 2001). While all farms had a cattle crush in the main farmyard, one farm had a cattle crush on an out farm (2). Six of the farms were found to have very strong crush facilities, while two were found to have old and quite poor handling facilities (4,5). Because of the concerns of handling cattle in a crush, one of the farmers always has a pour-on of the dose he is using in the event that encounters difficulty (3). In addition to crush facilities four farms were found to have restraining gates for calving cows (2,6,7,9), while one farm used the cattle crush for restraining calving cows (5). One of these gates was purpose built and was very strong; it offered complete safety for calving a suckler cow or for a vet to examine a cow (6). On one farm isolation sheds with hooks to tie up animals acted as the restraining facility (4).

5.5.2.4 Slurry Storage

Working with slurry has been identified as particularly hazardous farm activity. Slurry facilities should be properly fenced and precautions should be taken when opening access points to tanks to avoid people falling through (HSA, 2001). Most of the slurry storage facilities viewed were below ground (3,4,5,7,8,9), however, on two farms there was both below ground storage and also an open slurry pit (2,6). Although on both farms a reasonable effort was made to secure the perimeter of the open pit, on one farm it was found to be poorly secured (2). The majority of farms had manhole access to their slurry tanks; however one farmer still had an access which required lifting a panel of four slats (9). Although this system had been present on other farms manhole access points replaced it. Animals were not always released from slatted sheds during slurry agitation (2, 7). In addition there were differences in the practices employed when opening manhole access points and not all points had safety grates below them.

5.5.3 Farm Technology

There are many machines used in production agriculture that are powered in different ways including PTO driveline shaft, electrical power, engine power, hydraulic oil pressure and ground traction. In some instances a machine may be powered by two or more methods. These machines provide a wide variety of hazards to which the farm worker is exposed during operation, maintenance, servicing, adjusting, oiling and cleaning and clearing (Murphy, 1992). In addition agricultural chemicals and stock are also recognised as farm technology as they also reflect the application of science to commercial objectives. While farmer and animal interactions provide both health and traumatic injury hazards, the array of farm chemicals including pesticides, fertilisers, oil products, sanitising agents and veterinary medicines pose as significant ill health hazards (Murphy, 1992).

5.5.3.1 Machinery

According to the HSA, 2001, the prevention of accidents with machinery and equipment should occur on the day of purchase. Section 16 of the Safety, Health and Welfare at Work Act 2005 places particular responsibilities on those that design, manufacture, import and supplier articles for use in the workplace. In addition, the user must be provided with adequate information on how to use the item correctly. '*If accidents are to be avoided the user of the farm machinery must keep in place all the guards provided with the machinery and must adhere to the safe work practices listed in the instruction manual'* (HSA, 2001, P.33)

As would be expected the level of mechanisation increased in proportion to the size of the farm. However, the high-risk dairy farm relied on contractors for key activities and kept less machinery than a farm of its size might suggest (2). In general terms, machinery on all farms were well maintained, however, there were instances of guards broken on PTO shafts (2,4) and missing U-Guards on tractors (4,7,9). Not all trailers used on the farms were found to have brakes and lights, however all cattle trailers had both (3,6,8,9). Two tractors were found to have no Roll Over Protective Structures (2,5); both were kept for the specific purpose of yard scraping. Although neither of these tractors was in roadworthy condition, one made short road trips several times a year (2). Three of the farms each had three reasonably new tractors, which were very well maintained (1,2,6), while two were found to have tractors dated to 1990 (1,7). Six of the farms had tractors which were at least twenty years old and maintained in proper working order (1,3,4,5,8,9). With the exception of the tractors without ROPS, all of the tractors were well maintained with lights, indicators and brakes working properly.

Machinery and tractor servicing was found to take place both on the farm (1,2,3,6,8), and by local mechanics (4,5,7,9). One farmer reported that machinery is not always repaired as soon as there is a problem (4). It was highlighted that regular servicing of machinery does not mean that there will not be problems when the machine is in use as most problems occur while the machine is operational (1,3,6). Two farmers discussed transporting machinery on public roads (1,6). In addition two of the farmers highlighted that it is important to know and respect the limits of agricultural machinery (1,6). Both of these farms have defined procedures for clearing blockages from machinery and do not rely on making a judgement based on the particular situation. In addition one stressed the importance of operator experience while working with machinery (6).

5.5.3.2 Carrying passengers on tractors

There is no safe place for passengers on tractors, with the exception of additional seats in cabs of new tractors, yet the practice is common. Passengers are often taken to save time, for convenience, to teach them how to drive and as a babysitting facility. While experts advocate against carrying passengers, other factors conflict with this advice (Murphy, 1992). Four of the farmers admitted to carrying passengers on tractors (3,4,6,7) while three said it is a practice they never engage in (5,8,9). In addition the danger and dread of carrying a passenger on drawbars was expressed (3), however for one farmer it was acceptable to carry his son on the drawbars (4). Attitudes towards carrying children on tractors varied with the practice found never to occur, children getting tractor rides for their pleasure and children being tied into the cab for safety reasons. Newer tractors were perceived to be safer for carrying passengers, especially children, in the cab (9) while also reducing the ability to carry passengers outside as the cab is sealed (3).

5.5.3.3 Spraying/ chemical use

Six of the farms had spraying machines. Most of those involved in spraying wore masks while spraying and while mixing chemicals (1,2,9,6,3). For some a mask was not entirely necessary as they were operating in a sealed cab or a cab with ventilation.

Two of the farmers admitted that they never wear gloves when handling chemicals or clearing blockages in nossels of the sprayer (3,7). One farmer described himself as careless with chemicals and feels his son is much more careful than he is (2). Methods of chemical storage varied substantially among the nine cases. One farmer had a locked chemical store, which had a warning sign on the door (1), while another has a locked store in the workshop (3). Other arrangements ranged from unlocked cabinets (2,9), locked sheds or unlocked sheds (4,5,6,7) to a redundant deep freeze (5).

5.5.3.4 PTO shafts

There are specific guarding requirements for PTO shafts (HSA, 2001), yet people are routinely injured, killed or experience lucky escapes from accidents involving PTO shafts. These accidents are frequently reported by both the national and farming media in Ireland.

PTO shafts were perceived to be dangerous on all farms and all interviewees said they were conscious of having them properly guarded, although one farmer believed it more important to have PTO shafts guarded when somebody from outside of the farm was using the machine (4). One interviewee admitted that his employee's attitude to guarded PTO shafts was the driver to ensuring that they are all covered (3). For most the 'dread' of coming in contact with an unguarded shaft was sufficient to ensure that they are guarded. Two of the farmers aimed not to break the original guards on the PTO shafts (1,7) and felt that the original guard can often see the machine out. The quality and cost of guards was questioned by one farmer who felt that although they should be compulsory, dealers should not be allowed to sell them at such high prices (2). Despite describing themselves as being very conscious of having PTO shafts guarded, two of the farmers have PTO's which were not properly guarded (2,4).

5.5.3.5 PPE

Personal Protective Equipment is worn by farmers as a last resort, if possible safer products and working conditions should be pursued (HSA, 2001). The use of PPE on the farm feature throughout the discussions and in general it was in relation to particular situations. Behaviours and attitudes varied significantly according to the different types of PPE discussed. The most unacceptable item discussed was the use of a safety helmet for accessing heights. One farmer, who regularly had reason to work on a height, admitted to having two helmets neither of which he wore as they did not look the part. Other items such as coveralls were identified as being impractical and uncomfortable while gloves in certain circumstances were found to be cumbersome. In one case the farmer raised important issues in relation to the use of hearing protection. Often in cases where protection is required, it is necessary for the operator to be able to hear the machine e.g. the sound of bearings slipping. In addition, the use of hearing protection can create a disconnect between the operator and his environment and thus he is less aware of other hazards such as moving machinery in the farm yard.

5.5.3.6 Stock

Only one of the case study farms had no stock present on the farm, this was the large tillage farm. Through the discussions however, it became clear that safety issues are a reality when dealing with all types of stock. One farmer spoke of being more afraid of his ram than his bull. In relation to working with cattle, two very distinct opinions were presented by two of the younger farmers. While one farmer aimed to minimise the amount of work he would do with an animal in a day, i.e. when he had brought the animals into the yard, the other farmer tried too do as much as he could as it was difficult to get the animals in. The first farmer feels that it is important not to try to do too much with animals at one time as this stresses them. To minimise stress he usually had a pour dose for any difficult animals.

Two highlighted their awareness of the temper of suckler cows at calving time and after calving. Four of the farmers had restraining gates for calving cows, which varied quite significantly in strength and protection offered to the operator.

Five of the farms had a bull at the time of the researchers visit while one usually had a bull but had not at the time of interview. On three of the farms that had a bull it was ringed while no farms had chains on bulls or bull pole for handling. The two farmers that did not have rings on their bulls did not entirely agree with the practice, while one felt it was cruel the other thought it did not look good. All of the farmers spoke about being conscious of the bull; however two of the farmers described their bull as being quiet. One farmer felt quite vulnerable because of his age and limited mobility and thus always herded the cattle and bull from his Land Rover.

Generally bulls were found to be over wintered on slats, however one farmer had an old farm shed which was used for over wintering the bull. This shed appeared far from ideal as there was no protective barrier between the farmer and the bull for bedding and feeding. On one farm the bull was out wintered as the farmer believes housing bulls makes them more aggressive.

5.5.4 Factors having an indirect influence on farm safety

In the course of the interviews the effect of work scheduling and additional labour was discussed with the farmers. The impact of these four factors on their work was described.

5.5.4.1 Work scheduling

Glasscock *et al*, 1997 proposes that in order to manage farmer stress as it affects farm accidents, tasks should be planned in order to manage time and labour effectively. Most of the case study farmers said they always have an informal schedule, however, it is never written down (1,3,5,7,8,9). For one farmer scheduling of tasks was viewed as being very important as it allows him to deal with unforeseen circumstances (3). While in one case the farmer described himself as working to a rough schedule (2), another said he did not schedule tasks at all (4). One farmer has a rough weekly plan, which allows for interruptions (6). Although all but one farmer was involved in informal work scheduling, none had a written schedule of activities, which could be referred to in the event of unforeseen circumstances arising.

5.5.4.2 Labour

All of the farmers interviewed required additional labour at certain times of the year or when undertaking certain farm tasks. Although some had formal arrangements in the form of a full time labourer (3), or seasonal labourers (1,6), others relied on help from family or neighbours (3,5,7,8,9). On one farm the wife was very involved in the farm work (5) and a further three of the cases relied on a labour input from their wife (2,3,8). In one case both the farmer and his brother were full time employed on the farm (6). Eight of the interviewees are full time employed on their farms. Although being described as a part-time farmer, one farmer explained that in addition to his farm work he is full-time employed outside of the farm (7).

5.5.5 Conclusion

While the interaction of man and his working environment provide the context for the occurrence of occupational accidents, the case study findings illustrate the complexity of this interaction. According to the HSE (2001) successful organisations generally excel in health and safety as the skills and expertise that make the business itself a success are also employed in making health and safety in the organisation successful. This was quite clearly illustrated from the case studies in that farms where general farm management appeared to be good, the management of safety too was good.

While all farms ascribed an importance to health and safety as part of their work on the farm, this was clearly not translated into actions on the ground. A number of complex 'farmer' factors were explored in the research and the results are very interesting. By and large these farmers knew and understood the hazards present on their farms and the risk associated with these hazards. However, in many instances the farmers engaged in the risk, often to save time, because they always do it and have never gotten caught and often out of habit. In addition, where PPE could be used to eliminate or minimise the risk of the hazard farmers chose not to use them. Again as before, they understand the risks and the benefits of using the PPE.

Various aspects of the working environment were found to be hazardous by the researcher and in most cases the farmer also recognised the hazard. However, in relation to cattle handling facilities, farmers were working with restraining mechanisms (crushes, restraining gates) that were weak, badly rusted to the point of rotting and where the farmer was required to operate in a position that compromised his/her safety. The researcher found that none of these farmers truly appreciated the hazardous nature of these facilities; this fundamental lack of awareness was not found in relation to any other issue during the course of the case study research.

With the exception of two farmers, the remainder of those interviewed had inherited working environments which had inherent safety problems due to layout and design of structures that had not been improved. Obviously many factors impacted on the development of the actual facilities on these farms but one farmer begged the pertinent question *'How did we get it so wrong?'*. In reality development on farms was restricted in many ways. Many of today's problems were great solutions of the past, open slurry pit storage and asbestos roofs being two that were discussed in the interviews. While once innovations that were grant aided on farms, they are now hazards in the working environment which do require significant investment to resolve.

While all of the factors discussed above independently have an impact on health and safety on the farm, as Murphy (1992) discussed there is a synergistic effect of these factors of farm safety.

The use of the categorisation of farms according to high risk, medium risk and low risk requires some final comment. While those farms that were identified and determined to be high risk were in fact found to be so, in the main the approach to risk and the management practices employed on these farms served to minimise the level of risk present in the farm environment. Indeed, while some farms were categorised as low risk they did in fact have quite a high level of risk in the environment. Factors such as older technology and buildings, less defined protocols and a less structured management approach served to increase the risk in environments, which logically would be determined as low risk. It is evident from this analysis that risk determination is very much dependent on specific factors in individual farm environments.

CHAPTER 6

A MODEL OF HEALTH AND SAFETY IN FARMING: THE FARM SAFETY TRICHOTOMY

6.1 Introduction

The results of the Survey of Health and Safety on Irish Farms and the case study research provided an insight into the factors which influence the safety of Irish farms. Many models in safety research are constructed to represent the process of accident occurrence and thus present options for prevention (chapter 2). These models focus on the genesis of accident occurrence. However, few models examine the factors that generate risk in a particular environment. It is necessary to understand how unsafe behaviours, environments and social structures are created and how they can be changed to the better (Svanström, 1999). Accident statistics do not provide a true reflection of the real status of occupational accident risk. It is necessary to develop ways of recording the information which provides an accurate understanding of the manner through which individual workplaces are made dangerous (Dunne, 2000). The lack of knowledge that exists in relation to risk factors associated with farm injuries has long been identified as an impediment to prevention efforts (Layde, 1990). The following model has been designed from the findings of the literature review, quantitative and qualitative studies to provide a context in which health and safety exits on farms.

The research has identified factors at three levels: person, environment and technology, which interact to determine the status of health and safety on farms. At each level of the research individual factors have been identified and discussed which form the principle components of the farm safety trichotomy. This model platforms the status of health and safety on Irish farms, while also providing the context for analysing, interpreting, manipulating and improving farm safety into the future.

The objective of this chapter is to:

- Design a model that defines the context in which heath and safety exists on farms.

The case study findings defined the important and independent role that technology plays in health and safety on farms. The challenges and stressors presented by technology in the case study findings identified the need for technology to be portrayed as a separate entity to the farm environment. The findings of the literature review did not platform technology as a pivotal element of the health and safety dynamic on farms. Technology was portrayed as a function of the farm environment. However, the case study findings show that farm technology interacts with both person and environmental factors. Technology differs significantly between farms. The compatibility of technology to both person and environmental components has the potential to positively or negatively impact on farm health and safety. Going forward technology will be represented independent of farm environment. The factors that comprise technology will be outlined and the dynamics of the relationship to person and environment factors explored.

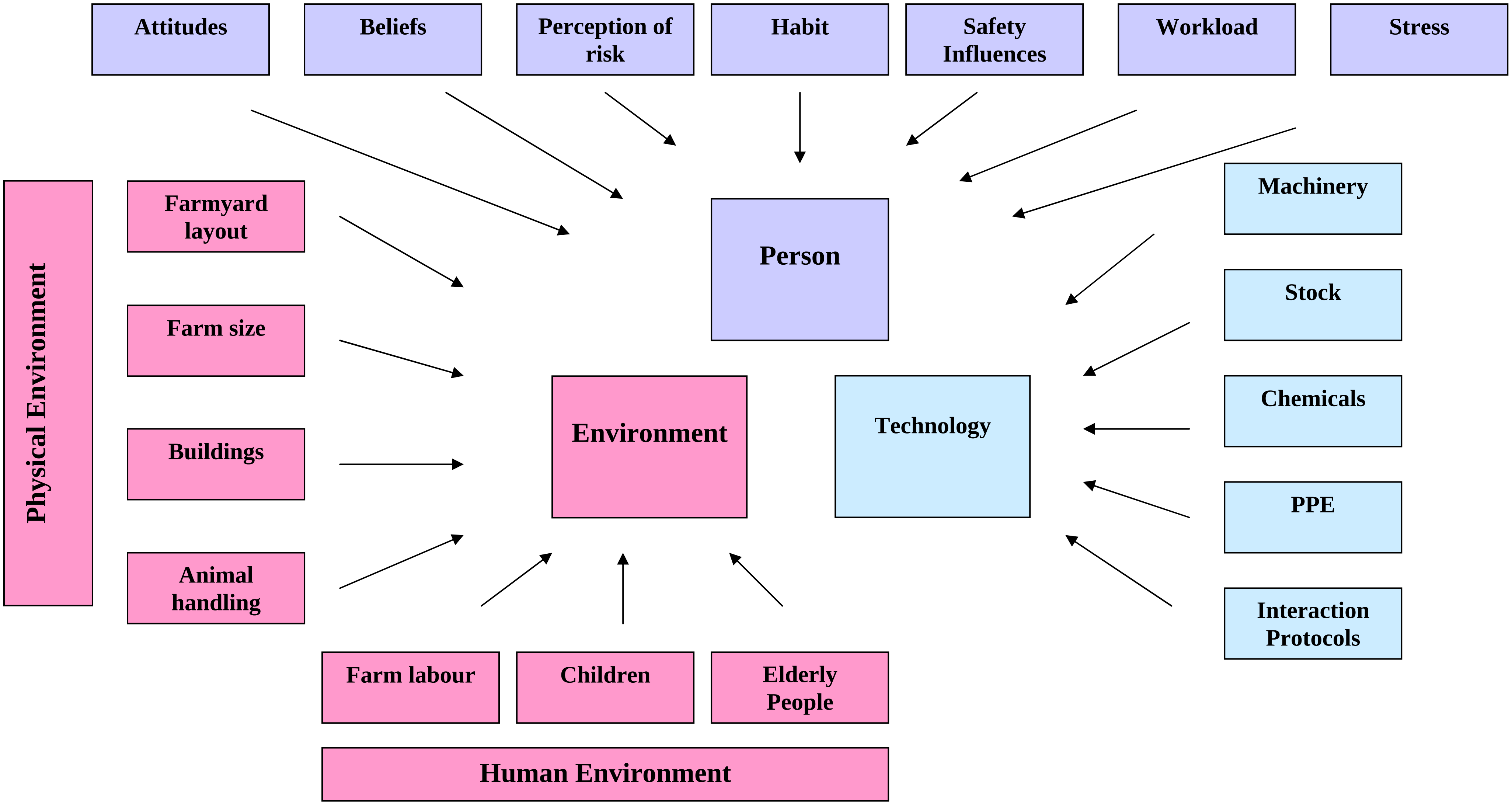


Figure 6.1: Factors identified as having an influence on farm health and safety

Figure 6.1 illustrates the three components: person, environment and technology, which have been identified as the fundamental components of the farm safety trichotomy. Further, figure 6.1 illustrates the individual factors which are the constituents of the three components. The environment component in the model has been divided into physical and human environment. Figure 6.2 illustrates the farm safety trichotomy which has been distilled from the above.

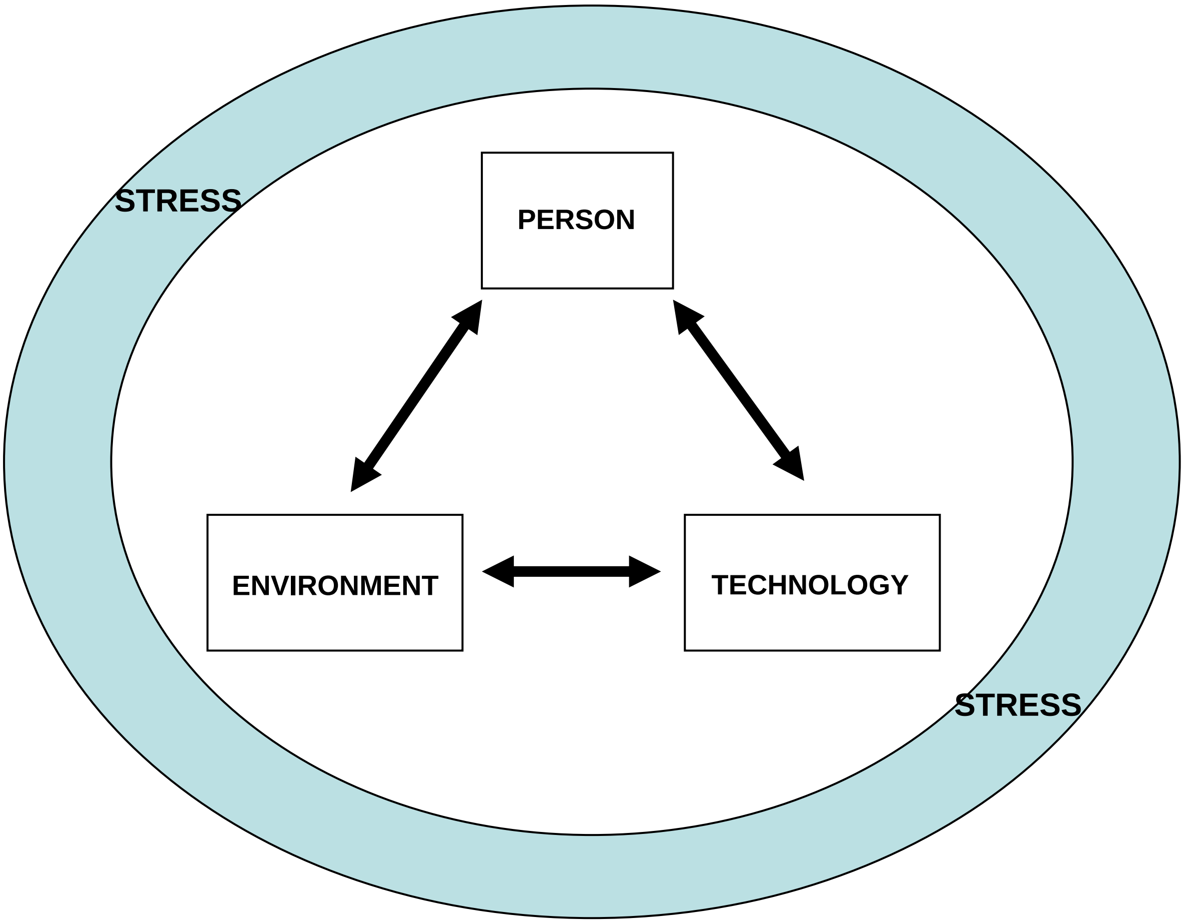


Figure 6.2: Farm Safety Trichotomy

6.2 Evolution of the model

The trichotomous model illustrates the dynamic relationship, which exists between the person, environment and technology characteristics of farming. From the literature review, the SHSIF and the case study research key person, environment and technology factors were identified as having an influence on farm health and safety. The model evolved in three stages.

From a thorough review of the health and safety literature, a conceptual framework was developed. Glasscock *et al*., 1997 developed a model of farm accidents, which assumed that risk situations arise as a function of both person and environmental factors. Glasscock's model reflects the overriding opinion from literature that person and environment are the principle components of farm health and safety. The literature review identified both the person and environment characteristics of farming which have an impact on health and safety. In addition, both the injury characteristics and the factors associated with injury risk related to either the person or the environment were identified (Chapter 3). Additionally, proactive strategies and prevention strategies are defined as either safe place strategies or safe person strategies (Section 2.4.2) as they act on the fundamental elements which give rise to accidents. Thus, person and environment were identified as the fundamental components of a farm health and safety model. This dichotomous model was applied to the design and analysis of the Survey of Health and Safety on Irish Farms in chapter 4. The case study research further pursued the relationship between person and environment characteristics as they apply to farming. The study sought to establish the reality of this relationship, how both components interact and the implications of this interaction for management. Dunne (2001) asserts that official accident enquires illustrate that the majority occur in the context of personal and interpersonal, technological and organisational situations in the workplace. In the case study research a clear distinction emerged between technology and environment components of health and safety. The analysis distinguished between the working environment and the technology that is employed in the environment. In this sense, technology was defined as the application of science to industrial or commercial objectives and thus included machinery, livestock, and chemicals. In addition, a distinction was made between the human and physical constituents of environment. The case study analysis clearly identified that person, environment and technology characteristics are discrete components of farm health and safety, each containing factors which interact during the course of farm work. It is within these interactions that the negative effects of individual factors result in negative safety outcomes and the positive effects ensure that activities are pursued without any negative consequences.

The model depicts the health and safety trichotomy in an environment in which stress is inherent. While stress was identified as an important person characteristic, it has been separated from the trichotomy as a result of the complexity of its interaction within the model. This is further discussed in section 6.3.4.

6.3 Model components

The following section examines each of the components of the farm safety trichotomy in detail.

6.3.1 Person

Person characteristics are identified as fundamental elements of the farm safety trichotomy. As discussed previously, person is comprised of the person factors which bear an influence on health and safety. It does not relate to the human presence implicit in health and safety. The literature review established that person characteristics interact with other mechanisms upstream (pre-accident) and result in harmful consequence to the human factor downstream (post-accident). Interaction can take place between characteristics of person and environment or person and technology, or between person and an environment/technology interaction. If interactions result in negative outcomes they can potentially cause harm or loss to the human factor.

The perceptions, attitudes and beliefs held by people have a significant impact on health and safety. While this was established in the literature review (chapter 3), crucial contradictions were observed and analysed (chapter 4). Farmers evaluate the danger on their own farms based on whether they experienced an accident or not. Risk perception at farm level is based on accident occurrence. Both the SHSIF and the case study research and the supporting literature indicate that farmers in general do not perceive that their occupation is dangerous. This was epitomised in the case study research by a farmer who had sustained three serious injuries resulting from three separate accidents asking the researcher if she was afraid to drive her car because of the associated accident rate. According to Dunne, 2000, P.30, *'Awareness of risk is the crucial factor in improving safety at work'*.

Socialisation into the working environment emerged as an important factor in the case study findings. This exhibited the importance of the persons learned experience which was discussed in (chapter 3). *His* (man's) *evaluation of what is safe and how safe is safe enough is governed by the cultural influences to which he was exposed during his formative years, influences that further shape the deeper causative factors implicit within his unsafe behaviour*' (Cooper and Germain, 1974, P. 23)

The case study findings illustrated the impact of safety socialisation in the workplace. Two participants had been positively influenced, in safety terms, by their father during their formative years. In one case the safety socialisation took place before the individual began working on the farm; the relevant knowledge and skills were acquired while working with her father in a non-farming environment, however, this process had an effect on her farm work at a later stage. One of the principle effects of positive safety socialisation in the workplace is that people have an awareness of risk and when they may be in danger. In accident prevention terms, Dunne (2000) advises that it is futile to expect people to react to exhortations about behaving safely because they simply do not believe they are in any danger. Safety socialisation in farming is an extremely important person factor.

The percentage of time spent farming has been associated with farm injury risk and is represented as workload in the person characteristics (chapter 3). The case study analysis highlighted the different perceptions that exist among farmers of their own workloads. The farmers spoke of periods of pressure, which in tillage farming, for example, can last up to two months. Farming as an occupation provides variable workloads which are greatly influenced by the seasons. Work overloads occur at busy periods on the farm when work is heavy and labour units are low, while work underloads occur while carrying out repetitive, boring tasks and when working alone (Aherin, 1992). Leahy (2003) reported on labour use on suckler farms which was found to be lowest in December at 8.32 hours. Therefore at its lowest, labour input on suckler farms is similar to that of the average for all in the workforce. Age also has a bearing on workload. Many farmers that continue to farm beyond retirement age are trying to maintain the level of work which they had previously engaged in. The case study analysis highlighted that case of an aging farmer in poor health that who often found himself working excessively long days in order to complete certain jobs. Given that over 27% of farms in the ROI are owned by farmers over 65 years of age (CSO, 2002). It is likely that this is not an isolated case.

6.3.2 Environment

The environment represents the actual workplace or the farm. The work environment refers to a concept broader than just the farmyard. It represents both the physical and human environment. The physical environment represents the built environment and the structural elements of the farm. The human environment represents the people that are present, at any time, in the farm environment.

Farm work takes place at locations other than farmyards, which include fields, homes, public roads and forested lands. In addition, not all work that takes place on farm is indeed production agriculture work. The farm is a site where contracted agricultural service, veterinary, mechanical and contract builder activities take place in addition to many activities relating to the home (Murphy, 1992). The case study findings illustrated the level of integration that exists on some farms between the home and the farm, which have no physical division in some cases. Environmental characteristics were identified in the literature as being associated with an increased level of risk on the farm (chapter 3). Many characteristics of the farm have been identified as being critical to health and safety management. Both the size and system of the farm were found to be significantly associated with injury on Irish farms (chapter 4) in addition the site and farm layout and farm facilities were identified as factors impacting on farm safety (chapter 5).

The size of the farm unit certainly has an impact on safety and health issues (McNamara *et* al, 1997; Zhou and Roseman, 1994). Farm size is proportionately associated to the level of risk on the farm (chapter 3, chapter 4). Larger farms are higher risk environments. Accident risk is largely determined by the types of work activity (Rasmussen *et al*., 2000). The size of the farm will inevitably determine the level of a particular work activity. Farm size also impacts on the level of farm technology. The case study research suggests that farmers and employees on larger farms do indeed have a greater exposure to risk in their work environment. However, that is not to say that smaller farms are without risk. A similar situation to that presented by Murphy (1992) was observed in the case studies in that smaller farms were frequently working with older technology, in an older environment which was sometimes less well maintained than that of larger farms. In addition, they may have a limited budget for farm improvements and often have a lower level of management skills.

According to the reviewed literature, the system of farming is associated with farm safety. While specialist dairy farms experience the highest proportion of injuries in Irish farming (chapter 4, McNamara & Reidy, 1997), tillage farms have a significantly higher incidence of injury than other systems (chapter 4). In addition, safety issues differ for the individual systems according to the seasonal requirements of the particular system (chapter 4). Undoubtedly, system of farming has a bearing on health and safety. However, it is important to emphasise that while there appears to be higher levels of risk on certain types of farms, no system of farming is without risk. Traditionally, farms in the ROI have developed on the same site as the family dwelling. In many cases there is no structural boundary between the family home and the farm. In other words there is nothing physically restricting the movement of people between the working environment and the home. Clear differences in farmyard situation were reflected in the case study research. In addition, single entrances serving both the house and farm yard remain common.

In Ireland farmyard development has commonly been restricted by the site and layout of the original farmyard. However, in the case study research one farmer spoke of the mistakes made in farmyard design given that he had started with a green field site. The case studies profiled the differences that exist in layout and size of farmyard in the ROI. Large farms were found to have large spacious farmyards, while the smaller farms had smaller yards with noticeably less planning (chapter 5). As many farmyards were designed in the past, they were designed with the needs of the system at that time in mind. The changes in labour supply on Irish farms in recent year's means that the current labour input often can not effectively operate within the design without modification (Ruane and Phelan, 2003). The highest proportion of injuries was sustained in the farmyard (chapter 4). This is consistent with findings from other research (chapter 3).

In the ROI there is a great deal of farm fragmentation which has been identified as having a significant association with labour use (Leahy, 2003). Farm fragmentation has implications for safety as machinery and animals are moved along public roads (chapter 5). In addition, specific locations on the farm were associated with a higher incidence of injury (chapter 3 & chapter 4) while time of injury occurrence was associated with farming system (chapter 4). The case study findings brought to the fore the variation that exists in the standard of the physical working environment on different farms (chapter 5). These standards may be the difference between an accident occurring or not and in the event that it did, resulting in injury or not.

The case study findings reflected the mix of both old and new buildings which exist in Irish farmyards. The older buildings were all significantly smaller than the new structures and generally had smaller entrances. All of the older farm buildings were found to serve a purpose on the farm. In some cases the facility was less than ideal for its current purpose. An example of this was a small shed which was used for housing the bull. The shed had one small entrance that led the operator directly into the bull pen. In some cases modification of farm structures were seen to be very successful and aimed to provide ease of operation for the farmer, others however appeared to have the sole purpose of providing capacity through minimum investment. In addition, workshops were more often found in small dark sheds as opposed to large bright well-fitted sheds on other farms.

Other structures such as open slurry pits, silos, silage pits and cattle handling facilities present challenges for farm safety. While other countries opted for above storage of farm manure in the past, Ireland used open slurry pits for the storage of farmyard manure. These storage facilities are still widely used throughout the country and some are still found to have inadequate or no perimeter fencing. However, slurry storage improvements were the principal safety changes implemented on farms (chapter 4).

The case study findings also reflected the variation which exists in the quality of animal handling facilities which are present on Irish farms. Crush and isolation facilities were found in some instances to be very strong and offered ease and safety of operation for the farmer. However, others were found to have crush facilities in which the upright bars were severely rusted, lacking a catwalk and required the operator to work from within the holding yard.

The human environment encompasses farm labour – including the principal operator, children, elderly people and others outside of the farm family who have reason to be present in the farm environment. Farm labour is undoubtedly the most significant presence in the farm environment in terms of time spent. However, it is evident from the literature and statistics that there are significant health and safety concerns for other people outside of this category, principally children and elderly people. While other groups of people emerged during the course of the case study research, they were not studied to same the degree as those central to the farm environment and are thus not included in this discussion.

Children are involved in the working activities of the farm for many reasons. According to Murphy (1992) farming parents face difficult child safety issues such as, children working on the farm because of economic necessity, parents wish to instil a sense of responsibility and work ethic, lack of childcare facilities and a cultural tradition which sees the farmyard as a giant playground for children. The obvious solution to childhood injury on the farm is to eliminate children from the farmyard altogether and thus eliminating the possibility of injury. However, in many instances the lack of a distinction between the home and the farmyard results in children not only being injured while working on the farm but frequently while playing on the farm. The results of the SHSIF show that almost one third of the respondent farms did not restrict children from certain areas of the farm yard. In addition, on certain farms children were permitted to engage in hazardous activities. The case study research clearly exhibited the value and importance placed on children participating in farm activities by farm families. Supervision and assigning age appropriate tasks were highlighted as the key management tools for integrating children into farming activities. Positive socialisation into the farm workplace is an important determining factor in farmer safety behaviour into the future.

In addition, both the literature and the case study findings illustrated the risk associated with elderly people in the farm environment. The physical limitations of the ageing process were detailed in the case study analysis – a clear conflict emerged for elderly farmers who wish to continue farming yet they are physically restricted. In addition, another case detailed the conflict which emerges for families when an older family member is experiencing dementia yet is still physically fit to engage in farming activities.

6.3.3 Technology

No distinction was made between the environment and technology in the literature or the accident models reviewed. However, the case study findings reflected a distinction between the environment and other components of the farm, such as machinery, chemicals and livestock, which have an impact on farm health and safety. These elements have been collectively grouped as technology for the purpose of the model. The use and application of these technologies in contemporary agriculture is guided and driven by science in an attempt to yield economic returns. The farm environment is one that has become progressively more technologically intensive and will continue to do so into the future. Technology was differentiated from the environment after the case study analysis as the importance of equipment, chemicals and livestock as factors in farm health and safety became more apparent. These technologies give rise to risk on the farm, which could be managed through environment or person interactions. These risks may be contingent on environment factors but not always and are in many cases they are inherent to the technology.

There are a multitude of machines used in farming which are powered in numerous different ways such as PTO drive shaft, hydraulic oil pressure, electrical power, engine power and ground traction. In some cases components of one machine may be powered by two or more methods. Interactions between animals and farmers provide the opportunities for both health and injury hazards to the person. While the variety of chemicals used in agriculture are frequent farm hazards (Murphy, 1992).

The SHSIF presented alarming findings in that on almost 29% of the respondent farms not all PTO shafts which were in use on the farm were properly guarded. Less than half of the respondents had the brakes on their tractors checked at least once a year while almost 20% did not check the lights on tractors before each winter. The case study analysis provided different perspectives on machinery maintenance. Machinery is not always repaired as soon as a problem becomes apparent, often tasks are completed and the machine returned to its shed without being adequately repaired. However, regular servicing of machinery does not guarantee that there will not be problems when the machine is operational. Ensuring that all maintenance and repair work is carried out, one farmer keeps a machinery logbook into which problems are recorded and crossed off when repair work is completed. When working with machinery that is required to intake, pull, chop, grind and mix material, blockages and stoppages are not uncommon. Often when people are required interact with machines to clear a blockage or thread a bailer it is at busy pressurized periods. So do machine interaction protocols exist in farming? Do farmers simply rely on circumstances of a particular situation to determine how they interact with the machine? In the course of the case study research two farmers spoke of defined procedures for interacting in this way with farm machinery. In one case, the procedure is so clear that before entering the body of the combine harvester the person who enters put the keys into their own pocket. In this situation, the worst that can happen is that the key can be mislaid!

Many traumatic injuries, ranging from minor injuries to fatalities occur during the routine handling of animals on the farm (Murphy, 1992). The more cause there is for interacting with animals, the greater the risk of injury. The larger the animal the greater the likelihood of injury and the greater the severity of injury. Certain animals such as bulls and recently calved cows are by their nature more aggressive than others. At the outset, animal interaction, similar to machinery interaction requires a defined protocol at farm level.

6.3.4 Stress

The case study findings indicate that stress is a person factor that has an impact on health and safety. However, the literature suggests that while stress impacts on work activities, the working environment and associated activities may in fact have an impact on stress. Recent research found that in addition to safety behaviour, stressors and stress symptoms were found to be good predictors of farm work related injury (Glasscock, 1999; Thu *et al.,* 1997). In addition, the most important stressor in this regard is perceived economic problems (Glasscock, 1999). Research on farm stress in

America has consistently found that difficult financial conditions are the primary source of stress experienced by farmers and farm families (Simpson *et al*, 2004; Thu *et al*, 1997).

The relationship between stress and injury is complex in its very nature. Glasscock, 1999 has proposed two different mechanisms through which stressors can lead to accidents. Deliberate unsafe acts characterized by risk taking can result from a single stressor, time pressure, for example. In this situation the stress is not of the magnitude that results in reduced capabilities, however, reduced cognitive abilities or errors can also increase risk and give rise to accidents through this mechanism. In addition, stressful working conditions may result in increased injury risk for those that are not themselves stressed. Neglecting safety rules or failing to tidy up in a stressful work environment causes hazards for others (Galsscock, 1999).

In terms of the dynamic that exists between the farmer, environment and farm technology the farm safety trichotomy illustrates the interaction between this dynamic and stress. Similar to the above mechanisms discussed by Glasscock, the case study findings reflected the presence of both single stressors and those impacting on chronic stress levels on Irish farms. Weather, time pressure and machine breakdowns are single stressors which have an affect on the person, environment and farm technology trichotomy and consequently impact on stress and risk taking. Other stressors such as financial worries, family pressures and business management pressures do not necessarily occur within the safety trichotomy, yet over time they may have an effect on cognitive abilities. Thus stress is found to have a reciprocal relationship to the interactions within the safety trichotomy. This relationship has a significant impact on farm safety. Similar to man, machines too have limits. And like man often the workload of a machine may be stretching the machine to the limits of its capabilities. In the case study research, on two machinery intensive farms the farmers spoke of knowing and respecting the limits of agricultural machinery.

6.4 Model interaction

The safety trichotomy provides the context for analysing, interpreting, manipulating and improving health and safety on Irish farms. Within each component of the trichotomy there are factors that exert an influence on each other and on the other model components.

The most significant interactions are the person – environment interaction and the person – technology interaction. Person factors such as attitudes, beliefs, safety socialisation and perception of risk influence how humans interact with the working environment and the farm technology. In addition, the interaction between environment and person, and technology and person characteristics impact on the attitudes, perception and beliefs of the farmer. These interactions impact on the schema or working model, which the farmer builds up relating to specific jobs (Dunne, 2000).

Interactions between technology and the farm environment influence safety on the farm and lead to increased risk in the environment. These interactions may involve person factors.

The trichotomy interactions have a reciprocal relationship to stress. The interactions between factors in the trichotomy as shown above exert an influence on stress and similarly stress can exert an influence on these interactions.

6.5 Moderating the interactions within the safety trichotomy

From the research it emerged that management plays a central role in influencing the characteristics of each component of the trichotomy and moderating the interactions between the components. The stages of farm management have been discussed earlier (chapter 2), and clear similarities were identified between these and the elements of successful health and safety management. According to Häkkinen, 1978 as refereed by Suutarinen, 2004, hazards must be examined as factors of the production system; they are not isolated factors. In addition, Reason, 1997, states that management and other underlying injury risk factors in production are concealed in supposed latent, general failures.

Numerous injury risk factors were identified on the individual farms in the case study analysis, which on examination reflect more than just a hazard. General housekeeping on the farms varied quite significantly, with one in particular being quite untidy. The level of planning engaged in by farmers was apparent from the interviews. On one farm in particular, planning and monitoring appeared to be fundamental to all the business functions, including safety management. However, in other cases the impression that general management appeared wanton at times was very strong and this was true for safety management on the farm. The case study analysis indicates that safety management on the farm is a function of farm management and the farmer's ability to manage successfully. It appeared that where the skills were present to allow for successful management of the farm business they were also applied to the management of safety.

Literature implies that although safety is a function of management, farmers do not have the skills required to adequately manage health and safety on their farms. However, the skills that are required for the successful management of health and safety are no different to those required for successful farm management. When safety is part of a groups norms and culture, irrespective of individual tendencies toward risk taking, individuals will be more likely to conform and work safely (Dunne, 2001). According to Lindsay, 1992 the creation of a positive safety culture helps achieve high safety standards. Traditionally farming in Ireland has not had a positive safety culture and thus safety was not identified as an important and rewarding element of farm management. However, from the case study analysis it is clear that there are farmers that identify safety as an integral element of farm management which does add to a successful farm business.

Management acts as a moderator of the safety environment. Effective safety management practices impact positively on safety. Overwhelming, management has the ability to impact either positively or negatively on the interactions within the safety trichotomy and as such impact on safety and health outcomes on the farm.

6.6 Conclusion

The health and safety trichotomy presents the components which interact on a daily basis on Irish farms from which accidents can potentially result. Health and safety has not been traditionally part of the norms and culture of Irish farming. The case study findings suggest that certain farmers, particularly younger farmers, with large commercial operations have recognized the importance of safety in their working life. These farmers are goal orientated; they want a good quality of life that is free from injury or ill-ness. Thus certain farmers have begun to assimilate safety into their general farm management. For others however, safety is viewed as a peripheral issue that is distinct from farm management issues. In this situation farm safety is in danger of becoming a 'paper shuffling exercise' in which farmers will aim to meet their legal requirements and no more. According to Dunne (2001) this situation does real harm to the cause of working safely. People that complete audit documents and 'shelve them' and hear no more about it soon develop a cynical attitude and will act accordingly. Farmers must be encouraged and motivated to do more than complete farm safety assessment documents. A more holistic approach to farm management which situates farm safety on the same level as activities such as farm financial planning and production management should be aspired to by farmers, farm representatives, extension agents, educators, researchers and policy makers.

CHAPTER 7
DISCUSSION AND CONCLUSION

7.1 Introduction

This chapter presents a summary of the main findings of the literature review. The Survey of Health and Safety on Irish Farms and the case study research. In addition, the chapter discusses the implications of the research.

7.2 Purpose of study

This thesis set out to assess the status of occupational health and safety on Irish farms and subsequently to provide the level of understanding of this area that is required for intervention activities.

The rationale behind this study was that there was an absence of up to date comprehensive accident and injury statistics pertaining to Irish farming. This gave rise to a reliance on fatality statistics as a benchmark of the safety status of Irish farms. Further, the Irish research previously undertaken focussed predominantly on the incidence of accident and ill health occurrence on Irish farms, which provided little understanding of the safety dynamic on farms.

Ultimately the research sought to provide an understanding of all of the factors related to health and safety on farms in an attempt to provide meaningful insights that would serve the cause of injury prevention and safety promotion in the farming community in Ireland.

7.3 Summary of Methodology

Initially a comprehensive review of health and safety literature was undertaken. The literature provided an understanding of the terminology, models and structures employed in the study of workplace health and safety and provided an understanding of farm health and safety, accident and injury. Subsequently, a quantative study was designed to determine the level of injury occurring on Irish farms and to gain a better understanding of the person and environment components of safety on Irish farms. This study was designed based on the model used in two previous Irish studies that examined the incidence and nature of accidents on farms. This research involved a survey which was administered by trained recorders on 1119 Irish farms. The survey population was weighted to be representative of all Irish farms.

The second phase of the research employed a qualitative methodological approach, which consisted of nine case study interviews that incorporated a farm walk through. These farms represented high risk, medium risk and low risk farms as determined by a risk index. This study sought to examine the reality of health and safety on Irish farm and how safety is incorporated into day to day farming activities.

The final stage of this research is the construction of a farm health and safety trichotomy model which provides the context in which health and safety exists on Irish farms. The model has three components and illustrates the significance of stress in the farm environment on farm health and safety. The model illustrates the interaction between person, environment and technology characteristics on the farm.

7.4 Main findings of the research

This research has identified the factors and conditions at farm level which give rise to risk and ultimately accidents and injury on Irish farms. This has been detailed in the farm health and safety trichotomy in chapter 6 of this thesis. The model provides an understanding of the dynamics that are involved in creating unsafe working conditions on Irish farms. As such, it provides the insight required for the development of both farm level and industry level farm safety interventions. Constructed using the findings of the literature review, quantitative and qualitative analysis, the model explores the interaction of different factors and the consequent safety implications. The principal findings of the thesis are detailed below and have been presented based on the components of the model.

7.4.1 Person

The literature review identified the person factor as the most fundamental component of occupational health and safety on Farms. The quantitative study examined the human toll of occupational injury in addition to the examining the perceptions, beliefs and attitudes towards health and safety of those engaged in farming. The qualitative study further pursued the interaction between the person and the farm environment from a safety perspective.

The findings indicate that Irish farmers evaluate the level of safety of their farm according to whether or not they have experienced an accident. Irish farmers predominantly recognise that farming is dangerous however; they do not believe that their own farms are dangerous working environments. Similar findings were put forward by Elkind, 1993. Further, farmers do not believe that farming is more dangerous than any other occupation. The anchoring bias discussed by Dunne (2000) may have some effect on farmers' perception of danger. The majority of farmer communication regarding health and safety focuses on fatality statistics and accident levels to a much lesser degree. Because the number of fatalities presented is actually a low number farmers perceive that this happens to so few people that they are not at risk. In addition, the emphasis on fatality and accident statistics as a measure of safety in farming results in farmers applying the same measurements to their own farms rather than identifying and evaluating the risk present in their environment.

There is a major disparity between farmers perceived concern about safety on the farm and the action that they take in relation to farm safety. This was exhibited in both the results of the SHSIF and in the case study findings. The most blatant example was that while the majority of farmers described themselves as concerned about farm safety fewer than one in ten had completed a safety statement. The case study farmers that had compiled a safety statement had some similarities, both had been inspected by the HSA, they were young motivated farmers and they exhibited a high level of management capability. Murphy's assertion that all farmers do not have the tools for engaging in thorough and continuous health and safety management (Murphy, 1992) appears to have relevance in the Irish context. The results concur with Byrnes assumption that farmers who have expertise in management and manage successful farm businesses will have the ability to effectively manage health and safety (Byrne, 1995). The survey found that the majority of farmers themselves felt they required more information on health and safety.

Only two of the case study respondents believed that all accidents, without exception, are preventable. It became clear that some farmers believe that accidents are phenomena over which people have little control. The case study research illustrates that there are instances on Irish farms where the farmer does not recognise the risk associated with a particular circumstance. However, in the main farmers can recognise hazards and their associated risk yet they are very often willing to take the risk. Machinery and tractors were perceived as the principal agents most frequently involved in accidents (SHSIF).

Safety socialisation in farming has a significant impact on the attitudes and beliefs that people develop towards farm safety. The findings show that on farms where the farmer experienced positive safety socialisation in the work environment, regardless of whether it was farming safety was a greater priority. This is substantiated by the literature discussed in chapter 4 on safety socialisation. The findings also exhibit that few farmers had undertaken specific health and safety training and thus relied on informal observation, as Knapp, 1966 described, for health and safety training.

The importance of engendering a safety culture in Irish Farming cannot be overstated. In discussing safety culture Murphy (2003) uses words such as ‘reinforced’, ‘ingrained’ and ‘commonness’. These words all emphasise the fact that safety beliefs, attitudes and behaviours are learned when we are children and become stronger as we grow older. Embracing positive safety socialisation on farms at an early age may be of greater merit than determining that children and young adults should not be involved in farm activities. As Green (1999) outlined, farmers with spouses and children have an increased perception of susceptibility. This was also illustrated in the case study research and as such it is likely that this group of farmers would be receptive to improving farm safety. There is a real opportunity to influence future generations of Irish farmers and indeed at present their parents, by developing interventions which will enable these farmers to positively socialise their children into the working environment.

Stress is another fundamental person factor that has an impact on farm safety. Both the literature review and the case study findings illustrate that farming is a stressful occupation. Farmers experience the same stressors as the rest of the population, however they also experience stressors, which are particular to farming. The literature identified a relationship between farmer stress and safety. This association is also indicated in the survey findings. In all of the farming systems, the incidence of injury was greatest at periods of highest activity and pressure on the farm. It is not possible to determine the strength of the relationship between stress and injury occurrence on Irish farms from this study. Therefore, we cannot rule out the assertion by Yuchtman-Yaar (1991) that this relationship is related to self-employment rather than farming.

7.4.2 Environment

The environment represents both the physical and human environment and thus components of each are discussed below.

Farm work related accidents result in a high level of injury in the farm population in Ireland. Over the five-year period examined, on almost one in ten farms a farm work related injury was found to have occurred.

Farm work related ill health problems are not explored in great detail in this study; however, the results suggest that the extent of occupational ill health problems on Irish farms exceed that of occupational injuries. Similar to the profile of those injured on farm, the vast majority of the ill health cases involved the farmer. The two over-riding ill health outcomes on Irish farms were back pain and dust related allergies. Almost three in ten of the ill health cases were classified as severe and a similar proportion reported that the ill health problem was persistent.

The findings illustrate that farm injury places a substantial burden on the medical system in Ireland.

At farm level the impact of injury is significant with the vast majority of farm work related injuries reported requiring treatment in hospital and a high level of impatient admission. A high level of surgery resulted from injuries and the length of rehabilitation was found to be significant in many cases. As a result, injured persons were required to take time off work and in the majority of cases alternative sources of labour were required. Family members predominantly provide this labour. The results found that economic loss to the farm business resulting from injury was common, however, this loss was not quantified in this study.

This research illustrates that the human factor is fundamental to occupational health and safety on Irish farms. The literature review indicates that the person was central to safety. The results provide a keen insight into the attitudes, perceptions and beliefs of farmers relating to safety and the factors which impact on these.

Certain farm characteristics have an impact on injury occurrence on Irish farms. Size and system of farming were both found to have an association with injury and these associations were supported by the literature. Large farms (< 40 ha) experienced significantly more injuries than smaller farms. However, the case study analysis showed that while this is true, larger farms exhibited a high level of safety management and the working environments were markedly better from a safety perspective than the small farm.

The results indicate that system of farming is a significant factor in accident and injury occurrence. In Ireland tillage farms experience significantly more injury than other systems of farming while farms with dairy enterprises were also found to experience significantly high proportions of injury. The case study analysis illustrated that vast differences exist in safety considerations between the different enterprises. The range of risk factors varies significantly. The particular enterprise in which a farmer is involved dictates much more than simply the end produce from the farm. The type of accidents and the location in which accidents occurred differ according to farming system and size of farm and thus could not be effectively impacted upon by generic intervention programmes. As a result, system of farming should be considered as the single most important factor when developing interventions. General safety interventions or mass appeal safety messages cannot be effective. Murphy (1992) as discussed in chapter 4, questioned the effectiveness of the mass appeal approach as it does not account for the reality of farm situations. As Dunne, 2001, so rightly observed we are all receptive to education and we inherently seek a better understanding of our environment. Farm safety interventions, whether safety messages or courses should be designed to provide specific information to specific people, which is relevant to their situation.

In Ireland the physical farm environment has predominantly been inherited, that is the physical siting of the yard and its design were determined by previous generations. Farm environments vary in the type of hazard and in the level of risk present. The farm environment consists of a characteristic factor (size and system), situation, housekeeping, farm buildings, cattle handling facilities and slurry storage facilities. The case study interviews illustrated that while certain environment hazards posed considerable risk, they were not perceived as such by the farmer. This indicates that farm risk auditing carried out by farmers may not be as effective due to their perception of risk. Auditing was identified as an integral element of the safety management process in the literature review. While sometimes wrongly assumed as a management tool, it is essential to inform the safety management process. Even with the correct tools to carry out an effective health and safety audit on a farm, farmers perception of hazards and risk on their own farm, as discussed above, may compromise the effectiveness of the audit. There is a strong case for external risk assessment of farms in Ireland.

7.4.3 Technology

Farmer technology includes machinery, implements, chemical technologies and stock and is fundamental to farming operations. Similar to the environment, the importance of health and safety while engaging with farm technology varies considerably between farms. The findings of both the survey and the case studies illustrate that farmers are aware of the hazards associated with farm technologies. In addition, similar to the environment, the perceived risks associated with particular technologies vary according to farmers' experiences and safety socialisation. In addition, as discussed in the literature farmers were willing to take risks with specific technologies that they would not allow others to engage in. The safety status of technology on the farm is strongly associated with the perceptions and beliefs of the farmer. There is a significant problem with guarding moving parts on machinery on Irish farms. Farmers understand the necessity to have moving parts guarded. They are aware of the consequences of coming in contact with a moving part yet these parts remain uncovered posing extreme risks in some cases. The case study findings indicate that other things take precedence over machinery guarding. In addition, farmers tend to perceive that certain technologies pose a greater risk than others based on their experience and that of other farmers in their community. The situation regarding chemical safety is broadly similar to that of machinery. However, the findings indicate that safety is a higher priority when working with chemicals on the farm.

7.5 Implications of the research

This section outlines the implications that can be deduced from the findings detailed in the above section. The implications are assumed relevant to those involved in farming in Ireland, at policy level, The Farm Safety Partnership, extension and education professionals, farming leaders and farm managers.

7.5.1 Returning to the approaches

The literature review discussed both the macro and micro level determinants of occupational health and safety, namely legislation and safety management. In addition, the specific approach an organisation adopts to health and safety management was discussed.

Legislation

The findings illustrate that the previous body of legislation governing health and safety in Ireland while acknowledged, was not fully comprehended by the farming community. Not all farmers were aware of their responsibilities under the legislation and few were fully compliant. The new legislation allows for the development of sector specific codes of practice, which will make the legislation more relevant to those involved in farming. The dissemination of information relating to farmers legal requirements under the current Health and Safety Legislation needs to be examined. While material was published to inform and aid farmers on their compliance with the 1989 legislation, this study suggests that the process was not entirely successful.

In addition, there is a need for a continuous and visible presence of inspectors in Irish farming in order to improve compliance with the legislation and also guide and inform the farming community on risk assessment. The actual inspection process has the potential to educate farmers on effective risk assessment and how this can be applied to safety management on the farm.

Promotion and intervention

In order for safety management to develop and become part of the culture of farming effective safety intervention programmes encompassing the factors comprising the farm safety trichotomy should be pursued. As discussed in the literature, the effectiveness of mass appeal educational campaigns is questionable as is issuing warnings to those who do not perceive themselves to be at risk. '*We don't and won't respond to advice and exhortations to take care because we simply do not believe that we are at risk. We don't believe we are in danger because our unsafe behaviour has not resulted in a near miss or in injury to ourselves or damage to property in the past*' (Dunne, 2000, P.29). The research has shown that farmers in Ireland do not believe that they are working in a dangerous work environment and they continue to take risks because the consequences have not been negative and indeed are sometimes rewarding. Risk and hazard communication should be explored in order to improve the effectiveness of farm health and safety communication. The significance of system of farming should be appreciated by those involved in developing interventions. The more targeted interventions are the more relevant they will be to specific farmer groups and the more likely they are to make an impact.

Improving farm safety among the future generation of Irish farmers should begin now. Children and young adults that are involved in farming require positive socialisation into the workplace. Farm families will require support and guidance in educating their children in farm safety and developing age appropriate work schedules for their children.

7.5.2 Managing the dynamics which result in unsafe conditions on farms

The farm safety trichotomy has defined the farm level factors which exert an influence on farm safety and it explores the dynamics which exist between these factors. The potential exists to manage these dynamics in order to create a safer working environment in Irish farming.

Person

Similar to other sectors of the Irish economy, farming is now being described as a 'rat race'. Business and personal goals have to be balanced. In addition, the speed and pace of operations, particularly on large farms, is perceived to have increased yet there is less labour available. Farmers' beliefs, attitudes and perceptions relating to safety are learned at an early age and are reinforced through their own actions. In addition, the farmer is working in an industry where a positive safety culture has never existed. '*The organisation creates the possibility for safer working. It does this through its commitment to safety. People see and experience this commitment in tangible form in the policies, procedures and management practices of the organisation, and in the resources allocated to safety*' (Dunne, 2000). In terms of primary agriculture the industry could be viewed as the organisation, the commitment to farm safety by the agriculture industry as a whole may have a significant role to play in influencing the perceptions and beliefs at farm level.

Improved work organisation and greater planning of tasks could have a significant impact on workload issues on the farm. In addition, management and supervision of the activities children engage in on the farm could lead to a structured and safe introduction into farming.

Environment

General house keeping, timely maintenance and anticipation and acknowledgement of problems in the working environment can lead to a greater level of control in the environment. Larger farms have a higher level of activity and thus farmers and employees are exposed to the hazards of farming to a greater degree. The degree to which activities are planned and controlled affects the risk involved. Farmers are constantly responding to the requirement of their farm in terms of structures and buildings. However, often a 'make do' attitude prevails and facilities are used for purposes and in ways that their original design had not intended. Greater planning and anticipation allows the farmer to foresee these needs and provide appropriate resolutions.

Technology

When dealing with machinery, chemical technology and animals good management allows farmers to have greater control over issues that arise which are often termed as unpredictable. Engineering has predicted and responded to the vast majority of issues that arise in this regard on farms. In general these engineering solutions are present to varying degrees on all farms. However, they may often be poorly maintained or discarded for a variety of reasons. For each of the above technology factors, simple protocols, if well conceptualised and adhered to serve to manage the associated risks.

Stress

Stress has a significant impact on the dynamics that exist within the farm safety trichotomy while these dynamics also have a significant impact on stress. Greater management and control of people, the physical working environment and farm technologies will have an impact on stress. In addition, better management practices will have an effect on specific stressors and how stress affects the farmer.

7.5.3 Recording data to improve farm safety

Based of the findings of this research, there is a need to re-examine our methods of accident and injury data collection and indeed examine the purposes which we require that data to serve.

Injury and ill health data

'*The aim of injury epidemiology in general is to provide information to decision makers in the field of injury control and safety promotion*' (Jansson & Svanström, 1999). In the absence of injury surveillance systems other means of collecting data such as the survey employed in this research are necessary. Comparisons with previous research illustrate that farm injuries are showing a slow but downward trend. However, as a result of recall bias it would be remiss to accept this as a reality. The differences that exist between the principal production systems have implications for farm work related injury and thus require further examination. Due to the nature of injuries, it is necessary that research take a multi disciplinary approach to data collection as farm injury has implications beyond the farm yard.

Injury and risk

'Focussing exclusively on either accidents, reportable accidents or fatal accidents, or some combination of these three statistics, is not a true reflection of the real state of affairs as regards occupational accident risk' (Dunne, 2001) There is evidence to indicate that farmers rely on accidents as a measure of risk in their environment and thus do not fully understand the process through which the farm is made dangerous. Risk assessment and statistics based on risk assessment would provide a more realistic picture of risk on the farm. Self assessment by farmers of their working environment

may be of limited benefit to farm safety management on the farm due to the judgement process which has seen to influence farmers perception of given hazards and risks.

7.6 Final remarks

Based on the farm safety trichotomy developed in this research there are a number of issues which require more attention. A number of recommendations are identified for future research:

- Use the farm safety trichotomy to guide the development of evaluated injury prevention strategy. The contribution of management to the status of farm safety in Ireland should be explored further.
- Adopt the farm safety trichotomy to reflect the individual farming systems in Irish agriculture. This would substantially aid the development of tailored Intervention strategies.
- Future research should examine factors beyond the farm gate which have an influence on the status and development of safety on Irish farms.
- Future research should adopt a multi-disciplinary approach and include agricultural professionals, medical professionals and psychologists concerned with workplace safety. Strengthening and developing the relationships and collaboration between these disciplines would provide a more holistic approach to farm health and safety research and promotion in Ireland.
- In order to foster and develop a culture of safety in farming, this must be developed and supported throughout the agriculture industry.

References

Agri Vision Committee, (2004). Report of the Agri Vision 2015 Committee. Dublin**:** 81.

Aherin, R. A. D.J. Murphy & Westaby, J. D. (1992). Reducing Farm Injuries: Issues and Methods. St. Joseph, American Society of Agricultural Engineers.

Andersson, R. (1999). Injury Causation, Injury Prevention and Safety Promotion - Definitions and Related Analytical Frameworks. Safety Promotion Research. A Public Health Approach to Accident and Injury Prevention. Laflamme, L., Svanstrom, L. & Schelp, L. Stockholm, Karolinska Institutet.

Health and Safety Authority, HSA (2006). "Statistics and Research." www.has.ie, Retrieved 24/01, 2006.

Baker, S. O'Neill, B. Karpf, R.S. (1984). The Injury Fact Book. Lexington, MA, Lexington Books.

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs, NJ, Prentice Hall.

Barancik, J.L. Chatterjee, B.F. Greene, Y.C. Michenzi, J.L. & Fife, D. (1983). "Northeastern Ohio Trauma Study. Magnitude of the problem." American Journal of Public Health **73**: 746-751.

Barnard, C. S. & Nix, J.S. (1979). Farm Planning and Control. Cambridge, Cambridge University Press.

Beegan, T. (2002). "Carnage Continues on Irish Farms." Irish Farmers Journal **3**(38): 2.

Berry, C. (1971). "Rural Employment." American Journal of Public Health **61**(12): 2474-2476.

Byrne, R. (1995). A guide to safety, health and welfare at work regulations. Dublin, NIFAST.

Casley, D.J. & L.ury, D.A. (1986). Data collection in developing countries. Oxford, Clarendon Press.

Chapman, L.J. Taveira, A.D. Josefsson, K.G. Hard, D. (2003). "Evaluation of an Occupational Injury Intervention Among Wisconsin Dairy Farmers." Journal of Agricultural Safety and Health **9**(3): 197-209.

Cogbill, T.H. Busch, H.M. & Stiers, G.R. (1985a). "Farm Accidents in Children." Pediatrics **76**(4): 562-566.

Cogbill, T.H. & Busch, H.M. (1985b). "The Spectrum of Agricultural Trauma." The Journal of Emergency Medicine **3**: 205-210.

Cole, H.P. (2002). "Cognitive-Behavioural Approaches to Farm Community Safety Education: A Conceptual Analysis." Journal of Agricultural Safety and Health **8**(2): 145-159.

Connolly, L. Finnerty, E. Kinsella, A. & Quinlan, G. (2003). National Farm Survey 2001, Teagasc.

Cooper, A.D. & Germain, G.L. (1974). "Social Cultural Influences Affecting Safety." Journal of Labour Science **3**(1): 19-32.

Crowley, C. Meredith, D. & Walsh, J. (2002). "Population and Agricultural Change in Rural Ireland, 1999-2002."

CSO. (2002). "Census of Agriculture Main Results, June 2002. General Details." Retrieved 19 May 2004, 2004, from www.cso.ie.

CSO. (2003). "Agricultural Labour Input." Retrieved 19 May 2004, 2004, from www.cso.ie.

CSO. (2006). "Agricultural Price Indices 2005 - Preliminary Estimates." Retrieved 19.01, 2006, from ww.cso.ie.

Darragh, A.R. Stallones, L. Sample, P.L. & Sweitzer, K. (1998). "Perceptions of Farm Hazards and Personal Safety Behaviour Among Adolescent Farmworkers." Journal of Agricultural Safety and Health **Special Issue** (1): 159-169.

Denis, C.A.R. (1976). "The Farmer: Resource at Risk." Agrologist.

Department of Agriculture and Food, (2004). The compendium of Irish Agricultural Statistics 2004.

Department of Agriculture and Food, Economics and Planning Division, (2006). Factsheet on Irish Agriculture.

Department of Agriculture, Food and Rural Development (2000). AgriFood 2010. Dublin.

DeRoo, L.A. & Rautiainen, R.H. (2000). "A Systematic Review of Farm Safety Interventions." American Journal of Preventative Medicine **18**(4): 51-62.

Diderichsen, F. Laflamme, L. Hallqvist, J. (1999). Understanding the Mechanisms of Social Difference in Injuries. Safety Promotion Research. S. L. Laflamme L, Schelp L. Stockholm, Karolinska Institutet. **:** 242.

Donham, K.J. & Mutel, C.F. (1982). "Agricultural Medicine: The Missing Component of the Rural Health Movement." The Journal of Family Practice **14**(3): 511-520.

Doyle, Y. (1988). How Safe Are Irish Farms? A One Year Survey Of Farming Accidents And Their Medical Outcome.

Doyle, Y. & Conroy, R. (1989). "The Spectrum of Farming Accidents Seen in Irish General Practice: A One-Year Survey." Family Practice **6**(1): 38-41.

Dunne, E. (2000). The Psychology of Working Safely. Dublin, Blackhall.

Dunne, E. (2001). Psychology and Working Safely - A practical perspective. NISO/NISG Annual Health and Safety Conference 2001, Kilarney, Co.Kerry.

Elkind, P.D. (1993). "Correspondance Between Knowledge, Attitudes, and Behaviour in Farm Health and Safety Practices." Journal of Safety Research **24**: 171-179.

Elkind, P.D. & Cody- Salter, H. (1994). "Farm Stressors: The Hazards of Agrarian Life." Annals Agric Environmental medicine(1): 23-27.

Evans, A. (1999). Farm Accidents in Rural Areas. Wales, UK, Institute of Rural Health.

Farm Safety Action Group. (2003). Farm Safety Plan 2003 - 2007. Dublin, Health and Safety Authority.

Finnegan, A. Ruane, D. & Phelan, J. (2005). A Study of the Impact of Farmer Disability on Farm Households - Case Studies From the Republic of Ireland. Proceedings of 17th European Seminar on Extension Education. August 30th – September 3rd 2005. Izmir, Turkey. Section 2 (5pp)

Fischoff, B. Slovic, P. Lichtenstein, S. Read, S. and Combs, B. (1978). "How safe is safe enough? A Psychometric Study of Attitudes Towards Technological Risks and Benefits." Policy Sciences **9**: 127-52.

Fishbein, M. & Ajzen, I. (1975). Belief, Attitudes, Intention and Behaviour. Massachusetts, Addison-Wesley.

Freeman, S.A. Schwab, C.V. & Pollard, T. (2003). "Assessment of Iowa Farmers'

Perceptions about Auger Safety." Journal of Agricultural Safety and Health **9**(1): 61-74.

Fugelli, P. (2003). Welfare in the 21st Century - The Pathology of Toomuchness. The 17th Nordic Conference in Social Medicine and Public Health, Aarhus.

Garavan, T.N. (1997). The Irish Health and Safety Handbook. Dublin, Oak Tree Press.

Gerrard, C.E. (1998). "Farmers' occupational health: cause for concern, cause for action." Journal of Advanced Nursing Studies **28**(1): 155-163.

Gil Coury, H.J.C. Kumar, S., & Jones, E. (1999). "Farm related injuries and fatalities in Alberta." International Journal of Industrial Ergonomics **23**: 539-547.

Giles, T. & Stansfield, M. (1990). The Farmer as Manager, C.A.B international.

Glasscock, D.J. Hansen, O.N. Rasmussen, K. Cartensen, O. & Lauritsen, J. (1997). "The West Jutland Study of Farm Accidents: A Model For Prevention." Safety Science **25**(1): 105-112.

Glasscock, D.J. (1999). Psychological factors and occupational accidents in farming: An empirical study and literature review of accident theories and research with special attention to stress. Institute of Psychology. Aarhus, Aarhus University. **Ph.D.:** 159.

Green, K.L. (1999). "Farm Health and Safety: Rural Couples' Beliefs and Practices." Journal of Agricultural Safety and Health **5**(1): 83-96.

Haddon, W.J. (1980). "The Basic Strategies for preventing damage from hazards of all kinds." Hazard Prevention **16**: 8-11.

Häkkinen, S. (1978). Tapaturmateoriat ja niiden kehittäminen. Teollisuustalouden ja niiden työpsykologian laboratoriot. Helsinki, Helsinki University of Technology.

Hansen, R.H. (1986). "Major Injuries due to Agricultural Machinery." Annals of Plastic Surgery **17**(1): 59-64.

Hard, D.L. Myres, J.R. & Gerberich, S.G. (2002). "Traumatic Injuries in Agriculture." Journal of Agricultural Safety and Health **8**(1): 51-65.

Harms-Ringdahl, L. (1993). Safety analysis: Principles and Practice in occupational safety. London, Elsevier Science.

Health and Safety Authority (2001). Farm Safety Handbook. Dublin, HSA.

Heinrich, H.W. (1941). Industrial Accident Prevention. New York and London, McGraw Hill Book Company, inc.

Hodne, C.J. Thu, K. Donham, K.J. Watson, D. & Roy, N. (1999). "Development of the Farm Safety and Health Beliefs Scale." Journal of Agricultural Safety and Health **5**(4): 395-406.

Hoglund, S. (1999). "Farmers Occupational Health-The Swedish Model." Journal of Agricultural Safety and Health **5**(4): 361-365.

Health and Safety Authority (HSA). (2001) Code of Practice on Preventing Accidents to Children and Young Persons in Agriculture. Dublin, Health and Safety Authority.

Health and Safety Executive (HSE). (2001) Managing health and safety. Five steps to success, HSE.

Jannson, B. (1989). "Injuries in Agriculture-A Review of the Literature." Intern. Journal of Environmental Studies **33**: 45-52.

Jansson, B. (1987). "The Yield of Systems for Continuous and Periodic Injury Surveillance in Emergency Care with Emphasis on Farm-work-related Accidents." Scandinavian Journal of Social Medicine **15**: 247-252.

Jansson, B. & Eriksson, C. (1990). "Accident Involvement and Attitudes towards Hazards and Countermeasures in a Swedish Rural Population." Scandinavian Journal of Social Medicine **18**(2): 139-142.

Jansson, B. & Svanström, L. (1999). Injury in A Public-Health Perspective - Behind the Figures. Safety Promotion Research. A Public Health Approach to Accident and Injury Prevention. L. Laflamme, Svanstrom, L. & Schelp, L. Stockholm, Karolinska Institutet.

Jaspersen, J. List, P. Howard, L. Morgan, D. & Von Essen, S. (1999). "The Certified Safe Farm Project in Nebraska: First Year." Journal of Agricultural Safety and Health **5**(3): 301-307.

Jespen, R.L. (1976). Principles of Farm Machinery. Connecticut, The AVI Publishing Co.

Kepner, R.A. Bainer, R. & Barger, E.L. (1972). Principles of Farm Machinery. Connecticut, The AVI Publishing Co.

Kidd, P.S. Isaacs, S.G. Cole, H.P. Parshall, M. Scharf, T. & Struttmann, T. (1998). "An Economic Motivator for Safe Farming: Changing Perceptions Through Learning." Journal of Agricultural Health and Safety **1**(Special Issue): 205-212.

Knapp, L.W. (1966). "Occupational and Rural Accidents." Archives of Environmental Health **13(**October): 501-506.

Layde, P.M. (1990). "Beyond Surevlliance: Methodologic Considerations in Analytic Studies of Agricultural Injuries." American Journal of Industrial Medicine **18**(2): 193-200.

Layde, P.M. Stueland, D. Nordstrom, D.L. Olson, K.A. Follen, M.A. Brand. L. Konitzer, K. Kerr, J. Leick, I. & Lezotte, C. (1993). Identifying preventable risk factors for farm injuries. Atlanta, Georgia, Centres for Disease Control and Prevention.

Leahy, H. (2003). Counting the hours & Making the hours count-a study of labour use efficiency on suckler farms. Irish Farm Buildings Association Spring Conference 2003, Teagasc, Kildalton College, Piltown, Co.Kilkenny.

Lees, F.P. (1980). Loss Prevention in the Process Industries. London, Butterworths.

Lewis, M.Q. Sprince, N.L. Burmeister, L.F. Whitten, P.S. Torner, J.C. & Zwerling, C. (1998). "Work-related injuries among Iowa farm operators: an analysis of teh Iowa Farm Family Health and Hazard Surveillance Project." American Journal of Industrial Medicine **33**: 510-517.

Lindsay, F.D. (1992). "Successful health and safety management. The contribution of management audit." Safety Science **15**: 387-402.

Lloyd, D.H. (1983). Agricultural aspects of accidents. Agriculture and Human Health - CAS paper 14. J. L. Jollans, Centre for Agricultural Strategy, University of Reading**:** 183-199.

Mather, C.T.L. (2001). "Farm Injury in Tasmania." Australian Journal of Rural Health **9**(5): 209.

May, J.J. (1990). "Issues in Agricultural Health and Safety." American Journal of Industrial Medicine **18**(2): 121-131.

McCurdy, S. (1995). Occupational health status of migrant and seasonal farmworkers. Agricultural Health and Safety: workplace, environment, sustainability (supplement). H. McDuffie, Dosman, J., Sernchuk, K., Olenchock, S., and Senthilselvan, A. Chelsea, MI, Lewis Publications.

McCurdy, S.A. and Carroll, D.J. (2000). "Agricultural Injury." American Journal of Industrial Medicine **38**(436-480).

McNamara, J. & Reidy. K. (1997). A Survey of Health and Safety on Irish Farms. Dublin, Teagasc.

McNamara, J. & Reidy. K. (1992). Survey of Health and Safety on Irish Farms, Teagasc.

Monk, A.S. Morgan, D.D.V. Morris, J., & Bradley, R.W. (1986). "The Cost of Accidents in Agriculture." Journal of Agricultural Engineering Research **35**: 245-257.

Mullen, J. (2004). "Investigating factors that influence individual safety behaviour at work." Journal of Safety Research **34**: 275-285.

Murphy, D.J. (1981). "Farm Safety Attitudes and Accident Involvement." Accident Analysis and Prevention **13**(4): 331-337.

Murphy, D.J. (1992). Safety and Health For Production Agriculture. St.Jospeh, MI, The American Society of Agricultural Engineers.

Murphy, D.J. (2003). Looking Beneath the Surface of Agricultural Safety and Health. St. Joseph Mich., ASAE.

Myres, J. R. (1990). "National Surveillance of Occuaptional Fatalities in Agriculture." American Journal of Industrial Medicine **18**(2): 163-168.

Myres, J.R. & Hard, D.L (1995). "Work-Related Fatalities in the Agricultural Production and Services Sectors, 1980-1989." American Journal of Industrial Medicine **27**: 51-63.

National Coalition for Agricultural Safety and Health (NCASH), (1989). A report to the nation: Agricultural occupational and environmental health: Policy strategies for the future. Iowa City, NCASH.

O'Brien, B. O'Donovan, K. Gleeson, D. Ruane, D. and Kinsella, J. (2004). "Dairy Farm Structural Features for Improved Labour Efficiency." Irish Farm Buildings Association Journal **2004**: 9-13.

Ogilvie, K.R. (1990). Agricultural Safety Equipment Usage: A Survey of Iowa Grain Farmers, University of Iowa**:** 159.

O'Sullivan, T. (1995). A Study To Measure the Effectiveness of the Farm Apoprenticeship Board's Safety Management Programme. Dublin, University College Dublin. **Master of Applied Science:** 162.

Petrea, R.E. (2001). "The Theory of Planned Behaviour: Use and Application in Targeting Agricultural Safety and Health Interventions." Journal of Agricultural Safety and Health **7**(1): 7-19.

Phelan, G. Frawley, J. (2000). Off-Farm Employment: Presnt Position and Recent Trends. Presentation to Agricultural Economics Society April 2000.

Phelan, G. Frawley, J. & Wallace, M. (2002). The Structure of Agriculture in the EU - an Irish Case Study. 8th International conference of the Economics Society of Thessaloniki, Thessaloniki, Greece.

Pickett, W. Brison, R.J. Niezgoda, H. Chipman, M.L (1995). "Nonfatal Farm Injuries in Ontario: A Population-Based Survey." Accident Analysis and Prevention **27**(4): 425-433.

Powers, J.H. (1939). "The hazards of farming." JAMA(113): 1375-1379.

Pratt, S.G. Hard, D.L (1998). "Injury Risk Factors Associated with Agricultural Workplace Fatalities." Journal of Agricultural Safety and Health **1**(Special Issue): 29-38.

Purschwitz, M.A. & Field. W.E. (1990). "Scope and Magnitude of Injuries in the Agricultural Workplace." American Journal of Industrial Medicine **18**(2): 179-192.

Rasmussen, K. Carstensen, O. & Lauritsen, J.M. (2000). "Incidence of Unintentional Injuries in Farming Based on One Year of Weekly Registeration in Danish Farms." American Journal of Industrial medicine **38**: 82-89

Rautianinen, R.H. & Reynolds, S.J.R. (2002). "Mortality and Morbidity in Agriculture in the United States." Journal of Agricultural Safety and Health **8**(3): 259-276.

Rauutianinen, R.H. Lange, J.L. Hodne, C.J. Schneiders, S. & Donham, K.J. (2004). "Injuries in the Iowa Certified Safe Farm Study." Journal of Agricultural Safety and Health **10**(1): 51-63.

Reason, J. (1997). Managing the Risks of Organisational Accidents. Brookfield, VT, Ashgate.

Reiling, J. (1997). Agricultural Injuries in Norway. Third NIOSH Agricultural Health and Safety Conerence, Iowa City, Illinois, The Haworth Medical Press, NY, USA.

Reis, T.J. & Elkind, P.D. (1997). Influences on Farm Safety Practice in eastern Washington.

Rivara, F.P. (1985). "Fatal and Nonfatal Farm Injuries to Children and Adolescents in the United States." Pediatrics **4**: 567-573.

Ruane, D.J. & Phelan, J.F. (2003). The Use of Labour on Irish Livestock Farms - some research results from south Tipperary. Irish Farm Buildings Association Spring Conference 2003, Kildalton Agricultural College, Piltown, Co. Kilkenny.

Saari, J. (1986). Epidemiology of Occupational Health M. M. Karvonen, M.I. Copenhagen, WHO.

Safety, Health And Welfare At Work Act, 1989, 7/1898, Ireland

Safety, Health and Welfare at Work Act, 2005., 10/2005, Ireland.

Sanders, M. S. a. E. J. M. (1987). Human Factors in Engineering and Design. New York, McGraw-Hill Book Co.

Scharf, T. Kidd, P. Cole, H. Bean, T. Chapman, L. Donham, K. & Baker, D. (1998). "Intrvention Tols for Farmers-Safe and Productive Work Practices in a Safer Work Environment." Journal of Agricultural Safety and Health **1**(Special Issue): 193-203.

Schelp, L. (1992). "The Occurance of Farm-Environmental Injuries In A Swedish Municpality." Accident Analysis and Prevention **24**(2): 161-166.

Simpson, K., Sebastian, R. Arbuckle, T.E. Bancej, C. Pickett, W. (2004). "Stress on the farm and its association with Injury." Journal of Agricultural Safety and Health **10**(3): 141-154.

Simpson, S.G. (1984). "Farm Machinery Injuries." The Journal of Trauma **24**(2): 150-151.

Small, A.M. Ed. (1987). Design for older people. Handbook of Human Factors. New York, John Wiley & Sons.

Smith, G. S. & Kraus, J.F. (1988). "Alcohol and residential, recreational and occupational injuries: A reivew of the epidemiologic evidence." Annual Review of Public Health(9): 99-121.

Sprince, N.L. Zwerling, C. Lynch, C.F. Whitten, P.S. Thu, K. Logsden-Sackett, N. Burmeister, L.F. Sandler, D.P. & Alavanja, M.C.R. (2003). "Risk factors for Agricultural Injury: A Case-Control Analysis of Iowa Farmers in the Agricultural Health Study." Journal of Agricultural Safety and Health **9**(1): 5-18.

Stallones, L. (1989). Education,Equipment Modification and Injury Control among Farm Workers in Kentucky. Journal of Occupational Accidents. **10:** 293-303.

Stallones, L. (1990). "Surveillance of Fatal and Non-Fatal Farm Injuries in Kentucky." American Journal of Industrial Medicine **18**(2): 223-234.

Strasser, M. K., Aaron, J.E., Bohn, R.C. (1981). Fundamentals of Safety Education. London, Collier-Macmillan.

Suutarinen, J. (2004). "Management as a Risk Factor for Farm Injuries." Journal of Agricultural Safety and Health **10**(1): 39-50.

Svanstrom, M. D. (1999). Foreword. Safety Promotion Research. A Public Health Approach to Accident and Injury Prevention. L. Laflamme, Svanstrom, L. & Schelp, L. Stockholm, Karolinska Instituet.

Tevis, C. & Fink, C. (1989). "We kill too many farm kids." Successful Farming **87**(3): 18a-18p.

Thelin, A. (2002). "Fatal accidents in Swedish farming and forestry, 1988-1997." Safety Science **40**: 501-517.

Thu, K.M. Donham, K.J. Yoder, D. & Ogilive, L. (1990). "The Farm Family Perception of Occupational Health: A Multistate Survey of Knowledge, Attitudes, Behaviours, and Ideas." American Journal of Industrial Medicine **18**(2): 427-431.

Thu, K.M, Lasley, P. Whitten, P. Lewis, M. Donham, K.J. Zwerling, C. & Scarth, R. (1997). Stress as a factor for agricultural injuries: Comparative data from the Iowa Farm Health and Hazard Survey (1994) and the Iowa Farm and Rural Life Poll (1989). The Third NIOSH Agricultural Health and Safety Conference, Iowa City, Iowa, Haworth Medical Press.

Van Maanen, J.V. Schein, E.H. (1979). Toward a theory of organisational socialisation. Research in Organisational Behaviour. B. M. Straw. Greenwich, CT: JAI Press. **1**.

Wadud, S.E. Kreuter, M.W. & Clarkson, S. (1998). "Risk, Perception, Beliefs about Prevention, and Preventive Behaviours of Farmers." Journal of Agricultural Safety and Health **4**(1): 15-24.

Walker, J.L. Walker, L.J.S & MacLennan, P.M. (1986). "An Informal Look at Farm Stress." Psychological Reports **59**: 427-430.

Walker, J.L. Walker, L.J.S. (1988). "Self-Reported Stress Symptoms in Farmers." Journal of Clinical Psychology **44**(1).

Walker, L.J.S. Walker. J.L. (1987). "Stressors and Symptoms Predictive of Distress in Farmers." Family Relations **36**(4): 374-378.

Walsh, M. (2000). "A Nurse Practitioner-Led Farmers' Health Service: Setting Up and Evaluating A UK Project." Australian Journal of Rural Health(8): 214-217.

Weigel, R.R. (1980). "Helping farmers handle stress." Journal of Extension **18** (3): 37-40.

Williams, W.A. (1970). An accident prevention program for school shops and laboratories Chicago, IL, National Safety Council.

World Health Organisation and the Karolinska Institutet, Department of Social Medicine (1989). Manifesto for Safe Communities. 1st World Conference on Accident and Injury Prevention, Stockholm.

World Health Organisation (2001). International Classification of External Causes of Injuries (ICECI). Amsterdam, WHO Collaborating Centre on Injury Surveillance.

World Health Organisation (WHO), (2002). The Injury Chart Book - A graphical overview of the global burden of injuries. Geneva, WHO.

Yin, R.K. (2003). Case Study research: design and methods. London, Thousand Oaks.

Zhou, C. Roseman, J.M. (1994). "Agricultural Injuries Among a Population-Based Sample of Farm Operators in Alabama." American Journal of Industrial Medicine **25**: 385-402.