The economic cost of farm-related fatalities and the perceptions and management of health and safety on Australian farms

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Abstract

Farm-related fatalities are a significant problem in Australian agriculture. Over the period 2001–04, there were 404 fatalities that occurred as a direct consequence of visiting, residing or working on a farm.

This research is comprised of two separate, but related components; the economic cost of farm-related fatalities and the farm health and safety study; a qualitative study into farmer perceptions and behaviour relating to farm safety.

This study employed a human capital approach to establish the economic costs of farm-related fatalities to the Australian economy. Fatalities were selected for analysis as they are the most reliable, accurate and comprehensive form of farm injury data available.

A study was conducted on 335 farm enterprises to examine farmer perceptions and estimates of performance relating to the culture of safety and their systems and procedures to manage health and safety and major hazards on their farms. Finally, the changes farmers were making to health and safety on their farms, the motivating drivers for those changes, and what they perceived to be the risks and hazards on their farms were also assessed.

Modelling of direct and indirect costs associated with farm-related fatalities estimated that the 404 traumatic deaths over the period 2001–04 cost the Australian economy $650.6 million, in 2008 dollars. This equates to 2.7 per cent of the 2008 farm gross

domestic product (GDP) due to potentially preventable farm accidents and injuries. The top five agents causing death (tractors, ATVs, drownings, utilities and 2 wheel motorcycles) accounted for exactly half of the fatalities, and 46.7 per cent ($303.5 million) of the economic cost.

Significant differences in gender, age and industry were revealed in attitudes and perceptions of farm safety and the management of health and safety and major hazards.

Farm enterprises also provided a considerable level of detail on the changes and improvement they had made to farm safety, the reasons and motivations behind those changes, as well as details on what they perceived as the key risks and hazards on their farms.

The outcomes of this research have questioned some of the preconceived ideas relating to farmers' perceptions, attitudes and practices in relation to farm safety and have also identified potential new approaches and target populations for increasing adoption and implementation of farm safety recommendations.

The challenge is for farm safety researchers, Farmsafe Australia, work safety authorities, industry and farmer groups and health practitioners to encourage further investment and resources into farm health and safety research, which will enable them to capitalise on these findings and re-evaluate farm safety strategies and initiatives to reduce the level of risk on Australian farms and therefore, the incidence of fatal and non-fatal injury and the cost of to the Australian economy.

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Abbreviations

ABS	Australian Bureau of Statistics
ACAHS	Australian Centre for Agricultural Health and Safety
AEC	Australian Electoral Commission
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ASCC	Australian Safety and Compensation Council
ATV	All terrain vehicle
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
CAISP	Canadian Agricultural Injury Surveillance Program
CASA	Canadian Agricultural Safety Association
CFOI	Census of Fatal Occupational Injuries
CRC	Cooperative Research Centre
ED	Electoral Division
ERAT	Electronic Resource Allocation Tool
ESWC	European Survey on Working Conditions
EU	European Union
FSHBS	Farm Safety and Health Beliefs Scale
FTE	Full-time equivalent
GDP	Gross Domestic Product
GP	General Practitioner
HSE	Health and Safety Executive

ICD-10-AM	International Classification of Diseases -- Australian Modification
NCIS	National Coroners Information System
NDS	National Data Set for Compensation-based Statistics
Nec.	Not elsewhere classified
NFIDC	National Farm Injury Data Centre
NIOSH	National Institute for Occupational Safety and Health
NOSI	National Online Statistics Interactive
NSC	National Safety Council
NSW	New South Wales
OHS	Occupational health and safety
PDS	Premium Discount Scheme
PPE	Personal Protective Equipment
PTO	Power Take Off
RCD	Residual current device
RIRDC	Rural Industries Research and Development Corporation
ROPS	Roll-Over Protective Structure
RSE	Relative standard error
SLA	Statistical Local Area
TFP	Total factor productivity
USDA	United States Department of Agriculture
VSL	Value of a statistical life
WTP	Willingness-to-pay

1. Introduction

1.1 Agriculture in Australia

Australian agriculture has seen significant changes over the past few decades; once contributing 14 per cent to the nation's Gross Domestic Product (GDP) during the 1960s (Productivity Commission, 2005b), it now contributes just 3 per cent, even though production levels continue to increase (Australian Bureau of Statistics, 2008a).

Structurally, the changes have been just as significant. Farms are getting larger; over the 20 years to 2002–03, average farm size increased by 23 per cent, from 2,720 hectares to 3,340 hectares (Productivity Commission, 2005b). As a consequence, the number of farms has decreased; in 2005–06 there were just 125,594 farms involved in agricultural production in Australia (Australian Bureau of Statistics, 2009), down from 169,158 in the early 1980s (Australian Bureau of Statistics, 1983).

There have also been changes to production systems, with a shift away from the more traditional enterprises of wool, wheat and sugar, and increases in the beef, horticulture and viticulture industries (Australian Bureau of Agricultural and Resource Economics, 2006).

The volatility of income from year to year and the long-term downward trend in farmers' terms of trade – the ratio of prices received relative to the prices paid for their inputs – have been long term fixtures in the agricultural industry. The added impact of severe drought over the past decade has seen the financial performance of farms tighten and forced many farmers to leave the land.

Notwithstanding these changes, it is estimated that there are just over 100,000 farming families throughout Australia. Of these, 36 per cent have children with the youngest child aged under 15 years, 18 per cent have children all aged over 15, while the remaining 46 per cent specify no children residing on the farm (Australian Bureau of Statistics, 2008b).

1.2 Farm injury in Australia

Farming, due to the nature of work involved, is inherently a high risk occupation. It involves working with a wide range of agricultural equipment and machinery, can involve very long hours during peak periods and work is often conducted in solitude and in isolation. Furthermore, the farm workplace often includes the family home, exposing children, family and visitors to the occupational risks and hazards associated with an agricultural enterprise.

Farmers are aware and understand that the work they are involved with is potentially dangerous to themselves and to bystanders, yet many remain relatively unconcerned about the threat and incidence of injury to themselves and others. Nor do their perceptions of hazards and risks match with documented injury records. This disconnect between safety knowledge, values and practices is known as the farm safety risk paradox (Murphy, 2003).

Farmsafe Australia is the leading Australian agency in the promotion and education of farm health and safety. Since 1988, the agency has implemented a range of farm health and safety programs and projects that are based on sound evidence of necessity and effectiveness.

A farm-related fatality is defined as a fatality that occurred as a direct consequence of living and/or working on a farm, as opposed to only those deemed work-related by the Coroner. A person electrocuted by changing a light bulb in the farm homestead would not be referred to as a farm-related fatality, but a child who drowns in a dam or who is involved in an all terrain vehicle (ATV) accident would be included, as dams and ATVs are essential to primary production, and hence the exposure to these hazards is a direct result of farming and earning an agricultural income.

Despite the best efforts of Farmsafe Australia and work safety authorities, farm-related fatalities continue to occur at an alarming rate, with an average of just under 100 farm-related fatalities occurring each year. Tractors, ATVs and drownings are the most frequently reported agent involved in the fatality (Fragar, Pollock and Morton, 2008). However, little is known of the economic consequences of these fatalities, nor about the behaviours of farmers relating to management and control of farm safety and major hazards.

There are presently no comprehensive studies relating to the economic cost of farm-related fatalities, as previous research has been based on workers' compensation statistics, which significantly underestimate the number of farm-related fatalities occurring in Australia, due to the high proportion of family owned and operated farms which fall outside the jurisdiction of work health and safety authorities.

Conducting a study to more accurately depict the true cost of farm-related fatalities will greatly enhance the argument for the increased allocation of financial and other resources to agricultural health and safety programs, through quantifying the benefits of injury prevention and providing guidance to policymakers regarding the appropriate direction and level of funding for agricultural injury-prevention initiatives (Locker et al., 2003).

Furthermore, there are significant knowledge gaps relating to the perceptions, attitudes and behaviours of farmers towards farm safety and therefore, little information is available to review the success of previous initiatives and campaigns and to identify priorities and approaches that should form the basis of future farm health and safety interventions.

1.3 Aim and objectives

Despite research into the incidence and agent associated with farm-related fatalities (Fragar, Franklin and Coleman, 2000; Fragar, Pollock and Morton, 2008; Franklin et al., 2000) there are no reliable estimates of the impact these farm-related fatalities have on the economy. This study aims to estimate, for the first time, the economic cost of farm-related fatalities in Australia over the period 2001–04.

Fatalities were selected for economic analysis as the National Coroners Information System (NCIS) is the most accurate, reliable and comprehensive of all injury data sources, as every injury death must be reported to the Coroner.

Additionally, the study will analyse farmer perceptions and performance relating to the culture of safety within their farm and their systems, procedures and processes to manage health and safety and major hazards on their farms. Finally, it will assess the changes farm enterprises are making to health and safety on their farms, the motivating drivers for these changes, and what they perceive to be the risks and hazards on their farms.

As a result of this research, the true scale of the impact of farm-related fatalities on the Australian economy will be revealed. Furthermore, the analysis of attitudes and behaviours relating to farm safety may highlight demographics or enterprise types from within the study population that may benefit from more specific and tailored interventions, a greater understanding of the interventions that have achieved implementation and adoption in the past, as well as new strategies and approaches to further improve the widespread adoption of farm health and safety practices and recommendations.

1.4 Overview of study

There are two separate, but related components to this research; the economic cost of farm-related fatalities; and the farm health and safety study, a qualitative study into farmer perceptions and behaviour relating to farm safety.

Chapter 2 reviews the farm health and safety problem and addresses the current literature in economic burden studies, farmers' perception to risk, farm health and safety intervention approaches and benchmarking health and safety systems.

Chapter 3 is a discussion on the data sources available for use in farm injury analyses, their coverage and limitations. Some examples of farm injury data are also contained in this chapter.

Chapters 4 and 5 relate to the economic cost of farm-related fatalities study. Chapter 4 outlines the methodology of the study and the different approaches that can be used to estimate economic costs, their advantages and limitations and the reasoning behind the model selected. It details the individual elements of the economic model, as well as assumptions and data sources. Chapter 5 presents the results of the study, including the demographics, distribution, economic cost and limitations of the research.

Chapters 6 and 7 relate to the farm health and safety study. Chapter 6 refers to the methodology, detailing the recruitment procedures, questionnaire design, scoring and analysis techniques. Chapter 7 presents the results of the study; the demographics of participants and scoring of Safety Climate, Safety Management Systems and Control of Major Hazards, as well as discussing the health and safety changes made on farms, the drivers for change, the risks farmers perceive as being present on their farms and the limitations of the study.

Finally, Chapter 8 brings the two components of the study together, discussing the implications of the economic cost of farm-related fatalities and farmer perceptions, behaviour and scoring in the qualitative analysis and its potential role in future farm safety interventions. The chapter also presents final conclusions and contributions of research as well as recommendations for further research.

2. Literature Review

This chapter provides a detailed discussion of the literature surrounding the key elements of farm health safety research and intervention. It explains the context and scale of the farm health and safety problem, both in Australia and internationally. Furthermore, it reviews existing research and findings into the economic cost of farm-related fatalities, the perceptions of farmers towards farm safety, risk and change, as well as domestic and international farm safety intervention approaches. Finally, it examines the theory of safety benchmarking, the principles behind it and the applicability of benchmarking to agricultural enterprises.

2.1 The farm health and safety problem

Agriculture is a very diverse industry, ranging from intensive production of livestock and horticulture, through to extensive, large scale production of food and fibre crops and livestock. To produce this wide array of products, there is an enormous range of tasks an agricultural worker may be involved with, from mechanics and welding, through to stock and chemical handling, operating equipment and machinery, working at heights or in confined spaces, manual lifting and prolonged exposure to noise and environmental factors, such as sun, heat and dust.

Agricultural workers, on both intensive and extensive operations, often work in both solitude and isolation, and the seasonal nature of production means that they, and often their children, will work arduous hours during peak periods, leading to a higher risk of injury relating to fatigue, haste and complacency and emotional and financial stress.

In many cases, the agricultural workplace also doubles as the family home, further complicating the farm injury problem, adding children, spouses, bystanders and visitors into the equation. In addition, it also means there are large scale machinery and mobile plant, power tools and workshop equipment, chemicals, waterways and dams, all often just metres away from the family home.

Finally, the average age of farmers is also increasing. In Australia, 38 per cent of farmers and farm managers are aged between 55–64 years and another 15 per cent are aged over 65 years (Fragar, Morton and Pollock, 2007), and this pattern is being repeated internationally. In the United States, the average age of farm operators increased from 55.3 in 2002 to 57.1 in 2007. The number of operators 75 years and older grew by 20 per cent from 2002, while at the same time, the number of operators under 25 years of age decreased 30 per cent (National Agricultural Statistics Service, 2009). This aging status of the workforce leaves them vulnerable to the natural effects and risks associated with aging including loss of muscle strength and agility; slower reaction times; diminished eyesight and hearing; impaired balance and reduced concentration (Fragar, Morton and Pollock, 2007).

The extensive array of hazards and contributing factors facing farmers has been summarised by Murphy (2003), as shown in Table 2.1.

Table 2.1: Factors contributing to the hazardous nature of farming

Factor	Comment
Environmental	
Weather	Work must often be completed regardless of weather extremes
Work sites	Commonly overlaps with residence
Emergency services	Not readily available, often involves a delayed response due to isolation
Isolation of work	Co-workers often not in eye sight or hearing distance
Environmental hazards (noise, vibration, illumination, dusts)	Not monitored or regulated, as with most hazardous occupations
People	
Young workers	Children less than 16 years old are commonly exposed to and interact with work hazards and environments that are beyond their normal physical, mental and/or emotional ability to safely respond to
Senior workers	There is no standard retirement age in agriculture, exposing farmers to risks of physical limitations (hearing, vision, balance, coordination, dexterity, strength deficits) and slow reaction times
Dispersion of workforce	Difficult to provide health and safety services due to geographical dispersion and mobility of workforce
Farm operators	Far ranging educational qualifications and hours of farming versus off farm work (i.e. full-time farmer, work full-time off farm, with farm for supplementary income, part-time work and farm, hobby farm etc)
Work activity	
Work hours	60 to 80 hour weeks are common
Labour and management roles	Separate in other industries, but often the same role in farming
Work demands	Can be highly erratic, frequently affected by weather and machinery breakdowns
Work routine	Highly irregular, many tasks are seasonal and not often undertaken
Specialisation	Not generally possible, usually 'jack of all trades'
Instruction	Learning is by observational and experimental methods
Holidays and vacation	Days off are not common for owner-operators
Labour demands	Frequently make use of temporarily available labour. Children included as labour source
Uncertainty	Farming is characterised by an inherently uncertain immediate and long term future, including impacts by weather, plant and animal disease, economic policy and unexpected world events
Agricultural production	Large variability in size and type of production units and the degree of mechanisation and technology used
Social, economic and political	
Lifestyle versus occupation	Commonly viewed as a 'way of life' rather than an occupation
Day care	Often not available, practical or affordable in rural areas, so often come with parents into workplace

Continued

Table 2.1 (Continued): Factors contributing to the hazardous nature of farming

Factor	Comment
Occupational Health and Safety (OHS) legislation	New standards and regulations often are not practicable, lack the ability to be enforced and create a substantial burden to farmers to comply
Cultural beliefs about farm safety and health	The cultural belief that safety is a hazardous and unpredictable occupation contributes to the attitude that little can be done about health and safety other than just being careful
Market forces	Farmers are price takers and therefore can't add cost of health and safety to products to recoup costs
Self reliance for safety	Farmers rely primarily on their own knowledge and awareness of hazards to work safely, and accept blame when an injury occurs
Enculturation	Children inherit family views and experiences on farming, which can be difficult to change

Source: Adapted from Murphy (2003).

2.2 International farm health and safety

2.2.1 Canada

From the early 1960s, agricultural health and safety began gaining prominence as an important rural health issue within the medical literature. Original work focused on the monitoring of agricultural injuries, while in more recent years, it has moved towards the epidemiology and prevention of injuries.

Agriculture rates as one of Canada's most high risk occupational sectors, having the third highest rate of fatalities. However, when absolute numbers are examined, agriculture is the most hazardous occupation (Pickett et al., 1999).

In 1993, the Canadian Agricultural Safety Association (CASA) was established in response to an identified need for a national farm safety networking and coordinating agency to address problems of illness, injuries and accidental death in farmers, their families and agricultural workers. In 1995, the Association developed and commenced funding of the Canadian Agricultural Injury Surveillance Program (CAISP). This surveillance program has filled an important void in providing national evidence of agricultural injury occurrence that can be used in developing and targeting effective injury-prevention strategies (Canadian Agricultural Injury Surveillance Program, 2008).

CAISP has recently released a report describing the incidence of fatal agricultural injuries in Canada by age group and mechanism of injury. Over the period 1990 to 2005, there were 1,769 farm-related fatalities, at an average of 110 fatalities per year. The top five causes of agricultural fatalities were machine rollovers (20.5 per cent), machine runovers (when an operator or bystander is struck by mobile machinery, 18.6 per cent), machine entanglements (8.3 per cent), traffic collisions (7.3 per cent), and being pinned or struck by a machine (7.0 per cent). Of those fatally injured as a result of agricultural work, 91.6 per cent were male, and the average agricultural fatality rate was 13.7 per 100,000 agricultural population (including non-workers), per year (Canadian Agricultural Injury Surveillance Program, 2008).

Of the 217 child farm-related fatalities over the period 1990–2005, almost 75 per cent were deemed work-related, most of which were when the child was a bystander to work being undertaken by an adult. Runovers (41.9 per cent) and drownings (15.2 per cent) were the two leading cause of deaths, and children under five were the most at risk, representing 45.6 per cent of all agricultural fatalities aged under 15 (Canadian Agricultural Injury Surveillance Program, 2008).

2.2.2 United States

Farm health and safety material commenced widespread circulation in the United States in 1918, with a United States Department of Agriculture (USDA) Farmer's Bulletin on *Fire prevention and fire fighting on the farm*. By 1937, a separate session for farm safety was held at the National Safety Council (NSC) Congress, where a resolution was passed to develop a '*national farm safety program*'. This in turn led to the first National Home and Farm Safety Conference being held in 1942 (Murphy, 2003).

As industrial health and safety was gaining in its prominence throughout the United States, so to was the recognition that agriculture was exposed to a series of unique challenges, including:

- a lack of uniformity and control of workplaces and activities,
- an overlap between home and work sites,
- the structure of the labour force, with more younger and older workers than other industries, and
- little government regulation of farm work hazards and risks (Murphy, 2003; National Safety Council, 1937).

The profile of agricultural health and safety increased rapidly through the 1980s, with the establishment of public health organisations directly focused on research and education into agricultural safety and health.

The development of a fatal injury surveillance database, National Traumatic Occupational Fatalities, further highlighted the need and importance of agricultural health and safety through the identification of agriculture as having one of the highest rates of fatal injuries across all industries (Centre for Disease Control, 1987).

In 1989, the Unites States Congress established and funded the National Initiative in Agricultural Safety and Health. This initiative has been implemented by the National Institute for Occupational Safety and Health (NIOSH) and is still in existence today. The strategic goals of the NIOSH Agricultural, Forestry and Fishing program directly related to agriculture are:

1. Surveillance: Improve surveillance within the Agriculture, Forestry, and Fishing Sector to describe: the nature, extent, and economic burden of occupational illnesses, injuries, and fatalities; occupational hazards; and worker populations at risk for adverse health outcomes.
2. Vulnerable Workers: Reduce deleterious health and safety outcomes in workers more susceptible to injury or illness due to circumstances limiting options for safeguarding their own safety and health.
3. Outreach, Communications and Partnerships: Move proven health and safety strategies into agricultural, forestry and fishing workplaces through the development of partnerships and collaborative efforts.
4. Agriculture Safety: Reduce the number, rate, and severity of traumatic injuries and deaths involving hazards of production agriculture and support activities.

5. Agriculture Health: Improve the health and well-being of agricultural workers by reducing occupational causes or contributing factors to acute and chronic illness and disease (National Occupational Research Agenda Agricultural, 2008).

Data on agricultural fatalities aged 16 years and above is sourced from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI). An analysis of CFIO data observed 779 agricultural deaths in 1992, at a rate of 23.1 deaths per 100,000 workers. In 2002, the number of agricultural deaths had remained relatively stable at 789 deaths, at a rate of 22.7 deaths per 100,000 workers. Agriculture is ranked third in the total number of deaths across all United States occupations, behind only construction and transportation (Smith, 2004).

In 2002, 49.6 per cent of fatalities were as a result of transportation, including tractor overturns. Another 23.1 per cent were as a result of contact with objects and equipment, including crushing injuries, entanglements and blunt force trauma from structures and agriculture implements. Exposure to harmful substance or environment accounted for 10 per cent of fatalities, while falls from heights resulted in 8 per cent (Smith, 2004).

In the United States, approximately 70 children aged under 15 die from farm-related injuries each year. Of these, nearly 40 per cent are a result of farm machinery accidents and 23 per cent are due to drownings. As with the Canadian data, almost half of the machinery and drowning deaths occur in children aged four and under (National SAFE KIDS Campaign, 2004).

2.2.3 United Kingdom and Europe

The Health and Safety Executive (HSE) was established in 1974 as a non-departmental public body in the United Kingdom responsible for the research and promotion of farm health and safety, as well as its regulation and enforcement. Research conducted by the HSE over the period 1997–98 to 2006–07, found there were 464 fatalities on United Kingdom farms, at an average of 46 per year. Of these deaths, 145 were employees, 254 were self-employed and 65 were bystanders, of which 26 (5.6 per cent) were children under the age of 16 years.

Although less than 1.5 per cent of the working population is employed in agriculture, the sector accounts for between 15 and 20 per cent of workplace fatalities each year. In 2007–08, the provisional fatal injury rate in agriculture was 9.7 fatalities per 100,000 workers, which was the highest of the industrial sectors (Health and Safety Executive, 2009).

The leading agents of death in agricultural fatalities are transport (runovers or vehicle overturns, 24 per cent), falls from heights (17 per cent), being struck by moving or falling objects (15 per cent), asphyxiation drowning (10 per cent) and livestock related fatalities (10 per cent) (Health and Safety Executive, 2009).

The evolving membership in the European Union (EU) has seen the role of agriculture in the EU workforce change dramatically; in the 15 '*pre May 2004*' Member States, just 4.0 per cent of the workforce was employed in agriculture, however, with the inclusion of the new Member States, that rate has increased dramatically to 13.4 per cent. It is estimated that there are over 10 million people working in agriculture throughout the expanded EU, mostly in small, family run businesses. The fatal accident rate for the old EU 15 member States in 2000 was 12.6 per 100 000 workers, and is among the highest rates for any industry (European Agency for Safety and Health at Work, 2008).

The third European Survey on Working Conditions (ESWC), conducted in 2000, found that in the EU15 countries, over 40 per cent of workers in agriculture and fishing felt that their health is at risk because of work and that just 30 per cent of workers felt that they were well informed about risks at work in agriculture – the lowest percentage of all sectors (European Agency for Safety and Health at Work, 2008).

2.3 Farm health and safety in Australia

Established in 1988, Farmsafe Australia aimed to bring together key stakeholder agencies to improve the productivity of Australian agriculture and the wellbeing of the workforce through improved health and safety performance. In 1996, Farmsafe Australia agreed on a defined set of goals, targets, and strategic activities that have governed the plans and programs of its member agencies as they relate to the prevention of farm injury (Fragar and Houlahan, 2002).

Farmsafe Australia took a multifaceted approach to farm health and health and safety promotion, which included:

- The establishment and coordination of local Farm Safety Action Groups, state Farmsafe programs, and reference groups established for commodity-specific programs and for specific hazards.

- Preparation of injury management resources, commodity-specific aids to hazard identification and risk assessment, templates for worker safety induction and the keeping of OHS records.
- Establishment of Farm Safety Training Centres in all states to oversee delivery of the *Managing Farm Safety* training programs.
- Data collection and analysis by the National Farm Injury Data Centre (NFIDC) provided Farmsafe Australia with information about the nature and scale of farm-related injury, which in turn enabled the development of more appropriate data standards and definitions to support injury prevention activities.
- Research programs through the Rural Industries Research and Development Corporation (RIRDC) mobilised a group of research and development funding agencies of other rural industries to form the Farm Health and Safety Joint Research Venture. The Joint Research Venture enables research to support the Farmsafe network with the evidence base for its program.
- Advocacy for improved legislation and standards to enhance farm safety.
- Specific nationwide campaigns and programs, including tractor safety, machinery safety, *Child Safety on Farms*, ATV safety, workshop safety and older farmers (Fragar and Houlahan, 2002).

As with the other countries profiled in the previous section, agriculture is widely regarded as a high risk industry in Australia, to the extent that the Australian Safety and Compensation Council (ASCC) rates agriculture, fishing and forestry as one of their priority industries, despite the fact the workforce accounts for just 3 per cent of the Australian workforce (Australian Safety and Compensation Council, 2008).

As analysis of farm-related fatalities between 1989–1992 found there were 578 unintentional deaths over the study period. The most common agent of death was farm vehicles (29.1 per cent), followed by mobile farm machinery and plant (21.0 per cent), most of which were tractors. Farm structures, including dams, accounted for 20.6 per cent of fatalities. Of these 578 fatalities, 19.7 per cent were children aged under 15 years, with dam drownings, tractors and utility vehicles the most frequent agent of death (Franklin et al., 2000).

The agriculture, forestry and fishing industry accounted for 14 per cent of all work-related fatality in 2006–07. The incidence rate of 13 fatality claims per 100,000 workers was five times higher than the all industry average (Australian Safety and Compensation Council, 2009a).

Farm-related injury is clearly a significant problem for Australian agriculture; the reported incident rate is considerably higher than other industries, and given the large number of family owned and operated farms in Australia, it is likely that the true incidence rate would be far higher, due to the under-reporting of injuries. Further information on Australian farm injury data and its issues and limitations is contained in Chapter 3.

2.4 Economic cost of farm-related fatalities

As discussed earlier in this chapter, agriculture is widely regarded as a high risk industry but conversely, there is very little information on the economic cost of farm-related fatalities to agriculture and the wider Australian community. The majority of economic studies in this field utilise workers' compensation statistics as the basis for their analyses. However, this approach is unsuitable for agriculture and farming for two key reasons.

Firstly, as discussed in further detail in the next chapter, there is substantial underreporting of injuries to workers' compensation agencies due to the family-based structure of the majority of Australian farms. Secondly, many injuries and fatalities on farms were deemed as *'not work-related'* by either the Coroner or by coders entering data in the National Coroners Information System (NCIS), as they were not incurred as a result of paid work or employment and are excluded from the majority of studies into farm-related deaths.

Conducting a study to more accurately depict the true cost of farm-related fatalities will greatly enhance the argument for the increased allocation of financial and other resources to agricultural health and safety programs, through quantifying the benefits of injury prevention and providing guidance to policymakers regarding the appropriate direction and level of funding for agricultural injury-prevention initiatives (Locker et al., 2003).

Currie et al. (2000) further argues that the expression of the cost of injury in monetary terms is thought to illustrate the importance of the problem and, therefore, its high priority for research and health service resources, and that cost of injury studies are also useful in the political sense, by raising public and political awareness of the burden of injury.

Tormoehlen and Field (1995) went into greater detail on the potential benefits that can be derived from investigating the type and magnitude of costs associated with farm-related injury;

1. Identifying the types of farm-related injuries that are most costly to society and create the greatest economic threat to the farm family.
2. Providing a realistic picture of the losses incurred.
3. Providing a means of comparing farm-related injury costs to other industries or occupations.
4. Acquiring concrete economic evidence to justify the expenditure of public, corporate and private funds in loss prevention programs.
5. Developing fair and equitable guidelines for the allocation of economic liability litigation resulting from farm-related injuries. A better understanding of the costs of farm injuries would assist in establishing more consistent and realistic award levels.
6. Providing a basis for designing realistic disability and health care insurance programs that ensures adequate coverage in the event of an injury.

The risks associated with farming and agriculture are well documented, but the analysis into the economic impact on society of these risks has not been adequately analysed in the Australian context and is therefore an imperative component of health promotion and safety within the farming sector.

2.4.1 International studies of economic burden of farm-related fatalities

There have been several international studies into the cost of farm-related fatalities. Some of these studies estimate the costs of occupational fatalities in agriculture, while others are of a more specific nature, focusing on fatalities involving a particular agent, mechanism or region.

Biddle (2004b) employed a '*bottom up*' approach to calculate the impact of occupational fatal injuries on the United States gross domestic product over the period 1992–2001, using a cost-of-illness theoretical approach. The indirect cost of a fatality was estimated by calculating the present value of future earnings from the year of death until retirement at age 67, incorporating the probability of survival. Benefits, economy wide productivity growth, life cycle wage growth, household production, inflation and medical cost were also incorporated into the model.

Over the study period, there were 7,943 occupational fatalities in the agriculture, forestry and fishing sector, costing the United States economy $4.1 billion in 2003 dollars, or approximately $400 million per year. This represented 13.5 per cent of recorded fatalities, but the agricultural industry only accounted for 8.4 per cent of total lifetime costs to the economy, primarily due to the lower average earnings associated with agricultural occupations. The Biddle model is discussed in greater detail in Chapter 4.

As with most occupational based studies, Leigh, McCurdy and Schenker (2001) used a human capital approach to estimate the costs of agricultural occupational injuries in the United States during 1992. They acknowledge that despite its weaknesses, the human capital approach is still the most popular method for estimating the cost of an illness or injury through the estimation of direct and indirect costs. The direct costs included in this study included medical and administration costs, while indirect costs included lost earnings, lost fringe benefits, lost home production and training and restaffing. Lost wages are recognised as the largest component of indirect costs, followed by fringe benefits and value of home production.

As a model component, lost wages are meant to capture not just the injury related financial hardship on the family losing the wages, but also the cost to the economy and society in terms of lost output. To capture their value, an all industry estimate was used as a starting point ($422,069), which was then applied to a present value formula. This formula assumes that had the person not died, they would have earned the same amount as others with the same age and gender over their lifetimes, adjusted to the probability of survival from one age to the next. The working lifetime was assumed to extend until 75, but only 18 per cent of workers were assumed to work over 65.

These values were then multiplied by the ratio of agricultural wages to the wages of the rest of the economy, a value of 0.5842. This figure assumes that the value of lost productivity for a typical farm worker or owner is just 58.4 per cent of the typical non-farm worker in the United States economy.

Using this method, Leigh et al. (2001) estimated that occupational injuries cost the United States economy $4.6 billion dollars in direct and indirect costs. Of this, approximately $293 million was related to agricultural fatalities, of which there were 841; 13.2 per cent of all occupational fatalities. The non-fatal injuries included in the study totalled 512,539 cases. These economic estimates and fatality rates are similar to the Biddle (2004b) study, discussed previously.

Myers et al. (2008) targeted a particular agent of injury in their fatalities study; fatalities relating to tractor overturns in the United States. They used the cost of injury methodology employed by Leigh, McCurdy and Schenker (2001), which includes indirect costs (lost earnings, household production, fringe benefits and time loss) and direct costs (medical, insurance administration, property damage, police and fire service, injuries to third parties and funeral expenses).

Their cost analysis followed several key principles:

- The perspective is social, in which all costs are included irrespective of who incurs the costs.
- The cost of injury approach is used, which excludes the cost of pain and suffering.
- The agricultural population is used to calculate the cost of injuries, which is less than that for all occupations.

- All occupations are used to calculate the cost of injuries as a sensitivity analysis to compare costs against the results for the agricultural population. Using all populations is warranted in part since, in Kentucky at least, 59 per cent of principal farm operators have off-farm jobs and are thus employed outside of agriculture.
- No age adjustments are made within this analysis, since some ethical principles consider all human life of equal value no matter the age.
- US dollars are used to measure the cost.
- Three rates (0, 3 and 5 per cent) are used to discount the cost of future injuries associated with tractor overturns.

They estimated that from the 125 fatal tractor overturns that occurred nationally in the base year, 1997, there would be 2,640 fatal tractor overturns over the 25 year study period (1997–2021), which would cost the United States economy $137.8 million in 2006 dollars.

Locker et al. (2003) conducted research into the economic burden of agricultural machinery injuries in Ontario over the period 1985–96 using conventional methodology embodied into a computer program, Electronic Resource Allocation Tool (ERAT). ERAT incorporates the indirect costs of injury, such as loss of productivity to society, in addition to direct costs of injury, including hospitalisation, physician services, pharmaceuticals and rehabilitation costs. The model represents losses to society, as opposed to payment made by agencies for the provision of health services.

Economic parameters were also incorporated into the model, including discount rate (3.0 per cent), real wage growth rate (1.0 per cent), unemployment rate (8.7 per cent), labour market participation rate (65.6 per cent) and average annual wage ($29,424). The injury related variables included resource intensity rates for specific injuries, length of hospital stay and rates of hospitalised injury and death.

To run the ERAT model, injury surveillance data for hospitalised injuries and fatalities were entered into the system. Profiles of non-hospitalised injuries and permanent disability were then derived from data sources, as were medical and rehabilitation costs. To estimate the foregone income, it was necessary to put upper and lower bounds of when individuals enter the workforce and when they retire. The nominated range in this study was 18 to 69 years, to recognise that farmers rarely retire by the standard age of 65. Finally, the model was run including the economic parameters and univariate sensitivity analyses were performed to assess the reliability of the cost estimates and the influence of variables on the model.

Of the 2,073 machinery injuries occurring in Ontario over 1985–96, 242 were fatal, costing the economy $274,573 (Canadian dollars) per premature death and $66.2 million in indirect mortality costs.

Kelsey (1991) estimated the income foregone and opportunity cost of labour lost due to fatal farm accidents in New York over 1985–87, using survey responses from surviving family members and discounted future earnings.

As with Leigh et al. (2001), Kelsey recognises the conceptual issues with using a discounted future earnings approach, in that it places a lower value on homemakers, children, retirees, and others who receive low wages, and instead biases towards those in the midst of their peak lifetime earnings.

Kelsey, however, goes on to distinguish that as a measure of the value of human life, the method is clearly problematic, but as a measure of the income foregone and opportunity cost of accidents, it is not a major limitation; as an accident to those in the peak of their lifetime earning cycle does have more of an opportunity cost than an identical accident to someone with less earning potential.

To estimate foregone expected income, discounted future earnings were weighted by age and sex specific survival probabilities for upstate New York residents, with a retirement age assumed to be 70 years.

As this was a qualitative study, using survey responses, on and off-farm wage income was able to be specified by most respondents, but for those who did not nominate a value, it was by multiplying the victim's hours of on or off-farm work by the average New York wage for the person's occupation.

The loss of household work was estimated for all married victims (both male and female) by sex, age, and by the number and age of the victims' children. Values for single people without children were not estimated as it was deemed that their deaths did not deprive any household of their labour, in that their own households ceased to exist when they died. It was assumed, therefore, that all single people without children lived alone.

The accidental death of farm children has an additional on-farm opportunity cost due to the loss in labour provided by the child, as well as foregone earnings of adulthood. National data on childhood labour on farms were unavailable, so respondents were surveyed about their own experience. From this information, the hours of adult equivalent work was assumed to be an increasing function of age, rising from an average of half an hour a week for 4 year olds to 27 hours a week for 17 year olds. These hours were then costed using non-supervisory agricultural hired-worker wages. Forgone adult wages were costed using average New York earnings.

Using this wage-based approach, which excluded direct costs of fatalities such as medical expenses, Kelsey estimated that the average annual present value of expected income foregone because of fatal farm accidents in New York was over $8.6 million (in 1987 dollars).

A second study undertaken by Kelsey (1992) focused on the economic cost of tractor rollover deaths in New York over the same period, again using a survey approach. The present value of lifetime income foregone was estimated from the survey responses using discounted future earnings, as detailed in the previous study. Age and sex-specific survival probabilities for upstate New York residents were again used to weight the calculations. The study found the average income forgone was $243,615, costing the New York economy more than $2.9 million in lost earnings.

Monk et al. (1984) examined the cost of farm fatalities in Britain over the 1981–82 financial year. The costs incorporated into the model included medical treatment, damage to property, output losses, delay avoidance costs, subjective costs and potential output losses.

Medical costs were derived from data published by the Department of Health and Social Security. They were expressed in 1981–82 dollar values using health service cost index. It was assumed that for each hospitalisation, there was one emergency department occasion as well as length of stay as an inpatient.

Damage to property costs were estimated as a result of monetary replacement costs provided by farmers. No explicit account was taken of monies received in settlement of insurance claims, as they were deemed to represent a transfer payment and in the long term approximate to insurance premiums that had been paid.

Output losses were defined as being from a temporary reduction in the availability of labour or machinery following personal injury or damage to property. Such delays can have a significant impact on output, given the seasonality of agricultural production and critical periods of work, such as sowing or harvest. There were four methods employed to estimate output losses:

- On-farm labour costs: when on-farm labour was reduced, but no additional labour was hired, it was argued that the value in lost output will be reflected in the average product of the injured person, and therefore, in their average wage.

- Seasonal labour costs: as the importance of a loss in labour availability is highly dependent on seasonal and commodity demands, a series of seasonal weights were derived from seasonal labour profiles for different production systems and scales.
- Timeliness penalties: for particular seasonal farming operations, it was possible to estimate the output loss caused by a critical delay using *'timeliness penalties'*, which originated from agronomic research data and enabled estimates to be made of physical reductions in crop yields.
- Contractor costs: the cost of hiring temporary labour and/or machinery services.

Delay avoidance costs were applied to cases where the farmer may be willing to pay for extra factors of production for a short period, including contractors, machinery, labour or overtime.

For fatalities, two additional costs were factored into the model; subjective costs, which were a measure of pain, grief and suffering caused by the accident; and potential output loss, which is the societal loss of the deceased's output. The subjective cost was estimated at £54,000 per fatality, while potential output cost was calculated using an annual worker cost multiplied by the number of years of economically active life lost, which was then discounted. The retirement age was assumed to be 65 years.

During the study period, there were 56 fatal accidents, which using the costs detailed above, were estimated to cost the British economy £4.64 million in 1982 values, at an average value of £84,140 per fatality.

2.4.2 Australian studies of economic burden of farm-related fatalities

There is little information available about the cost of farm-related fatalities in Australia. While some studies broadly examine the cost of agricultural injuries as a whole, there is no study that specifically addresses the economic cost of farm-related fatalities.

A study conducted by the ASCC (Australian Safety and Compensation Council, 2009b) estimated the costs of work-related injury and illness for Australian employers, workers and the community using a human capital approach. The following costs were modelled in the study:

- production disturbance costs: costs incurred in the short term until production is returned to pre-incident levels,
- human capital costs: long run costs, such as loss of potential output, occurring after restoration of pre-incident production levels,
- medical costs: costs incurred by workers and the community through medical treatment from work-related incidents,
- administrative costs: costs incurred in administering compensation schemes, investigating incidents and legal costs,
- transfer costs: deadweight losses associated with the administration of taxation and welfare payments, and

- other costs: costs not elsewhere classified.

Each occupational fatality was estimated to cost the economy $1,246,820 in 2005–06 (Australian Safety and Compensation Council, 2009b). Given that there were 12 agricultural fatalities in the workers' compensation database (Australian Safety and Compensation Council, 2009a) during that year, it could therefore be estimated that agricultural fatalities cost the economy $15 million in 2005–06.

However, while the methodology employed by the ASCC was robust and took a similar approach to international economic cost of occupational fatality studies, the considerable limitations associated with workers' compensation statistics implies that these results significantly understate the economic cost of farm-related fatalities in Australia. Further information relating to the limitations of the workers' compensation data is contained in Chapter 3.

2.5 Farmers' perceptions of farm safety, risk and change

Much of the literature related to health and safety on Australian farms has been related to cross-sectional surveys or data collection, which has been critical in the definition of industry priorities and OHS programs (Australian Safety and Compensation Council, 2006; Day and Stathakis, 2004; Durey and Lower, 2004; Sandall and Reeve, 2000). However, there is little information on the uptake and impact of OHS programs. Farmers routinely suggest that farm safety takes too much time, is too costly and involves too much paperwork, but there are changes being done to OHS systems on farms. So what are these changes? What is driving them to make changes? How do documented key hazards rate in comparison to what farmers see as risks on their farms?

Day and Stathakis (2004) undertook a qualitative and quantitative study to monitor changes in farm safety in Victoria over the period 1997–2001. Two random, cross-sectional surveys were conducted which aimed to determine the changes in farm safety behaviour and practices, factors that may have contributed to the observed changes, relationships between farm safety programs and behaviour, practices and physical changes and any differences in behaviour and results between commodity systems.

They found that farmers were indeed making changes to OHS systems and practices on their farms, with small increases in the number attending training sessions, the number of tractors with Roll-Over Protection Structures (ROPS) and the number of farmers using safety equipment and devices. Over the same period, there was a 14 per cent reduction in serious work-related injuries. The link between these changes and the reduction in injury was reported as being unclear, and it was noted that as the surveys were cross-sectional, temporal relationships between changes in behaviour and practice and injury reduction could not be firmly established.

Recommendations were made to investigate the feasibility of a longitudinal study to assess whether improved safety behaviour leads to a reduction in injuries, and for literature reviews into the effectiveness of farm safety campaigns and uptake of farm safety interventions.

Durey and Lower (2004) investigated the attitudes and beliefs of a small sample of Western Australian farmers, focusing on the development of a safety culture and the reluctance of farmers to adopt State regulations for occupational health and safety. The study found that despite improvements in the awareness and importance of farm safety, significant gaps existed between knowledge and practice.

While most rated the standards of safety on their farms as '*high*', there was a very strong message that farm safety was not a prime consideration on their farms, falling victim to a production and profit related focus. When participants were asked how they may modify current practices to enhance safety on their properties, the standard response was to update machinery. This not only improved safety, but also resulted in increased productivity. However, it was the productivity that was the key issue. They were also driven by improvements in ease of management and cost efficiency, again, with the safety improvements being more of a by-product. While the majority of participants believed that some regulations for farm safety were necessary, most felt they were impractical and were unsure how to comply.

From a behavioural change perspective, the primary means by which farmers learnt about injury risks and prevention measures was dependent on personal relevance. Aside from financial factors, experiencing an injury first hand or knowing someone locally who was involved in a serious incident were the main factors in driving changes to production and management systems.

Sandall and Reeve (2000) researched the attributes of farm hazards that are used by farmers to make decisions about accepting or reducing the risk associated with the hazards and also to produce and interpret perceptual maps to illustrate how farmers perceive hazardous situations that can lead to physical injury, relative to other hazards they face in the farming occupation.

They observed consistent patterns in the combinations of attributes that farmers associate with different hazards. For example, animal handling hazards tend to be associated with high likelihood, low controllability and low consequences, while machinery hazards tend to be associated with moderate likelihood, high controllability and high consequences.

The issue of controllability raises key issues for safety promotion approaches. Perceptions of '*low control'* can lead to difficulties in encouraging farmers to take preventative action for perceived low control hazards and *'high control'* hazards can result in farmers concluding that no further action is required, as the matter is in hand.

The idea of '*perceptions of relevance'* was also investigated and it was observed that when farmers' perceptions of the relevance of hazards were compared with information provided on the production context of their farms, there was an imbalance, in that a hazard may be present on a farm, yet a farmer may judge the hazard to be irrelevant for their situation. Graziers were an excellent example of this theory, with 20 per cent of graziers surveyed reporting that animal handling injuries were irrelevant to their situation.

The ASCC (2006) conducted a qualitative study into the improvement of occupational health and safety outcomes in Australian agriculture. Their aims were to identify the drivers or motivators influencing behaviour change, determine the critical issues, barriers and gaps preventing improved OHS performance, establish why recent efforts were not leading to an improvement in OHS in agriculture and to define pivotal national actions or key characteristics likely to address the critical issues identified and build upon drivers of behaviour change to inform the design and delivery of future national actions or projects.

The study highlighted that attitudes to safety were a significant barrier to the successful uptake and implementation of OHS programs in agriculture. Many respondents believed unsafe behaviour, or calculated risks, were acceptable, if you '*knew what you were doing'* and that *'common sense'* is a major requirement in avoiding farm injury. Another interesting observation was that near misses may improve the awareness and behaviour around a particular piece of machinery or equipment, but it doesn't translate to an improvement in their overall attitude to safety.

As observed in earlier studies, the ASCC found that to some extent, safety requirements and financial considerations were seen as competing priorities and there was the distinct perception that safety costs money.

Of concern was the observation that farmers described themselves as experts in farm safety and that many accidents could be explained away as carelessness, which whilst not desirable, was an understandable consequence of busy farm lifestyles.

Legislation was negatively perceived by all study respondents. While some negativity was more philosophical, such as the need for autonomy and personal responsibility, others saw it as offering no improvement to farm safety and in some cases even creating more hazards than they alleviate. The risk and overshadowing of legislation was a frequent concern and inhibitor in the hiring of outside labour.

A study by Knowles (2002) into the perceptions and risk taking of farmers in England and Wales found that, like Australian studies, farmers were aware of certain dangers and hazards, but continued to take risks, regardless. The report found that 56 per cent of farmers admitted to using machines with unguarded power take off shafts, despite being aware of the dangers associated with this practice. However, the study did recognise that there is an element of risk taking that can be attributed to a lack of awareness of the risks of injury.

Murphy (2003) further demonstrates this point through his discussion of the '*risk paradox*'; the considerable incongruence and large disconnects between farm people's safety knowledge, values and practices.

Murphy states that:

> While farmers understand farm work is potentially dangerous, they seem relatively unconcerned about their risks of injury, particularly in comparison to other, more immediately perceived concerns such as product prices, machinery repair, work loads, etc. Nor do farmers' perceptions of hazards and risk match up well with injury records. Finally, despite parents' concern for their children's safety and health, parents routinely expose their children to the same life-threatening work hazards and risks that they accept. (Murphy, 2003, p. 27)

This concept of the risk paradox is problematic for proponents of agricultural health and safety, as it suggests that approaches to farm health and safety research, education and intervention must consider the interconnectedness among the many facets of farming, and how they influence the cultural beliefs and practices of farmers. Therefore, they must embrace the fundamental social, political, environmental and economic realities shaping farming's culture and future (Murphy, 2003).

2.6 Farm safety intervention approaches

There has been substantial research into farm safety interventions. The most common intervention approach tends to be through education and awareness programs, but Murphy et al. (1996) challenge the success of this approach, suggesting farmers are not making the connection between the education and awareness programs and the elimination, reduction and control of physical hazards and the modification of work behaviour that may cause injury.

Stavea et al. (2007) follow this notion further, suggesting the focus of interventions is often on technical measures, aiming at controlling specific hazards, and while this may result in risk reduction, social and psychological factors hindering or promoting safety activity ought to be further explored. Their approach was to create socially supportive networks of Swedish farmers to encourage discussions and reflection, focusing on risk manageability. They found that while there were no changes to risk perception and perceived risk manageability, there was a significant increase in safety activity and a significant reduction in stress and risk acceptance.

2.7 Australian farm safety intervention approaches

The idea of elimination, reduction and control of hazards raised by Murphy et al. (1996) and Stavea et al. (2007) are in line with the approach taken by Australian work safety authorities, where it is referred to the '*Hierarchy of Control'* (Figure 2.1).

This hierarchy approach involves the legal obligation to apply the five levels of control, or a combination of the five levels, in the order specified, to minimise the risk to the lowest level reasonably practicable (New South Wales Government, 2001).

The hierarchy is based on the ten countermeasures of Haddon (1973) for injury prevention and focus on how to control, modify and interrupt energy that will cause injury. The countermeasures and how they relate to the hierarchy of control are detailed below.

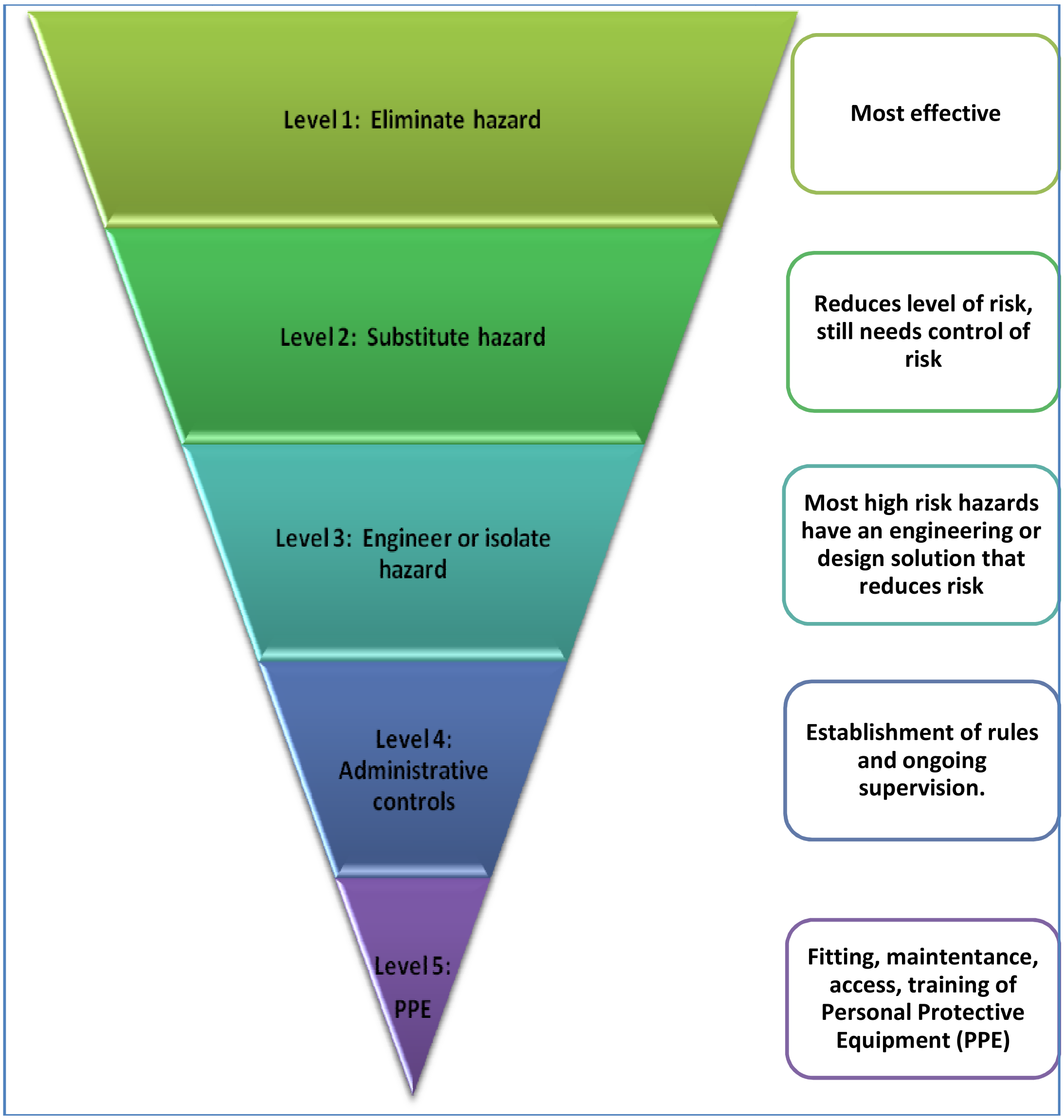
1. Prevent the marshalling of the form of energy in the first place: Eliminate the hazard.

2. Reduce the amount of energy marshalled: Engineer or substitute the hazard.

3. Prevent the release of the energy: Eliminate, engineer or substitute the hazard.

4. Modify the rate of spatial distribution of release of energy from its source: Use PPE.

Figure 2.1: Hierarchy of Control



Source: Adapted from Pollock, Fragar and Temperley (2008)

5. Separate in space or time, the energy from being released from the susceptible structure: Isolate the hazard.
6. Separation by interposition of a material '*barrier*': Isolate the hazard, PPE.
7. Modify appropriately the contact surface, subsurface or basic structure: Engineer the hazard.
8. Strengthen the structure: Administrative controls, PPE and training.
9. To move rapidly in detection and evaluation of the damage that has occurred or is occurring, and to counter its continuation or extension: Administrative controls and training.
10. The measures between the emergency period following the damaging energy exchange and the final stabilisation: Administrative controls.

Essentially, the hierarchy is weighted towards design-based solutions over a dependence on modifications to worker behaviour and practice. The first instance is to eliminate the hazard, that way the associated risk is completely removed. If it is not practicable to remove the hazard, the next step in the model is to substitute the hazard for another process, mechanism or machine than is of less risk. If this is not possible, then the next approach is to re-engineer or design the work process or isolate the worker and others from the hazard. Failing engineering solutions, the fourth level of the model is to use administrative control to reduce the risk, including setting and maintaining rules and standards for work processes, providing training, skills maintenance, safety inductions to workers and new machinery and systems. Finally, if all these measures are not reasonably practicable, then the last resort of risk minimisation is the provision, use and maintenance of personal protective equipment (PPE).

Australia's national farm health and safety advisory association, Farmsafe Australia, has been at the forefront of farm safety and awareness since its inception in 1988. Over this time it have implemented a range of initiatives targeted at rural Australia.

Farmsafe Australia member agencies have been directly involved in the development, promotion and implementation of the following initiatives, program activities and advisory boards:

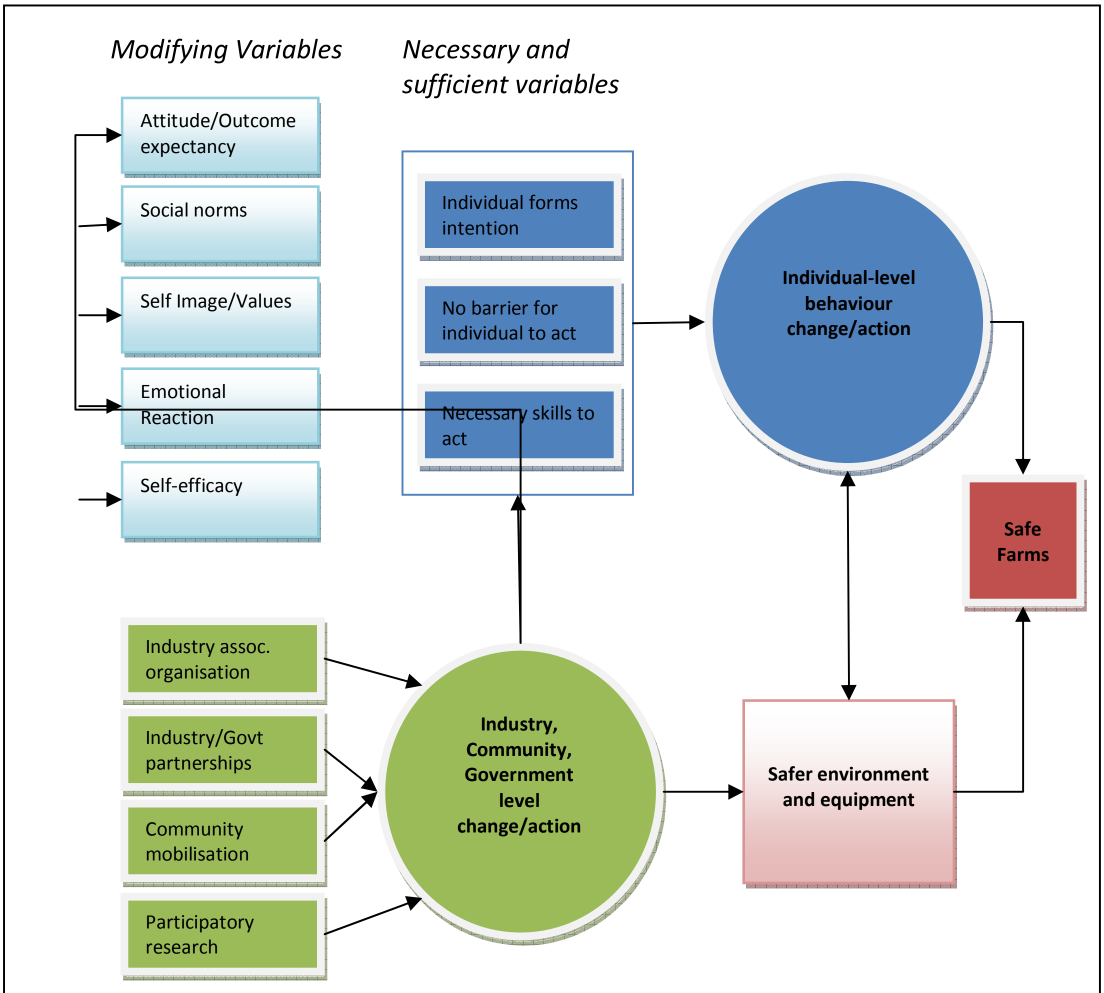
- Local community action, including Farm Safety Action Groups,
- Development and promotion of information resources and safety tools for managing farm safety risk at the industry level,
- Education and training, including national vocational competency standards, Managing Farm Safety Short Course, informal training and fields days,
- Media promotion,
- Financial incentives, including a government subsidy to fit ROPS to prevent deaths from tractor roll-over, ShearSafety, Power Take Off (PTO) guard rebate, Small Business Premium Discount Scheme (PDS) in the NSW Cotton Industry,
- OHS regulation, including Pesticides Act Training Regulation and the Occupational Health and Safety Act,

- Improved machinery design, including tractor access platforms to reduce the risk of tractor runover, silo standards, guarding of hydraulic wool presses, augers, post hole diggers and post drivers and other farm machinery.
- Improved services for injured farmers and farm workers, including *AgrAbility* and the *Toolkit* for general practitioners (Fragar et al., 2009).

Fragar et al. (2009) have built on the accepted conceptual model for injury prevention developed by Gielen and Sleet (2003) using findings and recommendations from evaluated and effective Australian farm safety programs, and established an integrated framework and model for describing farm safety change behaviour. The model identifies necessary factors for achieving individual-level farmer behavioural change, along with the roles that industry, community and government can play to achieve the farm safety performance. This framework is potentially valuable for:

- Raising the profile of farm safety to become a key agricultural value by industry leaders and commodity organisations,
- Developing industry-wide and commodity-specific farm safety programs,
- Addressing specific injury risks and development of programs to effectively target these risks, and
- Programs that work to reduce risk for specific at-risk groups – children, young people and older farmers.

Figure 2.2: Model of safety behaviour change on Australian farms



Source: Fragar et al (2009)

Following the framework of this model (Figure 2.2), to be effective, farm safety strategies must:

1. Use the range of known effective drivers that prompt action – Intent.
2. Anticipate and deal in a practical way with any real and perceived barriers to action – Barriers.

3. Ensure farmers have the necessary information, skills and capacity to take the recommended action – Skills and self-efficacy.
4. Take action to address the negative attitudes as they are identified – Outcome expectancies – Attitude.
5. Build programs on the characteristics that farmers recognise as positive, for example farmer individualism and autonomy – Social norms and self-standards.
6. Recognise and deal with strongly held feelings held by some farmers about safety – Emotional reactions.
7. Have key roles for industry associations and organisations to ensure adoption of safety on Australian farms.
8. Involve governments in partnership with industry to ensure adoption of safety on Australian farms.
9. Include local community action groups and community organisations to promote adoption of safety on Australian farms.
10. Ensure empowerment and participatory research continues to be the most relevant manner of development of innovations, strategies, programs and approaches to improve farm safety in Australia (Fragar et al., 2009).

The consideration of these ten principles, when planning, designing and implementing farm safety initiatives and programs, should assist is realising optimal adoption and an overall improvement in safety systems and management on Australian farms.

2.8 Benchmarking health and safety systems

2.8.1 Overview of benchmarking

Benchmarking health and safety systems enables an organisation to compare its systems and processes with other organisations or with itself over time, with an aim to reduce accidents and ill health, improve compliance with government regulations and reduce compliance costs. It enables an organisation to determine its strengths and weaknesses and also act on lessons learned (Health and Safety Executive, 2009).

Measuring safety performance should endeavour to answer key organisational safety challenges and questions, including:

- Where are we now relative to our overall health and safety aims and objectives?
- Where are we now in controlling hazards and risks?
- How do we compare with others?
- Why are we where we are?
- Are we getting better or worse over time?
- Is our management of health and safety effective?
- Is our management of health and safety reliable and consistent?
- Is our management of health and safety proportionate to our hazards and risks?
- Is our management of health and safety efficient?
- Is an effective health and safety management system in place across all parts of the organisation?

- Is our culture supportive of health and safety, particularly in the face of competing demands (Health and Safety Executive, 2001)?

Benchmarking, or measuring safety performance, can include a number of techniques, including direct observation of working conditions and employees' behaviour and practices, interviews and questionnaires to gauge experiences, perceptions and observations of employees and the review and examination of organisational reports, documents and records.

Benchmarking should be a balanced approach and cover all elements of risk control, including; monitoring the scale, nature and distribution of hazards created by the organisations activities; active monitoring of the adequacy, development, implementation and deployment of the health and safety management system and the activities to promote a positive health and safety culture and climate; and reactive monitoring of adverse outcomes with the potential to cause injuries, ill health, loss or accidents (Health and Safety Executive, 2001).

The day to day activities of any business or organisation will result in a number of hazards. These hazards will vary in their range, nature, distribution, seasonality or timing and significance and hence impact on the associated risks, which need to be minimised. The regulatory approach in Australia requires control through the five levels of the *Hierarchy of Control* (Figure 2.1).

The health and safety climate and the culture of an organisation are important factors in ensuring the effectiveness of risk control. The health and safety management system is an important influence on the safety climate and culture, which in turn impacts on the effectiveness of the health and safety management system. Measuring facets of safety climate and culture therefore forms an integral part of the overall process of benchmarking or measuring health and safety performance (Health and Safety Executive, 2001).

Within the safety literature, the concepts of safety climate and safety culture are often used interchangeably, and there has been much debate over their definitions. Zhang et al. (2002) conducted a review of 107 studies relating to safety climate and culture, and after a comparison of study definitions and theories, established two synthesised definitions for the terms:

> Safety culture: the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety; act to preserve, enhance and communicate safety concerns; strive to actively learn, adapt and modify (both individual and organizational) behaviour based on lessons learned from mistakes; and be rewarded in a manner consistent with these values.

> Safety climate: the temporal state measure of safety culture, subject to commonalities among individual perceptions of the organization. It is therefore situationally based, refers to the perceived state of safety at a particular place at a particular time, is relatively unstable, and subject to change depending on

> the features of the current environment or prevailing conditions. (Zhang et al., 2002, p. 3)

Williamson et al. (1997) greatly enhanced the field of safety climate and culture research and the theories underpinning the development of benchmarking instruments, through their development of a measure for determining perceptions and attitudes about safety climate, as an indicator of safety culture, for use within working populations. Safety climate was defined as the safety ethic within an organisation or workplace which is reflected in employees' beliefs about safety and is thought to predict the way employees behave with respect to safety in that workplace, while safety culture referred more to the overall organisational and company level beliefs and attitudes.

The study reviewed the structure and content of older, related measures of safety attitudes and developed a 62-item questionnaire. The self administrated questionnaire was distributed to over 1,500 workers in a variety of employment positions, with a response rate of 42 per cent. To estimate the internal consistency of the items, Cronbach's Alpha was applied to the questionnaire scores.

Cronbach's Alpha is a measure of reliability, that is, the likelihood a variable generated from a set of questions will return a stable response. Alpha coefficient ranges in value from 0 to 1 and may be used to describe the reliability of factors extracted from dichotomous (questions with two possible answers) and/or multi-point formatted questionnaires or scales (for example, rating scale: 1 = poor, 5 = excellent). The higher the alpha score, the more reliable the generated scale (Santos, 1999).

Table 2.2: Safety Climate Questions

Factor 1: Personal motivation for safe behaviour (alpha = 0.86)

- v41 It would help me to work more safely if my supervisor praised me on safe behaviour
- v42 It would help me to work more safely if safety procedures were more realistic
- v43 It would help me to work more safely if management listened to my recommendations
- v44 It would help me to work more safely if we were given safety training more often
- v45 It would help me to work more safely if the proper equipment was provided more often
- v46 It would help me to work more safely if management carried out more workplace safety checks
- v47 It would help me to work more safely if my workmates supported safe behaviour
- v48 It would help me to work more safely if I was rewarded (paid more) for safe behaviour

Factor 2: Positive safety practice (alpha = 0.84)

- v59 Our management supplies enough safety equipment
- v60 Our management checks equipment to make sure it is free of faults
- v61 There is adequate safety training in my workplace
- v62 Management in my workplace is as concerned with people's safety as it is with profits
- v63 Everybody works safely in my workplace
- V64 All the safety rules and procedures in my workplace really work

Factor 3: Risk justification (alpha = 0.79)

- v51 When I have worked unsafely it has been because I was not trained properly
- v52 When I have worked unsafely it has been because I didn't know what I was doing wrong at the time
- v53 When I have worked unsafely it has been because I needed to complete the task quickly
- v54 When I have worked unsafely it has been because the right equipment was not provided or wasn't working

Factor 4: Fatalism (alpha = 0.65)

- v12 Safety works until we are busy then other things take priority
- v16 If I worried about safety all the time I would not get my job done
- v24 I cannot avoid taking risks in my job
- v26 Accidents will happen no matter what I do
- v25 I can't do anything to improve safety in my workplace

Factor 5: Optimism (alpha = 0.39)

- v27 It is not likely that I will have an accident because I am a careful person
- v29 Not all accidents are preventable, some people are just unlucky
- v23 People who work to safety procedure will always be safe
- v4 In the normal course of my job, I do not encounter any dangerous situations.

Source: Williamson et al (1997)

While the alpha score was high, 0.81, the original set of 62 questions was considered too lengthy for acceptable use in the workplace, so questions were re-evaluated based on their level of skewedness, resulting in 30 items being removed from the set of questions. This led to very little loss of reliability, with the overall alpha for the set of questions remaining high, at 0.71. The remaining 32 questions are contained in Table 2.2.

The Williamson et al. study focused on five key categories of safety climate; personal motivation for safe behaviour, positive safety practice, risk justification, fatalism and optimism; and found there was little variation between respondents on a large proportion of the questions. Furthermore, the research found the set of questions to measure workplace perceptions and attitudes about safety demonstrated an acceptable internal consistency. They also appear to have reasonable validity, in that employees who had experienced accidents differed from those who had not and workers who perceived workplace hazards differed from those with no hazards in their workplaces.

The strongest response in the study was personal motivation for safe behaviour, reflecting the widely held belief that there are issues within the workplace that prevent employees from working safely. Following on from this was risk justification, suggesting that workplace systems cause the unsafe behaviour to occur. Positive safety practice reflects the perceptions of the role and commitment of management to safety. Fatalism refers to the importance and controllability of safety, while optimism reflects the extent that the individual believes that their level of personal risk is favourable.

Several questions used in the study related to both the attitude of the participant towards safety and also their perceptions of safety in their workplace. The use of both these measures enables insight into safety from two different perspectives. The attitudinal questions highlight participant beliefs about safety which may have been developed through experiences both inside and outside the workplace. The perception-based questions, while still examining safety beliefs, refer more towards participant views of reality in their workplace. In this way the suite of questions covers more general safety beliefs as well as perceived problems or issues within the workplace.

2.8.2 International benchmarking in agriculture

Hodne et al. (1999) developed the *Farm Safety and Health Beliefs Scale* (FSHBS), a measure derived from the Health Beliefs Model, which focuses on five constructs:

- Susceptibility: a person's sense of risk or likelihood that they may experience a farm-related health problem or accident,
- Benefits: beliefs about the effectiveness of a farm safety behaviour in reducing the threat of a health condition,
- Barriers: impediments to performing a farm health and safety behaviour,
- Self-efficacy: the perceived ability to perform a farm health and safety behaviour, and

- Severity: the negative consequences of a health problem or accident.

Based on these constructs, a series of questions were developed that were tested on a random sample of 259 participants from the *Certified Safe Farms* project; a project designed to reduce injuries and illnesses amongst farmers. From an original measure with 39 questions, 15 were found to have no load on a factor and were removed from the scale. This resulted in a suite of 24 questions that formally constitute the FSHBS (Table 2.3).

The study found that farmers' perceptions of their abilities to perform health behaviours in general were moderately correlated with their views on their abilities to perform farm health and safety behaviours. Farmers who performed better on general health behaviours also perceived more benefits and fewer barriers to practicing farm safety behaviours. They also felt less vulnerable to farm-related accidents and illnesses, and also expect less severe consequences should one occur. Finally, farmers placing more value on their overall health also placed more value on the benefits of implementing farm safety practices.

When the scoring on individual elements were examined, farmers scored highest on the benefits factors, followed by self-efficacy, which is in line with research that farmers tend to acknowledge the importance of farm health and safety practices and have adequate knowledge and understanding on its implementation.

Table 2.3: Farm Safety and Health Beliefs Scale

Factor 1: Susceptibility

- 36. It's very likely that a family member of I will have a farm-related accident or illness
- 6. Common activities and parts of the physical environment on our farm make it likely that someone will have a serious farm-related accident or illness someday
- 16. My usual stress level makes it likely that I'll have a farm-related accident someday
- 1. My heavy workload and long hours make it likely that I'll have a farm-related accident someday
- 31. Our farm's financial condition makes it likely that I'll have a farm-related accident or illness someday
- 21. I'm more likely than the average farmer to have a farm-related accident or illness

Factor 2: Benefits

- 22. Reducing farm hazards helps me meet my obligation to provide a safe workplace
- 12. The best way for me to protect my family's health is to reduce farm hazards
- 17. Spending money to reduce farm hazards is a good long-term way to save money
- 23. Removing hazards and focusing on farm safety and health priorities are *not* high priorities compared to other things I must do
- 7. Eliminating farm hazards is one of the best ways to maintain my ability to work
- 2. Practicing good farm safety habits is one of the best ways to maintain my health
- 27. Correcting hazards on our farm reassures me and gives me peace of mind

Factor 3: Barriers

- 35. I'm always able to focus attention on practising good safety and health habits, regardless of what is happening and how I feel
- 37. It's hard to find the time to eliminate hazards on our farm
- 18. I'm likely to practice farm safety and health-protection behaviours even if they're uncomfortable or unpleasant
- 3. Many things keep me from correcting hazards and practicing good farm health and safety habits

Factor 4: Self-efficacy

- 10. I'm quite accurate and thorough in identifying hazards on our farm
- 20. I'm very confident and competent in correcting hazards on our farm
- 25. I'm able to correctly perform most farm safety and health-protection behaviours
- 26. My alertness and concentration makes it *unlikely* that I'll ever have a farm accident

Factor 5: Severity/Finances

- 9. If a family member or I had a serious farm-related accident or illness, I'd face major financial hardship
- 13. I haven't corrected some farm hazards because of the related financial cost
- 29. If a family member or I had a major farm-related accident or illness, our health insurance would not adequately cover the costs

Source: Hodne et al. (1999)

Farmers scored lowest on susceptibility factors, implying their disagreement with the likelihood of farm injury or illness. Given the prevalence of farm accidents, this suggests an optimistic bias on the part of the farmers.

BOMEL Limited (2004) conducted a study into the understanding and influencing of farmer attitudes, though a series of interviews with 35 farmers in the south-west and south-east of England.

Responses to questions were examined qualitatively and quantitatively to estimate an overall safety attitude rating based on perceptions of five core safety issues; productivity versus safety, health, training, guidance and personal protective equipment.

To make the link between attitude and behaviour, behavioural risk ratings from the interview were applied to accident experience, and these results were analysed against participant safety attitude scores to determine whether positive safety attitudes also have positive safety behaviours.

Of the 35 farmers interviewed, 31 were found to have overall positive attitudes, three negative attitudes and one had a neutral safety attitude. Just one farmer was reported to have an overall negative behavioural risk rating.

A breakdown of safety attitudes revealed the following key findings:

- Production versus safety: 15 respondents were rated with a negative value, in that increasing commercial pressures that exist in agriculture were seen to put an emphasis on production volumes rather than the need to work as safely as possible. A further 19 respondents scored positively for this category.
- Health: 15 farmers received a negative score, believing that their health is *not* affected by working in agriculture. The remaining 20 scored positively, believing the demands of their job can affect their health.
- Guidance: Followed the pattern of the previous categories, with 15 farmers receiving negative ratings, implying that further guidance on farm health and safety was not required.
- Training and PPE: almost all respondents for these two categories received positive scores, recognising their importance in agriculture.

Whilst overall, behavioural risk ratings were positive, there were splits between negative and positive for the categories of health and guidance.

There were also demonstrated links between attitudes and behaviours for the core safety issues of training, personal protective equipment and guidance. This was particularly evident in training and personal protective equipment, with all but one farmer having positive attitudes and positive behaviours. In contrast, there were no apparent links between attitudes and behaviours for productivity versus safety and health.

2.8.3 Australian agricultural benchmarking

A common concern among farmers is that they are implementing changes to their management systems, machinery and day-to-day farm management, but they have no feel for how well they are performing from a farm health and safety perspective, nor whether they would be seen by work safety authorities to have taken all reasonable steps to minimise risk, should the Authority conduct an inspection on their property.

In 2001 the NSW WorkCover Workers' Compensation scheme instigated a Premium Discount Scheme, which offered an incentive of reduced workers' compensation premiums to employers implementing programs to improve workplace safety and return-to-work strategies for injured workers. The employer would receive up to a maximum of 15 per cent discount in year one, 10 per cent in year two and five per cent in the final year of the scheme, on the successful completion of an audit of their occupational health and safety and injury management systems (WorkCover NSW, 2001b). Different programs were established for small business and larger companies.

The WorkCover NSW Premium Discount Scheme Small Business Strategy was delivered to cotton enterprises in NSW by the Australian Centre for Agricultural Health and Safety (ACAHS), with support from the Australian cotton industry.

Of the 156 cotton growers with less than 20 employees registered to participate in the program in 2001, 131 met the benchmarks and successfully completed the program. In the first year of the program, participants completed the Farmsafe Australia's

Managing Farm Safety training, to assist in gaining the skills, knowledge and resources to manage safety systems (Temperley, 2005).

In the second year of the scheme, businesses implemented an OHS and injury management system and received further resources and advice in the implementation of their systems.

In the final year of the scheme, the safety and injury management systems were audited, using a series of farm benchmarks. The benchmarks were a combination of validated safety climate and safety culture questions from Williamson et al. (1997), with additional questions on major hazards identified as key priorities by Farmsafe Australia.

The development of the Cotton Premium Discount Scheme resulted in 40 per cent of cotton enterprises in NSW actively participating in a recognised safety management program. This resulted in significant changes to safety systems in all participating enterprises. Growers reported that the program provided a financial incentive to formalise farm safety systems within their businesses at an opportune time, particularly as the program coincided with the introduction of the Occupational Health and Safety Act 2000 and Occupational Health and Safety Act Regulation 2001 in NSW.

The benchmarking program was considered to be a useful process by the cotton growers involved. The approach and resources were specifically tailored to their needs as farmers and cotton growers, it was delivered by their industry and not WorkCover or external providers with little experience or understanding of cotton growing and its risk, and the delivery itself was in a non-litigious and practical manner. Furthermore, the audit process established a deadline, provided feedback and identified areas where further improvement to farm health and safety was required (Fragar et al., 2009; Temperley, 2005). The specifics of the agricultural benchmarking process and questionnaire are discussed in detail in Chapter 6.

2.9 Summary

Farm injury research is a challenging field of study, due to the difficulties in establishing an accurate and reliable estimate of the scale of the problem. The overlap of the farm workplace with the family home results in many injuries and fatalities occurring to children, bystanders and visitors to the farm, a factor not commonly present in other occupational industries. While there have been several international studies into the economic cost of farm-related fatalities, particularly in the United States, these have focused on occupational fatalities, and therefore would underestimate the true scale of the farm-related fatality problem. However, throughout the international literature, agriculture is universally acknowledged as one of the most hazardous occupations, due to the high incidence rate of fatalities per 100,000 workers.

Studies into the economic cost of farm fatalities generally follow a human capital approach to their analysis, although there are substantial differences in the fatality data underpinning the models. Some studies focus on work-related deaths, while others focus on a particular agent or local region as the basis of their research. Total cost estimates for fatalities are lower in agriculture than for other occupations, due to the lower average annual salary associated with agricultural occupations and the corresponding multiplying effect on lost future earnings.

A common element of research into the perceptions of farmers towards farm safety, risks and change was that despite improvements in the awareness and importance of farm safety, there was still a disconnect between knowledge and practice. That is, farmers do recognise the hazardous nature of their work, but at the same time still take risks and still see those risks as just part of their job. Changes to farm health and safety practices were far more likely to be driven by economic factors, such as improved efficiency or productivity, than a desire to improve farm safety. The farm safety improvements were more often a by-product of the economic gains.

To improve safety on farms in Australia, a '*hierarchy of control*' approach is taken to safety management. The hierarchy has five levels of control measures, ranging from the high level removal of hazard, through to more administrative controls, such as the provision of PPE. The lower down the hierarchy of the hazard control, the lower the reduction in risk.

In order to ascertain how a business or organisation is performing from a health and safety perspective, it is possible to establish a measure of safety performance that will enable comparisons over time or across a group of organisations. This process is known as safety benchmarking. There are many instruments around to assist in benchmarking safety systems, with several applicable to agriculture.

There are many gaps in the literature relating to the economic cost of farm-related fatalities and also the factors that are influencing changes on Australian farms, including: perceptions and attitudes, changes to management processes, control of major hazards, drivers for change and the risks and hazards that farmers identify on their farms. This research aims to address some of these information gaps and to improve the effectiveness of Australian farm health and safety interventions and initiatives.

3. Farm-related injury information sources in Australia

There are three primary sources of farm-related injury data; workers' compensation statistics, hospital inpatient and emergency data, and for fatal injuries, there is also the information collected as part of the coronial investigation process.

Unfortunately, there are a range of significant issues associated with the availability, quality, timeliness and suitability of the data sources, and thus, there is no single source that is able to paint an accurate and comprehensive picture of the status of farm-related injuries in Australia.

A common underlying theme across the three data sources is that they were each set up as internal record management systems, as opposed to injury surveillance and/or prevention tools, and therefore, while they offer some research value, their potential is limited by gaps and inconsistencies in their implementation.

This chapter details the sources of farm-related injury data and discusses their availability, scope, data elements and limitations.

3.1 Workers' compensation

Whilst workers' compensation statistics are generally an excellent source of occupational injury data, their application to agricultural-related injuries and/or fatalities is far less reliable than in other industries, due to the unusual structure of the farming sector.

Unlike most production based industries, the proportion of family owned and operated farms in Australia is very high, estimated at between 90 and 99 per cent (Australian Safety and Compensation Council, 2006; Clark, 2008; Guthrie, Goldacre and Westaway, 1997). Consequently, many farm managers are self-employed and therefore fall outside of the reporting and governance requirements of occupational health and safety legislation.

This issue was well summarised by Kelly (2004) at the Robinvale District Health Service's Public Hearing for the Parliamentary Inquiry into the cause of fatality and injury on Victorian farms:

> In a farm situation, as we all know, there is a very collegial association within a small group, especially in dryland farming. If you spoke to one employee, they have got a long history et cetera, and they have a close, almost family relationship. Often it is a family relationship. It could be the son, the cousin, the wife – whatever. They will not be processing a WorkCover case; they will just say it is an injury. (Inquiry into the cause of fatality and injury on Victorian farms, 2004, p.27)

This statement is further emphasised by Victorian WorkCover Authority estimates that only around 15 per cent of agricultural injuries and disease result in a WorkCover claim (Victorian WorkCover Authority, 2004).

From a fatality perspective, a study conducted by Driscoll et al. (2003) matched work-related fatalities by State and Territory OHS and compensation agencies against fatalities deemed work-related in coronial records. Across all industries, 33.7 per cent of fatalities were not reported to either OHS or compensation agencies. However, in the agricultural sector, which contributed the second highest number of fatalities in the study (n=308, 19.3 per cent), there was a far higher percentage of fatalities not being recorded by OHS or compensation agencies, at 50.3 per cent.

The other clear limitation of workers' compensation data is that it cannot account for injuries and fatalities relating to children or family members involved in unpaid work on farms, nor those who are bystanders to work at the time of injury.

3.2 Hospital data

There are two types of hospital data available that are of particular interest and relevance to injury research; emergency department data and inpatient data. Like other injury data sources, the primary focus of these datasets are for internal records management, and due to each state and territory having their own data collection systems, both the level of detail, data completeness and accuracy may vary between jurisdictions.

The more comprehensive of the two collections is the inpatient data, which records data on all persons who undergo a hospital's formal admission process to receive treatment and/or care. This includes admissions to public hospitals, public psychiatric hospitals, public multi purpose services, private hospitals, private day procedure centres, and sleep disorder centres. The collections generally exclude private residential aged care facilities, Commonwealth funded residential aged care facilities and beds, and hospital boarders (NSW Health, 2001b). Clinical coders at hospitals or health services code medical record information for each hospital admission episode and enter the data into a database that is periodically uploaded to a central data repository (Muscatello and Mitchell, 2001). As previously stated, each state and territory maintains its own inpatient data collection, and therefore there will be differences in the policies and procedures governing data collection and coding.

Inpatient data collections report on an extensive number of items including patient demographics, admission and discharge details, general episode items and clinical episode items (NSW Health, 2001b). Of particular interest to farm injury-related research are the fields relating to length of stay, mode of separation, principal diagnosis, external cause of injury, place of occurrence of external cause of injury and activity when injured.

Using the Australian Modification of the International Classification of Diseases (ICD-10-AM) coding, it is possible to use the code '*Y92.7'* to extract all inpatient cases within a given period which were nominated to have occurred on a farm. Unfortunately, the completeness of inpatient data has to be questioned, in that it firstly relies on the patient nominating the farm as the place of accident, which they may be reluctant to do due to the perceived risk of a work safety authority investigation. Secondly, it must actually make it onto the clinical notes to be entered into the data collection, so if hospital staff are distracted, under pressure, or do not perceive the location of the incident as relevant information, it may escape data entry, even if it has been nominated by the injured.

Another limitation of this type of collection is that there may be multiple counting of the same incident, if there are several readmissions for the same injury or complications from the injury.

The second form of hospital data, emergency data, is a far less detailed collection, generally including fields on demographics, arrival and departure details, triage categories and clinical data for all emergency presentations (NSW Health, 2001a) . The primary problem with emergency department data is that it is often coded by emergency department staff as they are doing their clinical work, so the accuracy and consistency of the coding depends on pressure and time availability in the workplace, the familiarity with the coding system and other workplace issues. It is therefore recommended that emergency data should only be used for indicative information and broad injury analyses (Muscatello and Travis, 2001).

3.3 Fatality data

When a fatality occurs, if the death is deemed reportable, it must be referred to the State Coroner to investigate the circumstances and cause surrounding the fatality. A reportable death includes those in which:

- the person died unexpectedly and the cause of death is unknown,
- the person died in a violent or unnatural manner,
- the person died during or as a result of an anaesthetic,

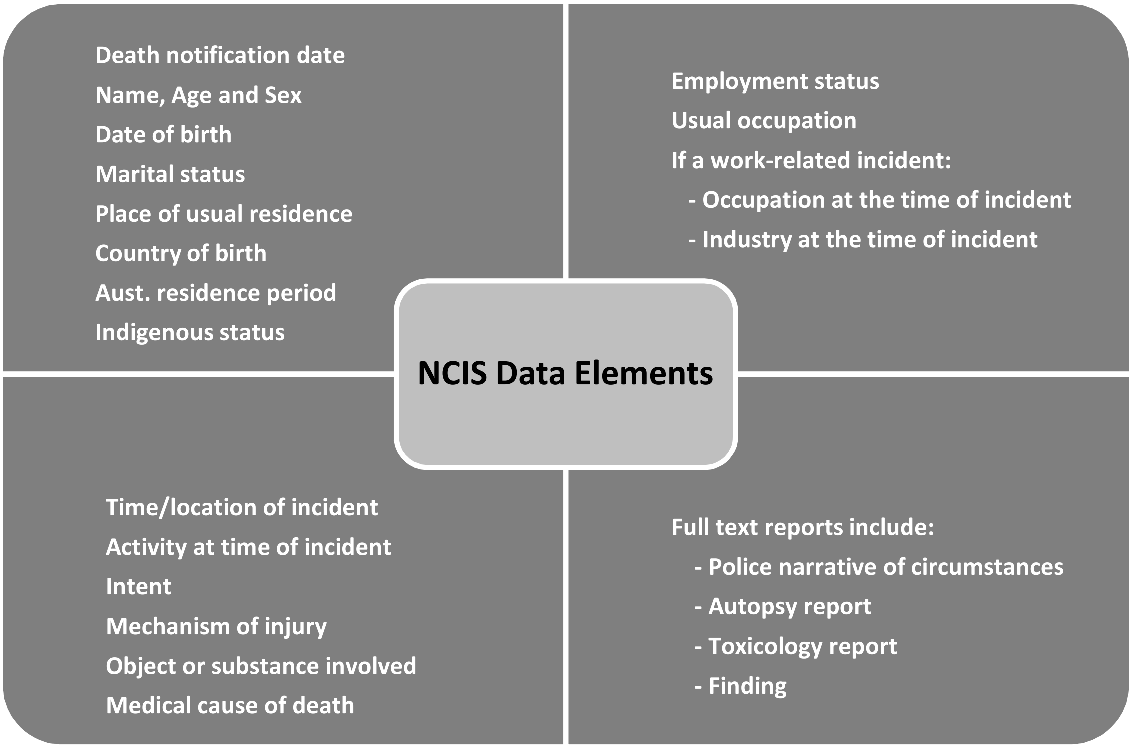
- the person was held in care or in custody immediately before they died,
- a doctor has been unable to sign a death certificate giving the cause or death, or
- the identity of the person who has died is not known (National Coroners Information System, 2009a).

In 2000, the National Coroners Information System (NCIS), a national collection of coronial records and information was launched. The NCIS was the first such system of its kind, anywhere in the world (National Coroners Information System, 2009b).

Each Australian State and Territory has a licence agreement with the Victorian Institute of Forensic Medicine, to permit the transfer of coronial information for storage and dissemination via the NCIS. Case management systems are used at each Coroner's office, and the fields are populated by Coronial Clerks using information contained in coronial files. Once data entry is complete, the case management systems are uploaded to the NCIS on a regular basis. All information transferred to the NCIS conforms with State and Federal Privacy legislation (National Coroners Information System, 2009c). Figure 3.1 details the data fields available in the NCIS.

While the NCIS is a comprehensive source of fatality information, it is not without its limitations. The manual nature of data entry means there will inevitably be errors in coding, which can to some extent be monitored and controlled, but more importantly, it leaves itself open to discrepancies in coding due to value judgements made by the Coronial Clerks. Whilst training is undertaken on the system, how particular circumstances are coded will depend on the understanding and perceptions of the data operator.

Figure 3.1: Data elements collected in the NCIS



Source: National Coroners Information System (2009d).

As previously discussed, the setup and layout of the NCIS as a records system, not an injury research tool, can be problematic. Of particular concern is that cases can only be searched using key words when the case has been closed by the Coroner, and this can, in some cases take years. Therefore, the completeness of any data extraction may take some time to be achieved.

Differences in state and territory emergency service systems are also problematic. The information provided in police narratives varies substantially between jurisdictions in the level of detail provided. Some narratives are a wealth of information, whilst others may just state where the deceased was found, without any detail of the circumstances and environment surrounding the fatality. Additionally, not all reports are attached to each case, so without a police report, if other text fields have not been populated, it can be very difficult to ascertain the events and circumstances leading to the accident.

However, while there are these limitations with the data, it is still one of the world's most comprehensive, readily searchable tools for fatality-based research, and offers significant value to injury prevention researchers.

3.4 Other sources

While workers' compensation, hospital and fatality data are able to paint a reasonable picture of the nature of the farm-related injury problem in Australia, there are many other cases that may fall under the radar, such as visits to general practitioners and allied health providers, including physiotherapists, chiropractors, osteopaths and pharmacists.

These cases may be less consequential in their severity, but they can still result in a considerable cost burden, through days off work, travel, medication and prolonged treatment costs. Regrettably, there is little potential for further development and understanding of the prevalence and nature of these cases.

3.5 Farm-related injury statistics

In order to illustrate the scale of the farm-related injury problem in Australia, this section details some of the workers' compensation, hospital inpatient and fatality data presently available.

As discussed previously in this chapter, the uniformity, quality and availability of farm injury information varies substantially. A sample of publicly available data is presented below, which demonstrates the variability in timeframes over which data have been collected, as well as its coverage (national versus state-based).

Table 3.1 outlines the number of workers' compensation claims lodged with state-based work safety authorities on a financial year basis. The average number of claims per 100,000 workers over 2000–01 to 2004–05 was 26.7 for the agricultural industry, far higher than the all industries average of 15 claims per 100,000 workers (Safework Australia, 2008).

Table 3.1: Workers' compensation claims in the agricultural industry, Australia, 2000–01 to 2004–05

	2000–01	2001–02	2002–03	2003–04	2004–05
No. non-fatal claims	4,274	4,237	4,027	3,747	3,604
No. fatal claims	16	13	18	18	11
Total claims	4,290	4,250	4,055	3,765	3,615
Claims per 1,000 workers	26.9	24.1	27.3	25.2	24.8

Source: Safe Work Australia (2009)

Unfortunately, unlike workers' compensation data, there is no single repository for hospital data that is readily accessible. Due to ethics submissions being required to access inpatient data, only information available in the public domain was reviewed for this section. The most comprehensive of this data was for NSW, and is summarised in Table 3.2.

Table 3.2: Farm-related NSW hospitalisations, by agent of injury, 1990–91 to 1999–2000

E-Code	Description	No. of cases	Per cent
E820-829	Motor vehicle non-traffic & other road vehicle accidents	4,798	30.1
	- *motorcycles*	*(1,976)*	
	- *other vehicles*	*(1,116)*	
	- *animal ridden*	*(1,706)*	
E862	Poisoning by petroleum products	13	0.1
E863	Poisoning by agricultural chemicals	141	0.9
E864	Poisoning by corrosives & caustics	6	0
E866-869	Poisoning by other solids, gases & liquids	46	0.3
E891-899*	Fire & flames	189	1.2
E905	Venomous animal or plants	460	2.9
E906.0	Dog bite	46	0.3
E906.8	Injury by other animal	1001	6.3
E919.0	Agricultural machinery	1189	7.5
E919.1-.9	Other machinery	375	2.4
E920	Cutting and piercing	956	6
E922	Firearms	104	0.7
E810-819	Motor vehicle traffic accidents	722	4.5
E850-865**	Poisoning	170	1.1
E880-E888	Falls	1983	12.5
E900-909[#]	Natural & environmental factors	528	3.3
E910	Drowning	23	0.1
	Other E- codes[##]	3137	19.7
	Unknown	28	0.2
TOTAL		**15,915**	**100.0**

* Excluding E893.0, E895 and E898.0 (if included are in other E-codes), **Excluding E862, E863, and E864, [#] Excluding E905, E906.0 and E906.8, [##] Includes all E-codes not represented elsewhere.
Source: Fragar, Thomas and Morton (2005)

Table 3.3: Farm-related fatalities, by agent category of injury, 2001–04

Agent category	Frequency	Per cent
Farm vehicle	138	34.2
- ATV (4 wheel motorcycle)	*51*	
- 2 wheel motorcycle	*17*	
- utility	*23*	
- truck	*11*	
Mobile Farm Machinery / Plant	107	26.5
- tractor	*76*	
Farm structure	64	15.8
- dam/creek/river/irrigation channel	*35*	
- powerlines	*8*	
Working Environment	34	8.4
- tree/branch	*18*	
Animal	25	6.2
- horse	*14*	
- cattle	*6*	
Fixed Plant / Equipment	10	2.5
Workshop Equipment	7	1.7
Materials	6	1.5
Farm chemicals	2	0.5
Unknown	1	0.2
Other	10	2.5
Total	**404**	**100**

Source: Pollock, K. (unpublished) and Fragar et al. (2008).

Fatality data for the period 2001–04 was extracted from the NCIS, and it is this data that forms the basis of the study population for the economic analysis. The reason for using fatalities, as opposed to non-fatal injuries or a combination of the two is that the NCIS does capture 100 per cent of injury-related deaths; albeit that some have little case information and attachments; as all such injury deaths must be investigated by the Coroner. The method of extraction, discussed in greater detail in Chapters 4, is complex and takes considerable time, but it is possible, and certainly the most complete and comprehensive of farm injury data sources. Table 3.3 contains a summary of the number of fatalities over the period by agent of injury, while more detailed information relating to demographics is contained in Chapter 6.

3.6 Summary

While workers' compensation estimates, hospital statistics and fatalities data all vary in their ability to capture of the nature and scale of farm injuries in Australia, they clearly demonstrate that the farm injury problem in Australia is of considerable magnitude, and furthermore, due to the large number of gaps and discrepancies in injury reporting, there would need to be a substantial body of work completed to enable the generation of a single, comprehensive, accurate fatal and non-fatal farm injury data source.

4. Economic cost of farm-related fatalities – Methodology

The methodology presented in this chapter relates to the first of the two components contained in this research; the economic cost of farm-related fatalities. The chapter first reviews the three most commonly used approaches for calculating the economic cost of injuries or illness – human capital, friction cost and willingness-to pay – and discusses their suitability for application to Australian farm-related fatalities. The economic model selected for analysis is presented, as well as the assumptions and data sources required for its population and modelling.

4.1 Methodologies for calculating the economic cost of farm fatalities

There are three common approaches to measuring the economic cost of injuries or illness: human capital, friction cost, and the willingness-to-pay approach. While these approaches explore different aspects of the value of human life and how it is measured, the economic costs of a fatality remain a central theme.

There are two categories of costs used in cost of injury studies; direct and indirect costs. Direct costs, while varying between analyses, are generally specific costs stemming from the treatment, care and rehabilitation of an injury that take the form of actual monetary payments. Indirect costs refer to the value of lost resources, including lost leisure and work time, particularly output, production and earnings (Access Economics, 2004; Public Health Agency of Canada, 1998; Rice, 2006). Table 4.1 details the direct and indirect nature of the costs associated with farm-related fatalities.

Table 4.1: Direct and indirect costs of fatalities

Category	Conceptual Group	Details
Direct Costs	Medical Costs	Public health system payments
		Gap payments
		Private health insurance payments
		Ambulance costs
	Administrative Costs	Legal costs, including enforcement of fines and penalties
		Insurance and workers' compensation payouts
		Investigation costs (police, coronial and workers' compensation)
		Travel costs
		Funeral costs
	Transfer and other costs	Welfare payments
		Tax losses
		Property damage
Indirect Costs	Human capital costs	Loss of income to worker
	Value of production costs	Loss of income to company
		Replacement and re-training costs
		Loss of goodwill and corporate image
	Leisure and quality of life costs	Loss of leisure time, unpaid work and household production
		Pain and suffering

Source: Adapted from Access Economics (2004).

The debate on how best to put an economic value on a human life is a contentious issue, and primarily centres on the inclusion and estimation of indirect costs. At the health sector level, the argument revolves around the issue of equity in health care, in that if the economic burden of injury includes productivity losses, and this data is used as the sole determinant for priority setting, then more resources will be devoted to the care of people of working age or of certain occupations (Drummond, 1992; Watson and Ozanne-Smith, 1997).

There has also been robust discussion on how a human life can possibly be valued or measured, when so much of the benefit and contribution to society is seen as invaluable and not represented in estimates of lost earnings. Finally, it is argued that a focus on lost productivity results in bias against the value of life lost in women, the elderly, children and students, the mentally impaired or the unemployed (Koopmanschap and van Ineveld, 1992; Leigh et al., 2000; Segel, 2006).

The following section outlines the three approaches for estimating the economic value of a life and discusses their practicality in overcoming some of the issues detailed above, as well as the more generic advantages and disadvantages of each approach.

4.1.1 Human capital

The human capital approach was originally popularised by Rice (1969) and is based on neoclassical economic theory, in that wages and other marginal costs are assumed to equal the value of the marginal revenue generated by an additional worker under conditions of full employment and thus indirect costs are quantified in terms of forgone earnings (Berger et al., 2001). Full employment is defined as the either the state when all those wanting to work at the going wage are employed or the percentage of the labour force not employed. The reason for some unemployment occurring at full employment is due to frictional (those moving between jobs or careers) and seasonal unemployment (Hoag, 2002).

Despite its many criticisms, the human capital approach is perhaps the more traditional and common method of the measuring and valuing the *potential* loss of work-related production or income through premature mortality (Koopmanschap et al., 1995; Watson and Ozanne-Smith, 1997). Pritchard and Sculpher (2000) found that of 40 cost effectiveness and cost utility analyses extracted from the Health Economic Evaluations Database, 26 had utilised the human capital approach, compared to just seven with the friction cost method.

In addition to the calculation of the direct medical and administrative costs of an injury, illness or fatality, the human capital approach aims to estimate the resulting indirect costs, through the sum of annual earnings from the year of death until retirement age. These values are calculated using discounted market wage rates, which may or may not be adjusted to account for labour force participation by age and/or gender (Goeree et al., 1999).

The Bureau of Transport Economics (2000) explains the fundamentals of the human capital approach:

> The human capital approach characterises people, and therefore life, as a labour source and input to the production process. This approach argues that the value to society of preventing a death or injury is the saving in potential output or productive capacity. It is an ex-post accounting approach that uses the discounted present value of a victim's future earnings as a proxy for the cost of premature death or injury. The human capital approach can also be used to value non-paid work in the form of service to family and community. (Bureau of Transport Economics, 2000, p. 19)

The primary limitation of the human capital approach is that it implicitly assumes that labour markets are in equilibrium with little or no unemployment, in that if a worker was to die prematurely, they would not be replaced and therefore, the burden of that production loss would be carried until retirement (Goeree et al., 1999).

Additionally, it is unable to account for non-financial externalities, including pain, suffering, grief, friendship, love and moral support. Moreover, the emphasis on valuing productive people over less productive people, may undervalue intellectual, artistic or cultural contributions to society (Bureau of Transport Economics, 1992).

4.1.2 Friction cost

The friction cost approach revolves around the principle that the production losses associated with a premature mortality are over-estimated in the human capital approach, as the work may be taken over by the unemployed or through a reallocation of employees across positions. Whilst this method may derive more realistic estimates of indirect costs in certain circumstances, there is no comprehensive theoretical economic framework underpinning the technique (Berger et al., 2001).

The *'friction period'* refers to the time required to restore production to the initial level (Koopmanschap et al., 1995), essentially recruiting and training the vacant position. In the case of premature mortality, the friction period may be extended, as the deceased is replaced by an employed person, who subsequently requires replacement. However, it is assumed that this replacement chain is eventually ceased with the appointment of an individual who was previously unemployed (Sculpher, 2001). Therefore, the income earned by the deceased employee is now earned by an individual who was previously unemployed, and hence, there are no long term earning or production losses at the societal level (Pritchard and Sculpher, 2000).

The challenge with the friction cost method is defining the length of time associated with the friction period. Koopmanschap et al. (1995) estimated that friction periods in the Netherlands in 1988 ranged from 2.2 months for those with a basic level of education, to 3.8 months for those with a university education, with the average value being 2.8 months. This reflects higher levels of unemployment for lower educated workers, whilst a longer period was required to replace university educated positions. In 1990, when the unemployment rate in the Netherlands decreased, the average friction period extended to 3.2 months, suggesting the friction period is sensitive to changes in the unemployment rate.

There are several strong arguments against the use of friction cost methods. At the fundamental level, Rice (2006, p. 178) contends that studies that suggest the person who died can be replaced are 'specious and contrary to public health principles, which value human health and life as society's goals.'

At the theory level, it is suggested that there are *two* components to productivity losses; the initial disruption until productivity is restored to previous levels (friction period); but also the loss of the labour resource over the longer term, which reduces the capacity of the economy to produce at any given unemployment level (Access Economics, 2004).

The Australian Safety and Compensation Council's research into the cost of work-related injury and illness (2009b) also takes the view of Access Economics, stating that if the friction cost approach is used instead of human capital, then it is only the initial productivity disruption that is captured. The report states that 'while some lost potential is likely to be "picked-up" by previously unemployed workers entering the labour force, it will not entirely be replaced' (ASCC, 2009b, p. 13).

4.1.3 Willingness-to-pay

The willingness-to-pay (WTP) approach does not involve the estimation of direct and indirect costs, but rather it assesses the value people place on health, pain and suffering and on the variation of these values across individuals and communities (Leigh et al., 2000). There are three general types of WTP studies; expressed value or contingent valuation (interview and questionnaires); preference or observed behaviour relating to the purchase, consumption and use of safety-related items; and hedonic or compensating wage differentials of workers in hazardous jobs (Bureau of Transport Economics, 1992).

The fundamentals of the WTP approach are well defined by Freeman III (1993).

> The economic question being dealt with here is not about how much an individual would be willing to pay to avoid his or her certain death or how much compensation that individual would require to accept that death. In this respect, the term 'value of life' is an unfortunate phrase that does not reflect the true nature of the question at hand. Most people would be willing to pay their total

> wealth to avoid certain death; and there is probably no finite sum of money that could compensate an individual for the sure loss of life. Rather, the economic question is about how much the individual would be willing to pay to achieve a small reduction in the probability of death during a given period or how much compensation that individual would require to accept a small increase in that probability. (Freeman III, 1993, p. 320)

This WTP approach underpins the theory behind the value of a statistical life (VSL), a commonly used statistic, which measures the monetary amount that an individual would trade to reduce mortality risk by a small increment. The sum of these individual monetary amounts provides a societal value of one unit of fatal risk reduction or one statistical life (Biddle et al., 2005).

Aldy and Viscusi (2007) further clarify this concept by explaining that although an individual cannot purchase a reduction in their mortality risk, they can implicitly reveal how much they value mortality risk reduction in the decisions they make, for example, driving over the speed limit to save time or purchasing more expensive equipment with a higher safety value are risk tradeoffs. Tradeoffs between the risk of fatality and a monetary value are referred to the value of a statistical life.

The mean VSL for Australian occupational research studies (Knieser and Leeth, 1991; National Occupational Health and Safety Commission, 2004; Viscusi, 2005) is A$5.5 million (Access Economics, 2008). While prominent international studies estimate VSL at around US$7.0 million for a middle aged worker (Murphy and Topel, 2006; Viscusi and Aldy, 2003).

Like the two previous approaches, human capital and friction cost, there are several criticisms of the WTP approach. The first argument is based on the idea that WTP estimates represent marginal costs – that is, the cost to save an injury, illness or loss of life occurring, as opposed to the average or total cost of an incident. Therefore it is not a suitable means for estimating the overall cost to a community, industry or nation. Secondly, it assumes that there is reasonable understanding of the risks involved as well as rational decision making when it comes to risk. Finally, it does not only exclude the medical costs incurred, but also assumes that people have an understanding of the medical care expenses associated with intervention or improving their health, and that they would be required to pay that expense, a situation which is highly unlikely amongst most of the population (Leigh et al., 2000).

While the WTP method is able to overcome the theoretical difficulties of the human capital approach associated with the value of intangible elements such as quality of life, health and leisure, it involves more empirical difficulties in its measurement (Bureau of Transport Economics, 2000), creating further problems in its implementation.

4.2 Suitability of methodologies for Australian farm-related fatalities

More recently, it has been suggested that friction cost analyses are the preferred means of estimating the cost of illness and health related economics (Brouwer, Koopmanschap and Rutten, 1997; Canadian Agency for Drugs and Technologies in

Health, 2006). However, influential studies into the cost of occupational injuries continue to use the human capital approach as their preferred methodology (Leigh et al., 2000; Leigh, McCurdy and Schenker, 2001; Watson and Ozanne-Smith, 1997).

Although this study includes both work and non work-related fatalities, all fatalities have occurred as a direct consequence of visiting, living and/or working on a farm; and hence this study is very much aligned with the objectives and assumptions of occupational fatality studies and their methodologies. The use of the human capital approach also enables the results of this study to be compared with other relevant international studies.

Furthermore, as the Australian economy runs at near full employment, averaging unemployment rates of just 6.1% across the 2001–04 period (Australian Bureau of Statistics, 2001b; Australian Bureau of Statistics, 2002; Australian Bureau of Statistics, 2003c; Australian Bureau of Statistics, 2004c) then the friction cost approach is generally not applicable for estimating lost productivity from Australian fatalities, as there is not an adequate sized labour pool from which to draw the required labour resources. Therefore, the labour market and wages adjust, which results in a decline in the availability of labour.

This point is further demonstrated by Access Economics (2008):

> Frictional approaches are appropriate to measure productivity losses in the short term or in situations of a relatively large unemployment pool. Human

> capital approaches are appropriate in the longer term in economies like Australia operating at near full employment. (Access Economics, 2008, p. xv)

This is particularly the case for agriculture, which is estimated to employ a labour force of just 295,000 people. Additionally, agriculture is very seasonal in its growth and contraction, varying by 66,000 positions over the 2001–04 study period (Department of Education, 2009). This is a critical consideration in assessing the suitability of the three different approaches, as 43 per cent of the cases in this study were employed as either farmers, farm managers, farm hands or agricultural contractors (shearers, fencers etc) at the their time of death.

The suitability of the friction cost approach for fatal injury studies in Australia is further questioned by Watson and Ozanne-Smith (1997, p. 6), who suggest 'while this method may better determine the actual loss of production, it is not capable of determining the societal burden of injury'.

The appropriateness of the WTP approach is immediately challenged, as it assumes that there is a complete understanding of the risks and hazards, which in this study are associated with visiting, living and/or working on a farm. Whilst this may be successfully argued for some managers, workers and families residing or working on a farm, it could certainly not be assumed for new employees, contractors, visitors and children and is therefore not a suitable method for analysis in this study.

This lack of knowledge or understanding of risks is highlighted in Table 4.2, which compares the five most frequent agents involved in farm fatalities over the 2001–04 period against hazards identified by farmers as risks on their farms (Fragar, Pollock and Morton, 2008; Pollock, Fragar and Temperley, 2008).

Table 4.2: Comparison of agent of fatality and farmer identified risks and hazards

Top five agents involved in farm fatalities, 2001–04	Farmer identified hazard ranking
1. Tractors	14th (n=15)
2. ATVs	11th (n=17)
3. Drownings	37th (n=4)
4. Utilities	Not reported
5. Two-wheel motorcycles	8th (n=18)

n = number of farmers identifying hazard

As can be seen, four of the five most common agents actually causing deaths on Australian farms did not feature in the top ten risks or hazards most frequently identified by farmers.

Knowles (2002) surveyed farmers in England and Wales about their perceptions of risk and found that while farmers were aware of the risks of machinery, livestock and electricity, they underestimated the risk of injury from moving vehicles, falling objects and vehicle rollovers.

This is a common occurrence in the analysis of safety behaviour; people tend to overstate dangers attributed to infrequent causes of death and underestimate frequent causes (Aherin and Murphy, 1987; Schwab et al., 1995).

Table 4.3: Summary of advantages and disadvantages of economic cost approaches

Economic Approach	Advantages	Disadvantages
Human Capital	- Data readily available - Simple and transparent approach to use - Many studies to compare findings against - Based on neoclassical economic model	- Assumes near full employment and that loss carried until retirement - Unable to account for non-financial costs - Devalues the loss of women, the elderly, children and students, mentally impaired, unemployed, intellectuals, creative and artistic contributions - Overvalues indirect costs - Overestimates costs in economy with less than full employment - Does not reflect a key reason for the investment in safety: aversion to death/injury rather than income protection - Actuarial uncertainties regarding life expectancy and earnings
Friction Cost	- Generally seen as the more accurate of the approaches	- Lacks theoretical framework underpinning calculations - Requires extensive data to estimating length of friction period and the losses involves - Argument that a deceased person can be replaced is against public health principles - Unable to measure the reduced capacity of an economy to produce at given employment level - Unable to account for non-financial costs - Contains few reduced productivity measurements
Willingness-to-pay	- Can overcome theoretical difficulties of Human Capital approaches - Comprehensive - Reflects individual preferences	- More complex and difficult to measure - Measures marginal costs rather than total cost of an incident - Assumes knowledge of risk and rational decision making - Individual perceptions of risk may differ - Does not necessarily imply ability to pay - Aggregating individuals' WTP may not produce social WTP as individuals may ignore social costs

The Bureau of Transport Economics (1992) further argue that:

> The numerical facility associated with the human capital approach can be enhanced and the maximum benefits derived from its actuarial nature by

> drawing on available statistics such as the working life tables, by using the measures and methods most compatible with the overall approach and by attempting quantification of as many relevant cost factors as possible. On the basis that the human capital estimates generally provide lower bound estimates to willingness-to-pay, a carefully computed human capital figure could well be more useful than an uncertain willingness-to-pay estimate. (Bureau of Transport Economics, 1992, p. 86)

As a result of these many considerations, summarised in Table 4.3, and the overriding aim of the study to estimate the impact of a premature death on society, rather than to measure an individual's value of reducing the risk of a fatal injury, the human capital approach was deemed to be the most appropriate measure to estimate the economic cost of farm-related fatalities in Australia.

4.3 Economic model

As discussed previously, selecting an economic modelling approach that was most suitable for the estimation of the cost of farm-related fatalities was challenging. While each of the three methods have their benefits and limitations, in the end it was decided to take a human capital approach, in line with most occupational fatality and injury studies, as well as accident cost studies in Australia.

Investigation into the practical elements of designing an economic model to estimate the cost of fatalities to the economy led to an economic model developed by Biddle (2001; 2004b) as part of her Master of Science and then Doctor of Philosophy in

Occupational Safety and Health at West Virginia University, Morgantown. The approach taken by Biddle is summarised below.

> This project developed a computerized model for calculating cost consequences, which provides a tool for policy makers to systematically examine current and potential research impacts, using standard economic measures. The model estimates comprehensive national costs for all occupational fatal injuries reported through CFOI (Census of Fatal Occupational Injuries) and specific estimates for the burden on selected groups and characteristics of the fatality... This study provides the means to determine the loss to U.S. income resulting from the contribution loss of the deceased workers—nearly $50 billion for 1992-2001 demonstrating the substantial loss of human capital that could be prevented. Unlike earlier works, this model uses a "bottom-up" approach by estimating the value of an individual fatality based on the key characteristics of that fatality, and then sums the individual fatality costs to arrive at the national burden in the aggregate and by individual characteristic. (Biddle, 2004. p. i)

The Biddle model was adapted from an original model by Rice (1965). The refinements to the model were primarily due to improvements in data availability and the need to model constant dollars to allow for aggregation across differing years of death.

Figure 4.1: Economic model for estimating present discounted value of future earnings

PVF = $\sum_{n=y}^{l} P_{(y,s)}(n)\left[Y_{s,j}(n) + Y_s^h(n)\right] * (1+g)^{n-y} / (1+r)^{n-y}$

Where:

PVF	= present discounted value of future earnings due to premature death
$P_{(y,s)}(n)$	= probability that a person of sex (*s*) and age (*y*) will survive to age (*y+1*)
y	= age of the individual at death
s	= sex of the individual
n	= age if the individual had survived
l	= life expectancy
$Y_{s,j}(n)$	= median annual earnings of an employed person of sex (*s*), occupation (*j*), and age (*n*) (includes benefits and life-cycle wage growth adjustment)
$Y_s^h(n)$	= mean annual imputed value of home production of a person of sex (*s*) and age (*n*)
g	= wage growth rate attributable to overall productivity
r	= real discount rate

Source: Adapted from Biddle (2004)

The Biddle model was selected as the most appropriate model for this research, and the estimated present discounted value of loss of earnings due to farm-related fatalities was modelled using the adapted equation in Figure 4.1, to which direct costs of a fatality were then applied.

In line with Bureau of Transport Economics (1992) recommendations to improve the accuracy and validity of the economic estimate, the cost model used in this study includes variables for probability of survival, median earnings by occupation and gender, age adjustments, employee benefits, lifecycle wage growth and annual household production. However, it is recognised that the other limitations discussed previously in this section remain valid and need to be considered when interpreting the results from this study.

To run the economic model, two equations were generated in Microsoft Excel for each individual fatality. The first equation, at the year of death, calculated wages, benefits and household contribution values based on the age at death, which were then multiplied by the probability of survival. The direct costs relating to ambulance, police, hospital, premature funeral, coronial and work safety authority investigation and death compensation costs, as well as the friction cost for those in the workforce at the time of death, were also added to this figure.

For year two, and every year until the Australian Bureau of Statistics (ABS) median age of death was reached, a second equation was used. This equation excluded indirect costs, and calculated wage, benefit and household production values, which were multiplied by the probability of survival for age, *n*, the age if the individual had survived. This figure was then divided by the discount rate.

4.4 Assumptions

4.4.1 Annual income

The occupation nominated on the deceased's coronial file was mapped to Australian and New Zealand Standard Classification of Occupations (ANZSCO) codes to derive an estimated annual income for each fatality. Children, students and those with an unknown occupation had a national average earnings figure applied, while homemakers/home duties, the unemployed, pensioners and retirees were given an annual income value of zero for their earnings. Children and students were only allocated an average annual income from 18 years of age.

4.4.2 Retirement

For the purpose of the model, it was assumed that an individual would commence retirement and hence have zero earnings from the age of 65, with the exception of Farmers and Farm Managers. These occupations continued full-time employment from the ages of 65 through to 70. Upon reaching 71, their full-time equivalent (FTE) status was scaled back at a rate of 0.1 FTE per year (0.9 FTE at 71 years, down to 0.5 FTE at age 75). At 76 years of age, they were deemed to be retired (0 FTE). This scaling was to reflect the fact that many farmers to not actually retire, and are still actively working until their time of death from natural causes, albeit in a more limited capacity (Foskey, 2005).

4.4.3 Household production value

Unlike annual income earnings, household production commenced valuation at the age of 16 years and continued until the ABS median age of death, which was the terminating condition for the model. The median age of death values were 75 (2001) and 76 (2002–04) for men and 81 (2001) and 82 (2002–04) for women (Australian Bureau of Statistics, 2005a). Fatalities involving victims beyond this age had only the relevant direct fatality costs of ambulance, police, hospital, coronial costs, work safety authority investigation and death compensation costs.

4.4.4 Death compensation payments

Death compensation values were only applied to cases where the Coroner had certified the fatality as '*work-related'*. There were ten cases that were still under investigation by the Coroner at the time of this study, and had no work-relatedness specified. These cases and those certified as not being work-related did not have a death payment applied to their value of lost production.

4.4.5 Friction period

As discussed earlier in this chapter, a fatality not only results in a loss of future earnings relating to the deceased, but also a loss in output from remaining workers, and training and recruitment costs for the employer over a period of time. It is recognised that estimating this period can be challenging, particularly given its link to the employment status of the economy. However, in line with Australian and international reports (Bureau of Transport Economics, 2000; Cadilhac et al., 2009; Koopmanschap et al., 1995; National Highway Traffic Safety Administration, 1996), the friction period was estimated to be three months, and therefore 25 per cent of annual salary was applied to the year of death in the model for victims that were employed at their time of death.

4.5 Data Sources

4.5.1 Fatality data

Fatality data was derived from a study conducted by Fragar et al. (2008), which extracted all farm-related fatalities from the National Coroners Information System. The original searches were replicated to identify any additional cases that may have been closed by the Coroner following the completion of the Fragar et al. study.

All fatalities that occurred within a farm workplace were included in the study, not just those deemed '*work-related'* by the Coroner. However, accidents that occurred within the farm homestead were excluded from the analysis. The reason for this approach is that farming often necessitates workers and families to live in close association with an active, fully functioning workplace, thereby exposing them to risks and occupational hazards. For example, a child drowning in a dam or involved in an ATV (quad bike) accident would be included in the study, as dams and ATVs are essential to primary production, and hence contact and involvement with these hazards are as a direct result of farming and earning an agricultural income.

Farm-related fatalities were extracted from the NCIS using several approaches:

a) Location field: farm
b) Occupation field: ABS occupational categories relating to farming and free text searches
c) Agent field: specialised agricultural equipment, as coded in ICD-10-AM and free text searches

Finally, every closed, unintentional injury case on the NCIS system was manually scanned, including the fields of work relatedness, activity at time of incident, mechanism of injury, object or substance involved, and the context for deaths related to a motor vehicle accident.

It is important to note that only closed cases as at December 2008 were able to be identified for inclusion in the study due to data access limitations discussed in Chapter

3. Therefore, open cases that were still before the Coroner at this time have not been included in this analysis.

This extensive search process resulted in the extraction of 404 farm-related fatalities over the period 2001–04.

4.5.2 Probability of survival

To calculate the potential loss of earnings ensuing from premature mortality, the probability of a person actually surviving to an age (n), must be considered. To account for this probability, ABS Life Tables were used for the period 2002–04. Life tables are essentially a statistical model used to represent mortality of a population. In its simplest form, a life table is generated from age-specific death rates and the resulting values are used to measure mortality, survivorship and life expectancy (Australian Bureau of Statistics, 2005c).

The ABS data focuses on the number of persons surviving to age, n. Therefore, to estimate the percentage of people who having survived to age, n, will continue to survive to age, $n+1$, the number of people who survive to $n+1$ was divided by those surviving to n, and multiplied by one hundred.

This approach follows the methodology of Biddle's Masters and PhD theses (2001; 2004) and the subsequent publications, which have been endorsed by the United States Department for Health and Community Services, Centres for Disease Control and Prevention, National Institute for Occupational Health and Safety and the Bureau of Labor Statistics (Biddle et al., 2005; Biddle, 2004a; Biddle, 2009).

While there are other approaches for calculating survival statistics, such as the Kaplan-Meier method, where survival time to any point is calculated as the product of the conditional probabilities of surviving each time period (Bland and Altman, 1998), it is recommended that this become the focus of future research, to enable comparisons of the different approaches.

The probability of survival values used in the model are contained in Appendix 1A.

4.5.3 Median income earnings, employee benefits, age adjustment and life cycle wage growth

Median income earnings, by gender, were extracted from the ABS Employee Earnings and Hours publications (Australian Bureau of Statistics, 2001a; Australian Bureau of Statistics, 2003b; Australian Bureau of Statistics, 2005b), a biennial survey of employers. The occupational data presented in this publication are based on the ANZSCO First Edition.

The structure of ANZSCO has five hierarchical levels: major group, sub-major group, minor group, unit group and occupation. The categories at the most detailed level of the classification are termed *'occupations'*. Each of these groupings is assigned a code, one digit at the major group level, through to six digits at the occupational level (Australian Bureau of Statistics, 2006a).

In the ABS Employee Earnings and Hours publication, data are only publicly available at the one digit level for Managers, but at the three digit level for all other major groupings. All Farm Manager type occupations fall under this major Managers group, so to enable greater accuracy in earnings estimates, unpublished data from the same ABS employer survey was sourced from Rodney Stinson, Yorkcross Pty Ltd.

Employer surveys were conducted in 2000, 2002 and 2004, so to estimate values for 2001 and 2003, an average was taken from the preceding and postceding years. These values are detailed in Appendix 1B.

To get a more comprehensive estimate of earnings, it was also necessary to consider the benefits offered to employees, such as superannuation and fringe benefits tax. The ABS conducted a Major Labour Costs Survey at the industry level in July 2003, which is reported in their Labour Costs, Australia, 2002–03 publication (Australian Bureau of Statistics, 2004b). Agriculture was not reported in the study, so an all industries average figure has been used. It was assumed that the benefits percentage of earnings were constant over the study period, due to a lack of data availability (Appendix 1C).

As average earnings data were only available based on gender and not age, an age adjustment factor is needed to modify average earnings to reflect the idea that a 25 year old in a nominated occupation would generally be earning less than a 45 year old in the same position.

To construct these age adjustment tables, average earnings by gender and age groups for all industries were used to generate two polynomial equations (Male: $y = -0.0692x^4 + 12.227x^3 - 804.57x^2 + 23{,}433x - 212{,}757$; Female: $y = -0.0477x^4 + 8.4273x^3 - 554.54x^2 + 16{,}151x - 146{,}640$; where x = age) that would estimate average earnings for each year of working life for each gender. The data sourced for each year were from the ABS

Characteristics of Wage and Salary Earners in Regions of Australia publications (Australian Bureau of Statistics, 2004a; Australian Bureau of Statistics, 2006b). These values were then indexed back to the average earning for each gender to provide an adjustment value. As data are only available for 2000–01 and 2002–03, 2001–02 values were applied to 2001 and 2002 fatalities, while 2003 and 2004 cases were based on the 2002–03. These values are contained in Appendix 1D.

Following on from the original age adjustment of average earnings at the time of death, consideration needs to be given to how wages would have continued to increase, should the deceased have continued to survive. The ABS data used in the age adjustment tables were also used to generate a life cycle wage growth index, by age and gender. These values are reported in Appendix 1E.

4.5.4 GDP Deflator and employment cost indexes

To account for inflation and the changes in the cost of labour, GDP deflators (Appendix 1F) and Employment Cost Indexes for Wages and Benefits (Appendix 1G) were also included into the model. Data for these components were sourced from the ABS 2006 Yearbook (Australian Bureau of Statistics, 2006c) and the Labour Price Index, Australia publications (Australian Bureau of Statistics, 2001b; Australian Bureau of Statistics, 2002; Australian Bureau of Statistics, 2003c; Australian Bureau of Statistics, 2004c).

4.5.5 Discount rate

The discount rate was taken from the average value of the indexed Australian government bonds over the period of July 1986 to September 2009. This value was calculated to be 3.93% (Reserve Bank of Australia, 2009a).

4.5.6 Annual household production values

In an attempt to rectify a key limitation of the human capital approach in estimating the economic cost of fatalities, a variable was included that represented the value of household production by an individual. Unpublished data on hours of unpaid work by gender and age group were provided by Dr. Duncan Ironmonger (Melbourne University) from the ABS 2006 Time Use Survey. Polynomial equations were generated based on these grouped values to estimate the household production hours on a year-by-year basis (Male: $y = - 0.10x^3 + 3.81x^2 - 71.22x + 541.18$, Female: $y = - 0.27x^3 + 8.84x^2 - 143.67x + 942.09$; where x = age). Average per hour earnings for Elementary Service Workers (the three digit ANZSCO occupational code that includes domestic help and work) were then extracted from average earnings data (Appendix 1B) and applied to the total number of hours to give an annual value of production figure, by gender and age. These values are summarised in Appendix 1H.

4.5.7 Direct costs

To enable a more accurate and realistic estimate of the economic costs of a fatality, direct costs relating to ambulance, police, emergency department, admitted patient, premature funeral, coronial costs, work safety authority investigation and death compensation costs were also modelled in year one of the economic model. The values used in the model can be found in Appendices 1I and 1J.

Ambulance, emergency department and coronial costs were all estimated from data collected by the Productivity Commission's Report on Government Services over the period of the study.

Ambulance costs were derived by dividing total ambulance expenditure by the number of reported ambulance incidents, responses, patients and transport (Tables 11A.17 and 11A.23, (Productivity Commission, 2002); Tables 8A.20 and 8A.26, (Productivity Commission, 2005a; Productivity Commission, 2006).

Emergency department costs were based on cost per occasion of service for the category *Admitted Triage Category 1* (Table 9A.29, (Productivity Commission, 2004; Productivity Commission, 2005a; Productivity Commission, 2006; Productivity Commission, 2007) . This category is the most serious of all emergency department admissions and by definition requires resuscitation of the patient (Australian Government Department of Health and Ageing, 2009). As this is a fatality-based study, it was assumed all cases that were still alive upon presentation at a hospital were in a life-threatening condition, and therefore had *Admitted Triage Category 1* economic costings applied.

To calculate admitted patient hospital costs, a length of stay figure was estimated based on time and date of incident and time and date of death, as reported in the NCIS. An average cost per day per intensive care bed figure of $2,670 was obtained for 2002–

03 (Rechner and Lipman, 2005), which was then indexed based on the total health price index and industry-wide index for the same year (Australian Institute of Health and Welfare, 2005). These two figures were multiplied together to form the estimate of admitted patient costs.

As discussed in the Chapter 3, all unexpected deaths and hence the vast majority of accidents must be referred to the Coroner. This process may be a simple administrative type procedure, or in some instances may require a Coroner's Inquest and Hearing. However, for the purpose of this analysis, Coronial costs were calculated using the real net recurrent expenditure per finalisation for Coroners' courts, reported by the Productivity Commission (Table 6A.30, (Productivity Commission, 2004); Table 6A.23, (Productivity Commission, 2006; Productivity Commission, 2007; Productivity Commission, 2008).

There are several elements of police involvement when a fatality occurs, including attendance time, notification of next of kin, coronial attendance and investigation, incident investigation and administration. Police costs were estimated using data from the Bureau of Transport Economics' report (2000) on the cost of road crashes. The cost was then indexed to 2001–04 prices, using the study year, 1996, as the base year.

A fatal farm-related accident places an unexpected financial burden on the estate or family of the deceased, as funeral related costs must be paid. Generally, people do not save for funerals, and the costs must be taken from savings or borrowed, which results in a financial loss. Therefore, premature funeral costs represent the difference between costs at time of death and costs at the actuarially expected lifetime with appropriate discounting (Bureau of Transport Economics, 2000).

The Bureau's report used an average funeral cost of $3,200 and applied a 2 per cent growth rate that was annualised for the number of years the individual would have otherwise been expected to live, and then discounted back to the year of death dollars using a 4 per cent discount rate. This approach resulted in a 2 per cent annual fall in the real price of funerals.

This 2 per cent annual fall in the real price of funerals was applied to all cases under the ABS median age of death. Cases involving victims over this age were deemed to have no premature funeral cost.

In the majority of farm-related accidents, the relevant work safety authority will become involved and conduct their own investigation, as the farm is deemed a workplace. As with Coronial investigations, the work safety authority investigation may be a more administrative process and quickly establish that the case was not work-related and take no further action, or it may warrant further investigation that may or may not lead to prosecution under the local Health and Safety Act. To represent the cost associated with these investigations, an average cost was calculated, based on NSW WorkCover investigation expenses (WorkCover NSW, 2001a), divided by the number of major claims. This figure of $2,791 in 2001 values was then indexed for the years 2002–04.

The final direct costs included in the model were lump sum payments made for injuries resulting in death that occurred in the workplace and were deemed to be directly work-related, as covered by workers' compensation legislation. Median values for fatality claims by age group and year were extracted from the National Online Statistics Interactive (NOSI), a database of claims information from National Data Set for Compensation-based Statistics (NDS). To be included in the NDS, a claim must be accepted by the State or Territory jurisdiction and involve either a death, permanent incapacity, or a temporary incapacity for which payments have been made (Safework Australia, 2009).

4.6 Summary

As identified previously in this chapter, the selection of the most suitable economic approach to model the cost of fatalities is a contentious issue. Each of the three methods – human capital, friction cost, and willingness-to-pay – all have relative strengths and weaknesses in their ability to accurately assess and model the economic impact of injury or illness.

However, based on assessment of the advantages and limitations of each approach, their ability to be applied to the Australian farming environment, and the availability of data, an adapted model developed by Biddle (2004) was seen as the most effective and comprehensive measure of estimating the economic cost of farm-related fatalities in Australia.

5. Economic cost of farm-related fatalities – Results and Discussion

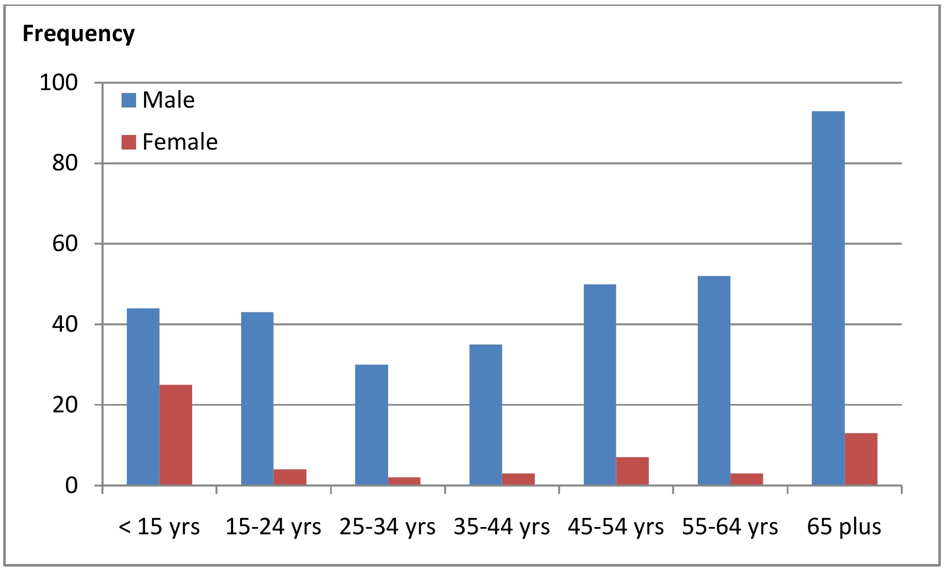
This chapter details the results from the modelling of the economic cost of farm-related fatalities. Basic demographic data are presented, followed by more detailed analyses of economic cost, including the distribution of cost by age and gender, the total economic cost to the Australian economy of farm-related fatalities, the breakdown of cost by agent of injury, as well as discussion on the results and the limitations of the research.

5.1 Demographics

There were 404 on-farm fatalities extracted from the NCIS over the 2001–04 period. Of these fatalities; 108 (26.7 per cent) occurred in 2001, 99 (24.5 per cent) in 2002, 104 (25.7 per cent) in 2003, with the final 93 cases occurring in 2004 (23.0%). The lower number of cases in 2004 is most likely attributable to the higher percentage of open cases still before the Coroner. As at April 2008, just 6 per cent of 2001 cases remained open and before the Coroner. However, for 2004 cases, this figure increased to 13 per cent (National Coroners Information System, 2008). As only closed cases are able to be searched and accessed through the NCIS, it would be expected that the later years of the study were under-represented.

Of the 404 victims, the overwhelming majority were male (n=347, 85.9 per cent). Deaths amongst those aged 65 and over had the highest frequency (n=106, 26.2 per cent), followed by children aged under 15 years (n=69, 17.1 per cent). From a gender perspective, females differed in their age group distribution; of the 57 female cases, 25 (43.9 per cent) occurred in children aged under 15 years (Figure 5.1), compared to just 12.7 per cent of males.

Figure 5.1: Frequency (n) of fatalities, by age group and gender of victim, 2001–04



As noted in the methodology, this study aims to estimate the economic impact of all farm-related fatalities, not just those deemed work-related by a Coronial or work safety authority investigation. At the time of their death, 232 cases (57.4 per cent) were actively engaged in the workforce. Of these, 122 were employed as Farmers or Farm Managers.

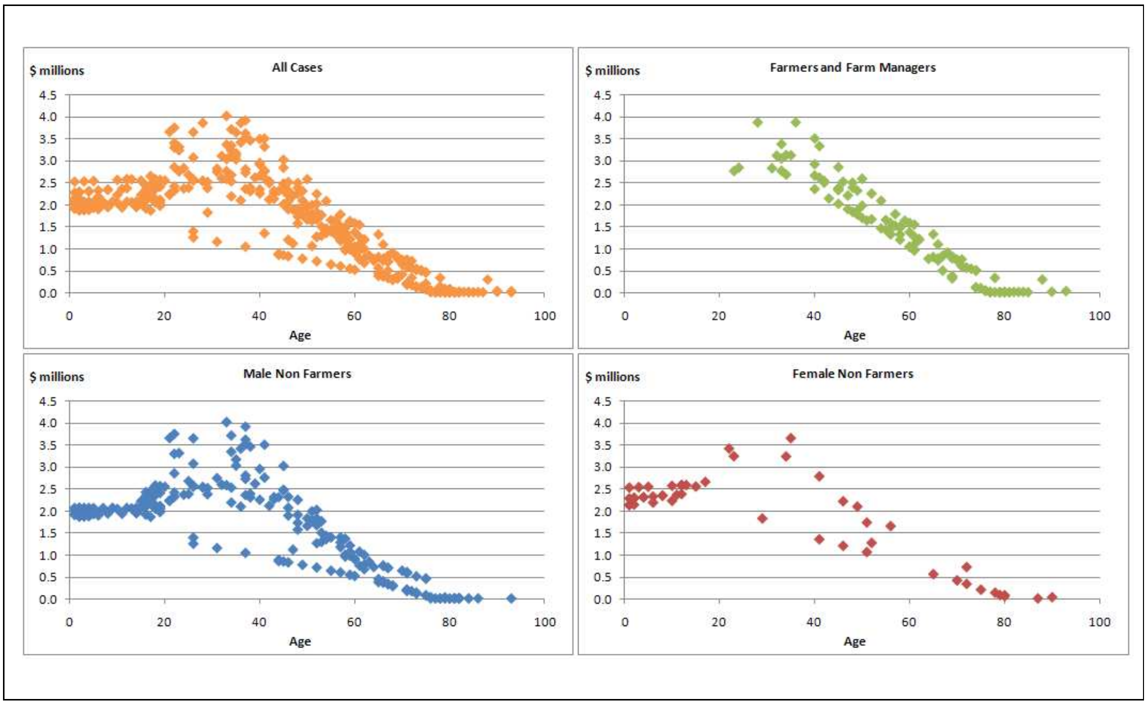
The majority of fatalities, 80.0 per cent, occurred at the scene of the accident. Of the remaining cases that survived long enough to be admitted to hospital, the average survival time was 4.4 days, with a survival range of less than one hour to 59 days.

5.2 Distributions of economic cost by age and gender

Using the model detailed in Chapter 4, each case had age and gender derived direct and indirect costs applied in the year of death, with indirect costs (costs relating to lost earnings and household production) continuing to be applied until the median age of death, as calculated by the ABS.

Costs for each year of data were adjusted back to 2001 prices, then these values were summed to provide a total economic cost per fatality. Finally, in order to reflect current prices, the total figures for each fatality were adjusted to 2008 prices.

Figure 5.2: Distribution of total economic cost, by age, gender and farmer grouping, 2001–04



The distribution of the total economic cost per fatality is illustrated in Figure 5.2. The fatalities were split into four groups for analysis, based on the gender and occupation of the victim; male non-Farmers, female non-Farmers, Farmers/Farm Managers and all cases. Farmers and Farm Managers were extracted for separate analysis due to the scale of the employment group, accounting for 30.2 per cent of all cases within the study.

A recognised limitation of the human capital approach in estimating the economic cost of fatalities is the undervaluing of fatalities involving children, women and the elderly. In the case of children, they have the Australian average salary applied as their lost earnings, which may significantly underestimate their potential earnings. Furthermore, the estimated lost earnings are discounted each year, from the year of death until the ABS median age of death. Therefore, a one year old female would have the discount multiplier applied to her earnings every year of a model run spanning 81 years, substantially downgrading her potential loss of earnings and productivity.

Women are similarly undervalued, in that annual salaries for women are typically around two thirds of male salaries (Australian Bureau of Statistics, 2003b; Australian Bureau of Statistics, 2005b) and therefore, their lost occupational annual earnings resulting from premature mortality is of less economic consequence than their male counterparts.

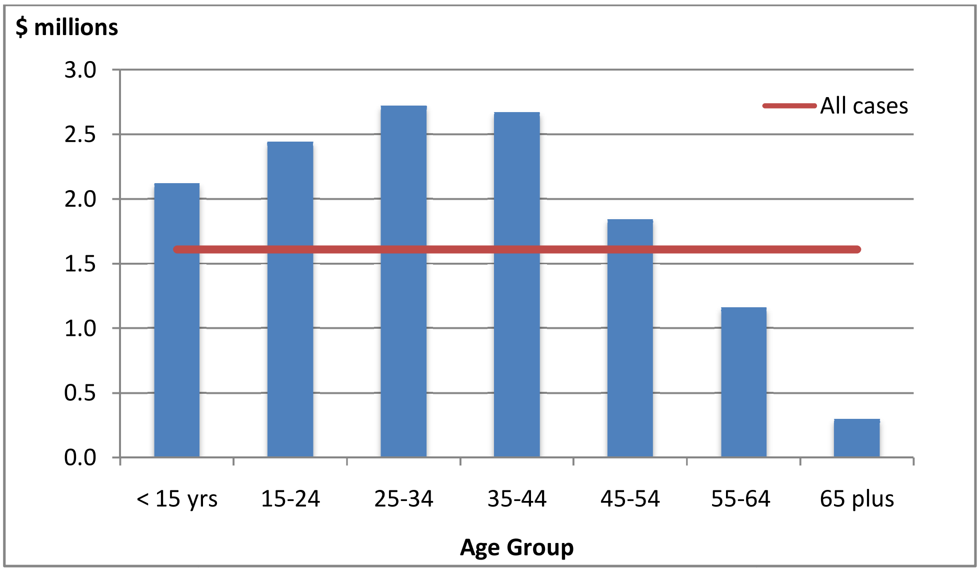
Likewise, fatalities occurring to the elderly are calculated by the model to be of less economic value. As they are most often in retirement and therefore without an annual salary included in the calculations, they are theoretically of little economic significance to the economy.

This undervaluing of children and the elderly can be clearly seen in Figure 5.2. The impact of lower salaries on the economic cost of female cases is not apparent in this figure, as the increased value of household production has compensated for the lower salaries. Female household production values are on average 48 per cent higher than male household production values, and at their peak (30 years of age) female values are more than double the male values, due to the number of hours spent each week on childcare and domestic duties.

The average economic cost per fatality by age group (Figure 5.3) further illustrates the impact of age on productivity values; childhood fatalities, through the high number of lost life years, could be expected to have the highest average economic cost relating to a premature fatality, as the model, depending on their age of death, may run for up to 81 years. However, childhood averages are lower than young adults and middle aged fatalities, primarily due to the discount rate and assumption of average earnings.

For those aged 65 and over who, for the purpose of the model, are deemed to be retired and therefore only subject to direct costs and household production values, the average economic cost per fatality is just 18.6 per cent of the average for all age groups.

Figure 5.3: Average economic cost per fatality, by age group



To further demonstrate the impact of age and gender, some case studies were selected for a cumulative analysis; a male and female 1 year old child, an employed male and female in their 30s and an older male and female farmer and farm manager.

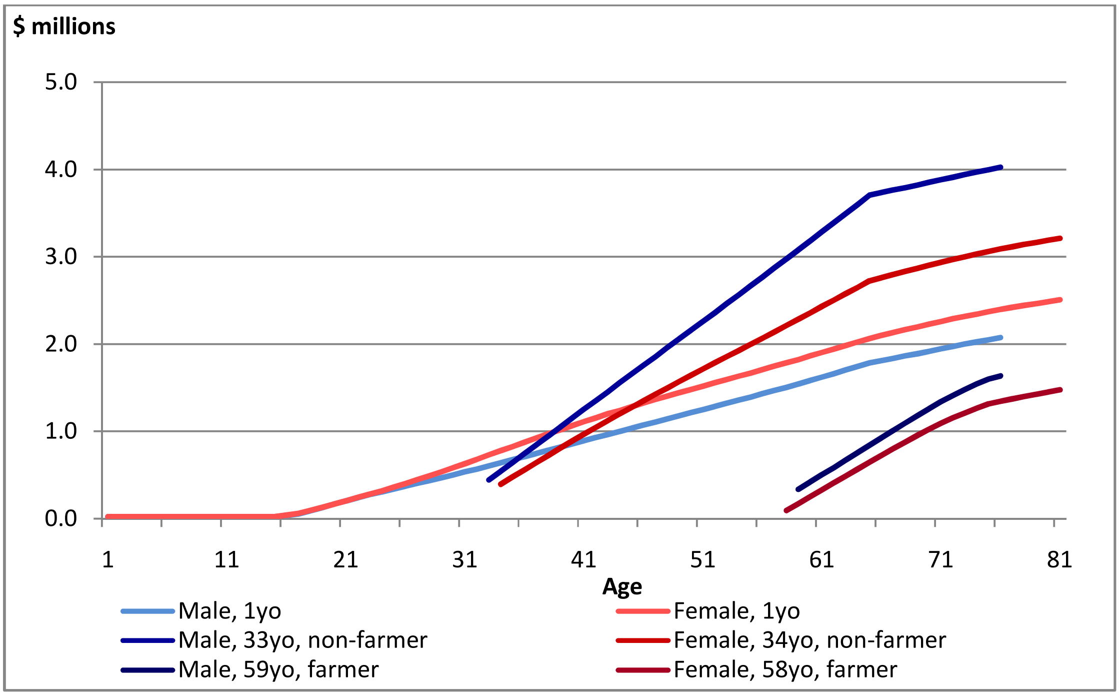
Figure 5.4 clearly demonstrates the following:

- The children: Modelled on average national wages (Male: $43,080; Female: $29,352). Females end up with a slightly higher economic figure, attributable to the increased household production values. Also, due to longer life expectancy in females, the model runs for an additional five years. Values are considerably lower than the 30 year old cases, but still higher than the older farmers.
- The 30s: Modelled on average occupational wages for their particular field of employment (Male: $53,553, Female: $25,872). The large difference in annual salaries between males and females is enough to override the effect of higher

female household production values noted previously. Therefore the total economic cost of premature mortality involving a male in his 30s is far higher than a female the same age, and also the children and older farmers.

- The older farmers: Modelled on average occupational wages for their field of employment ($29,341 – data is not available on farmer and farm manager salaries by gender). The older male farmer had higher direct costs (medical, death payments etc), which reflects the slightly higher end value. The difference in the value of household production between males and females diminishes substantially as they age, due to the lessening role of women in childcare. Hence, with the exception of the direct costs, the total economic cost of male and female older farmers remains quite similar.

Figure 5.4: Cumulative economic values, age case studies, 2008 dollars



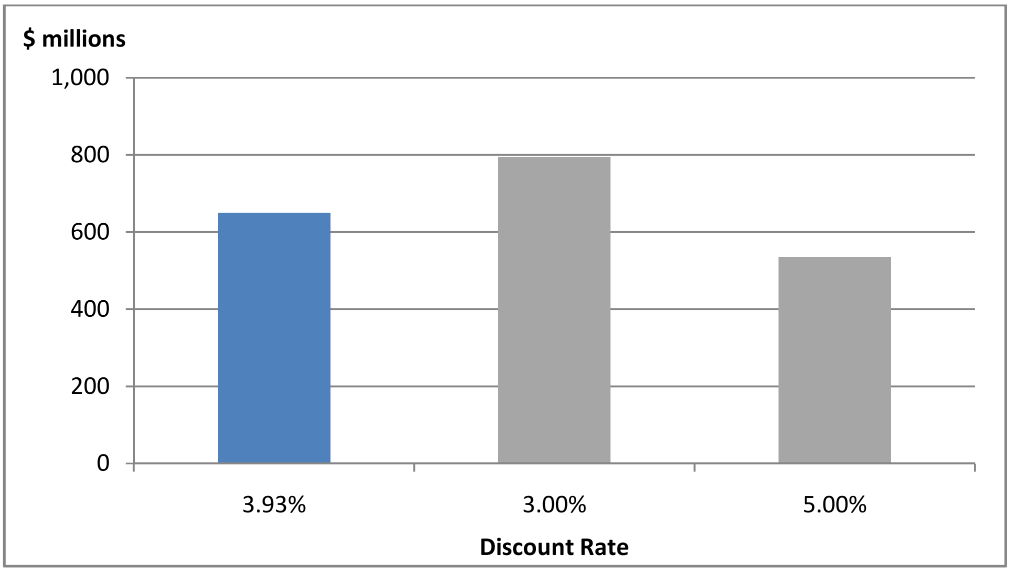
5.3 Overall economic cost of farm-related fatalities

The total economic cost of farm-related fatalities over the period 2001–04 was estimated to be $650.6 million dollars (in 2008 values), at an average cost of $1.6 million per individual fatality. The year by year breakdown can be found in Table 5.1.

Table 5.1: Annual totals of economic cost, by gender and occupation group, 2001–04 (2008 dollars, millions)

	Farmers/Farm Managers		Other Occupations		Total
	Male	Female	Male	Female	
2001	35.57	--	90.78	28.61	**154.94**
2002	47.8	5.04	102.34	15.54	**170.72**
2003	36.13	0.78	100.94	20.7	**158.56**
2004	38.09	1.5	93.74	33	**166.33**
Total	**168.36**	**8.19**	**433.21**	**110.06**	**650.55**

Figure 5.5: Impact of discount rate on economic cost of farm-related fatalities, 2001–04 (2008 dollars)



A sensitivity analysis was conducted to ascertain the impact of the discount rate (3.93 per cent) on overall economic value, with additional analyses conducted using 3.0 and 5.0 per cent. It was found that a 1.0 percentage point increase in the discount rate reduced the total economic cost of farm-related fatalities by approximately 19.0 per cent. This impact is demonstrated in Figure 5.5.

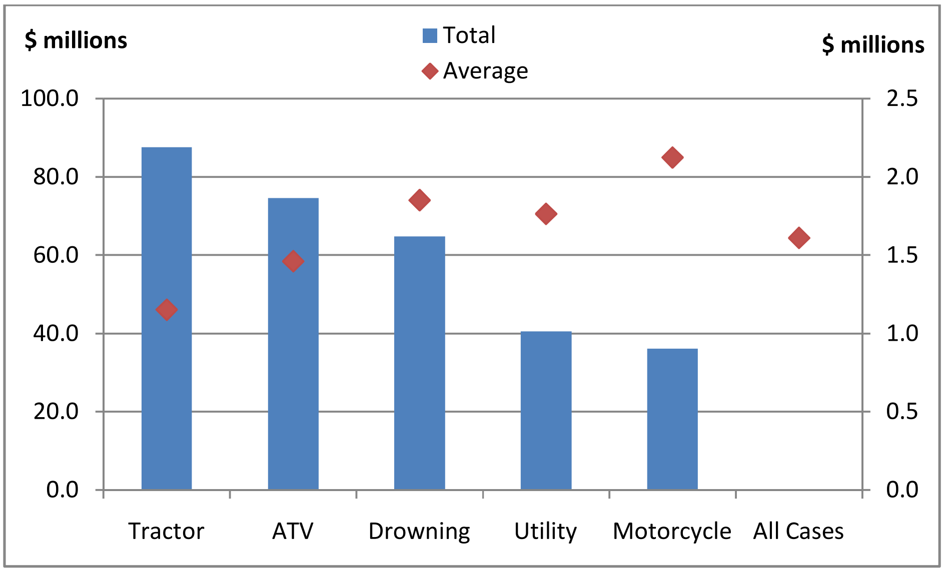
5.4 Economic cost by agent of fatality

The five most common agents causing death – tractors, ATVs, drownings, utilities and 2-wheel motorcycles – were extracted for further analyses to determine the total economic cost associated with each agent and also to examine differences in the average economic cost of the principal agents.

The total economic cost clearly followed the frequency of fatalities for each of the agents. Tractor fatalities cost the economy $86.7 million (in 2008 dollars), followed by ATVs at $74.5 million and drownings at $64.8 million (Figure 5.6). The top five agents accounted for exactly half of the fatalities and 46.7 per cent ($303.5 million) of the economic cost.

Analysis of the average cost of the five most common agents revealed some considerable differences (Figure 5.6). Motorcycle fatalities resulted in the highest average cost per fatality, at $2.1 million (2008 dollars), followed by drownings ($1.9 million) and utility accidents ($1.8 million).

Figure 5.6: Economic cost of the five most common agents causing death, by total and average



A further comparison between the percentage contribution to the number of fatalities and to the total economic cost demonstrated that both tractors and ATVs contributed less to the total economic cost than they did to the number of fatalities. This was particularly evident in tractors, which accounted for 18.8 percent of all fatalities, yet only 13.5 per cent of the total economic cost (Figure 5.7).

The reason for the discrepancy between contributions to the number of fatalities and the total economic cost is due to variations in the age group distribution of the five key agents. Section 5.2 discussed the impact of age on the economic cost of a fatality; those killed in their 30s resulted in a significantly higher cost to the economy than childhood fatalities, while older fatalities resulted in the lowest economic cost to society, due to the lower value relating to lost future earnings and household production.

Figure 5.7: Percentage of fatalities and economic cost, by top five agents

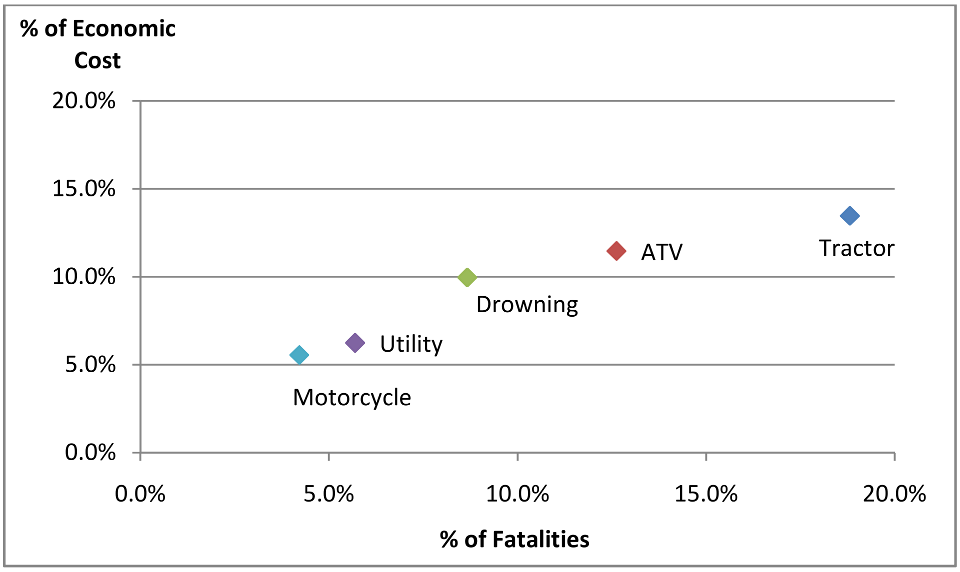


Table 5.2 contains the age distributions of the top five agents causing death. Drowning (skewness statistic = 2.102, skewness standard error = 0.434) and 2 wheel motorcycles (skewness statistic = 1.208, skewness standard error = 0.580) are heavily skewed towards younger age groups. As a result, the relatively large proportion of younger fatalities, which have higher economic cost values, lead to higher average economic cost values for these two agents.

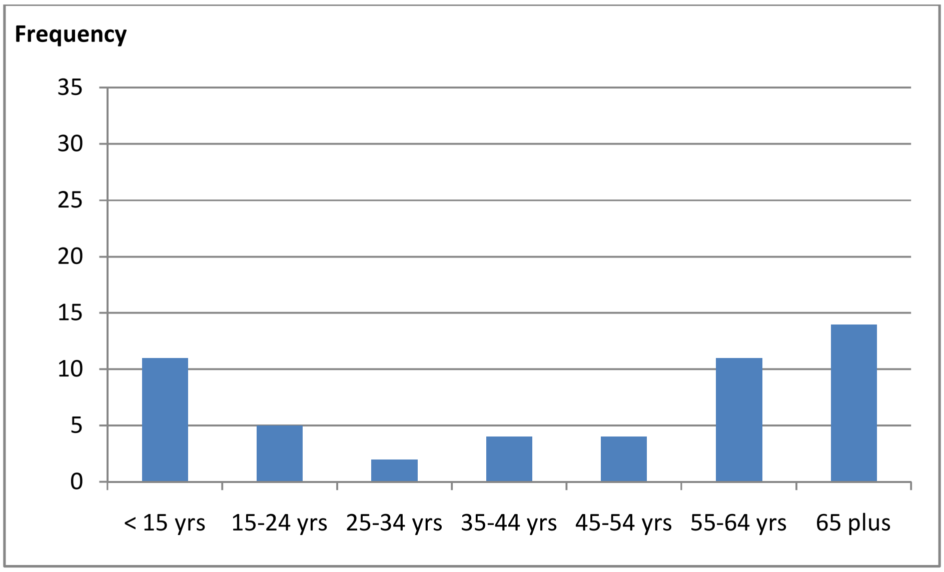
Table 5.2: Frequency of top five agents, by age group

Agent	< 15 yrs	15-24 yrs	25-34 yrs	35-44 yrs	45-54 yrs	55-64 yrs	65 plus	Total
Tractor	2	3	1	10	13	15	32	76
ATV[1]	11	5	2	4	4	11	14	51
Drowning	25	--	2	1	1	2	4	35
Utility	5	4	2	1	3	4	4	23
Motorcycle[2]	3	9	3	1	--	--	1	17

1. 4 wheel motorcycle
2. 2 wheel motorcycle

Analysis of ATV fatalities demonstrated a very '*U-shaped'* distribution (Figure 5.8), with higher frequencies of younger and older cases and lower frequencies of those aged in between. Therefore, the average economic cost of $1.5 million for ATV fatalities was very close to the all cases average, with the frequency of older fatalities effectively cancelling out the impact of the increased economic cost associated with the younger fatalities. Utilities followed a similar pattern to ATVs, however, the lower frequency of fatalities results in this distributional effect being less evident in Table 5.2. They are slightly more weighted to younger fatalities than ATVs (skewness statistic = 0.249, skewness standard error = 0.637), resulting in a higher average economic cost of $1.8 million.

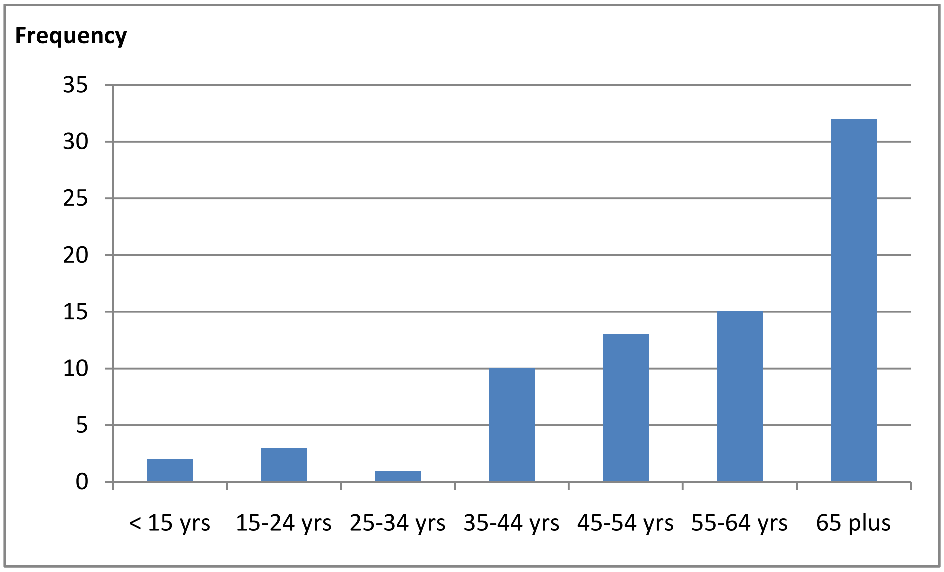
Figure 5.8: Frequency of ATV fatalities, by age group



Tractor fatalities, conversely, were significantly skewed towards older farmers (skewness statistic = -1.271, skewness standard error = 0.501), as demonstrated in

Figure 5.9. Of the 76 tractor related fatalities, 61.8 per cent (n=47) occurred in those aged greater than 55 years. Figure 5.4 clearly indicated the lower total economic cost associated with older fatalities due to the impact of lower future earnings and household production. Therefore, as the older age groups are over represented in the tractor fatality statistics, it would be expected tractors have a lower average economic cost per fatality ($1.2 million) that the other principal agents causing death ($1.5 to $2.1 million).

Figure 5.9: Frequency of tractor fatalities, by age group



5.5 Discussion

Farm-related fatalities result not only in pain, loss, grief and suffering for family, friends and loved ones, but also in a significant economic burden to the national economy. The 404 farm-related fatalities over the 2001–04 study period, affected all sectors of society, not just the agricultural community. The deceased included children, young adults, males, females, farmers, non-farmers and older members of the community.

Furthermore, while not all fatalities were deemed work-related by the Coroner, they each occurred on a farm workplace.

Farming, by its very nature, is a hazardous industry. The work varies immensely over the different seasons and covers a wide range of trades and activities, from working at heights and with machinery, to handling livestock and working with chemicals. The work is often arduous, with long hours, exposure to the elements and manual handling. As well as the physical risks and hazards, there are also those resulting from emotional distraction, and the impact of financial pressure and seasonal conditions, particularly drought.

To further compound the many risks and hazards already present in the physical workplace, there is the issue of the family home, often right in the middle of an active and hazardous workplace. This adds another dimension to the risks and hazards involved in agriculture, bringing family members and visitors into the working environment. Children are at particular risk, whether it be young children wandering away from their parent's watch at a moments notice towards nearby dams or in the way of machinery or equipment, or older children trying to help out around the farm, both with and without their parent's consent. Visitors on farms see the '*fun*' associated with motorcycles, ATVs or riding in the back of utilities, but lack the understanding, familiarity and experience to know the risks involved or the means to operate he machinery and equipment safely. There are the older members of the family, keen to help out and continue an active role on the farm, but not as steady on their feet, or as strong, or with as good eyesight and hearing as in their younger days, and with perhaps a lack of familiarity with some of the newer machinery and equipment.

Human nature has a tendency to make society think accidents '*will not happen to me*', but they do happen, at an average rate of 100 fatalities per year, that is, one fatality per 1,380 farms each and every year.

Aside from the human and emotional costs arising from these fatalities, there is also a considerable economic cost. Direct fatality costs relating to emergency services, hospital, premature funeral, autopsy, coronial investigation, work safety authority investigation and insurance payouts all cost the Australian economy, and then there are all the indirect costs arising from loss of future income and household production.

While there have been studies conducted into the economic cost of occupational fatalities in Australia by work safety authorities, including agriculture, as discussed in Chapter 3, these studies do not accurately reflect the true scale of farm-related fatalities. The purpose of the economic analysis in this research was to acknowledge that there are many more fatalities that occur as a direct consequence of living, working or visiting a farm than are officially recorded by work safety authority, and that these fatalities are costing the Australian economy a considerable amount in direct and indirect costs.

By modelling direct and indirect costs for each farm-related fatality extracted from the NCIS system over the period 2001–04 from the age at death, until the median death age for Australians, an estimate of the economic cost of farm-related fatalities was able to be attained. In 2008 dollars, this figure was found to be $650.6 million dollars, at an average of $162.4 million per annum or $1.6 million per fatality.

To put this value into perspective, $650.6 million is equal to 2.3 per cent of the national farm GDP in 2008 (Reserve Bank of Australia, 2009b), or the equivalent economic loss of 2.2 million tonnes of wheat, valued at 2008 prices.

The most commonly reported agents involved in farm fatalities (tractors, ATVs, drownings, utilities and 2 wheel motorcycles) accounted for 46.7 per cent ($303.5 million) of the total economic cost of fatalities. There are recommendations and guidelines available through Farmsafe Australia relating to the control and risk minimisation of each of these major hazards. If on-farm compliance with each of these hazard guidelines was able to be achieved, particularly at the higher end of the hierarchy of control, then the potential cost savings to the Australian economy due to fewer fatalities would be considerable.

It is suggested that this overall estimate of cost to the Australian economy is conservative in its nature, as it does not include costs associated with grief and loss, damage to equipment and machinery, loss of income due to timing and labour impacts on production, increases in insurance and workers' compensation premiums, fines and penalties, loss of taxation to the government and a myriad other costs that while small on their own, may add up to a significant total cost.

It must also be emphasised that the $650.6 million in costs estimated in this study is the cost of farm-related fatalities alone, the inclusion of non-fatal injuries would increase this figure markedly.

A survey of NSW farmers conducted by Low and Griffith (1996) established that the average cost of a farm injury was $1,000, with the average cost for a serious farm injury being $2,500. Fragar (1996) estimated that agricultural illness and injury cost the economy between $200–$300 million in 1991–92. A further study by Fragar and Franklin (2000) using national workers' compensation data, estimated the cost of farm injury in Australia to lie between $0.5 billion and $1.29 billion per year, with the average cost per farm injury at $6,920 compared to an all-industry cost of $5,635 per injury. While estimates of the total cost of farm-related non-fatal injury are wide ranging, it is clear that their impact on the overall cost of fatal and non-fatal farm-related injuries would be substantial.

The farm-related fatalities data underpinning this model is among the most comprehensive of its kind, covering all fatalities that occurred on a farm workplace throughout Australia over the period 2001–04. While other national cost of farm-related fatality studies have utilised work-related fatalities in agriculture as their data source (Biddle, 2001; Biddle, 2004; Leigh, McCurdy and Schenker, 2001), the economic cost studies that have included all fatalities that occurred on the farm workplace have either been regional in their nature (Kelsey, 1991) or have focused on a particular agent involved in fatality (Kelsey, 1992; Locker et al., 2004; Myers et al., 2008).

5.6 Limitations of study

As with all studies endeavouring to put an economic cost of the loss of life, this study is not without its limitations. As discussed previously, in both the methodology and this chapter, the selection of the human capital approach as a model is not without criticism and limitations, particularly relating to the undervaluing of children, women and the elderly, due to the emphasis placed on annual salary in calculating the cost of premature fatalities. As with other international studies in this field (Biddle, 2001; Biddle, 2004b; Leigh, McCurdy and Schenker, 2001), it is suggested that the total economic burden of farm-related fatalities derived by the research may be conservative and towards the lower bounds of possible estimates.

Furthermore, the study cannot provide an absolute measure of the cost of farm-related fatalities in Australia, as there are many indeterminate costs involved in a fatality that have not been included in this research. Some costs, such as pain, suffering and emotional trauma, have been subject to considerable debate regarding their inclusion, measurement and perceived accuracy; they remain contentious issues in the field of economic burden of fatalities. Other costs are recognised, but considered to be too difficult to include in research due to limitations in data availability, completeness and reliability. Some studies, through interviews with surviving family members, have attempted to address some of these costs (Kelsey, 1991; Kelsey, 1992; Monk et al., 1984), but the authors recognise the subjective nature of responses and estimates involved. Figure 5.10 provides a summary of the costs involved in a farm-related fatality. The boxes in the figure which are outlined in red have to some extent been accounted for in the economic model in this research.

Figure 5.10: Costs involved in a farm-related fatality

Other economic approaches, such as willingness-to-pay and the value of a statistical life, aim to capture more of the quality of life and emotional costs associated with fatalities and it is recommended that future research be undertaken in this area to determine a more comprehensive estimate of the economic costs of fatalities.

The final area of limitation relates to data availability and sources. As discussed previously, while the NCIS is one of the world's most comprehensive sources of fatality information, only cases that have been closed by the Coroner are able to be searched by keywords or through location of incident. Additionally, the quality of the information available on closed cases is variable. Some closed cases contained detailed police and finding reports, while others have almost no information at all, making it impossible to ascertain if the fatality occurred on a farm or not. Consequently, it is likely that the 404 fatalities included in this study underestimate the true nature and economic cost of the farm-related fatality problem.

There are also some issues regarding annual income data, sourced from the ABS. The data are derived from a randomly sampled Labour Survey, conducted every two years. For some occupations, particularly Farmers and Farm Managers, the average salaries appear to be exceedingly low – in 2004, the average salary for Farmers and Farm Managers was estimated to be just $29,341. One possible explanation of this is the exclusion of other benefits, including vehicles and accommodation. While all occupations had a benefits percentage factored into the analysis, the data, again collected by ABS, does not include the agricultural sector, and therefore, an all industries average was used, most likely leading to an underestimation of salaries.

Finally, there is the issue of the age that one enters and leaves the workforce. For all fatalities, it was assumed that working age commenced at 18 years of age, with retirement beginning at 65 for the general population and 70 for the farming sector. It is acknowledged that this is a limitation of the model, as it is overlooking family-based child labour on farms, adolescent part-time work (both on and off-farm) and the realistic scenario that employees will often continue to work past the nominated retirement age of 65. The scaling back of the farming full-time equivalent (FTE) status over the ages 65 to 70 was an attempt to recognise and, to some extent, rectify this shortfall. However, it is acknowledged that, particularly in farming, older workers may continue to work until well into their 80s or even until death from natural causes, and as such, the model is undervaluing the potential lost earnings of these cases.

5.7 Summary

There were 404 farm-related fatalities that occurred over the 2001–04 period. The majority of fatalities were male (n=347, 85.9 per cent), with fatalities most commonly involving those aged 65 years and older (n=106, 26.2 per cent), followed by children aged under 15 years (n=69, 17.1 per cent).

The total economic cost of farm-related fatalities over this period was estimated to be $650.6 million (2008 dollars), at an average cost of $1.6 million per fatality. Averages were higher for those fatalities aged in their 30s and 40s at time of death, followed by teenagers/children. Deaths of older people were, on average, of lower average economic cost to the economy, as once people reached retirement age, lost future earnings were no longer included in the model.

The five most frequent agents associated with farm-related fatalities – tractors, ATVs, drownings, utilities, and 2 wheel motorcycles – accounted for half of all fatalities. There are guidelines and standards available from Farmsafe Australia to reduce the risk associated with each of these hazards. Improved, widespread adoption and implementation of these recommendations could result in a substantial reduction in the rate of fatalities associated with these agents, which cost the economy $303.5 million over the period of the study.

6. Farm health and safety study – Methodology

Knowledge of the perceptions of farmers towards health and safety, the changes they are making on their farms and the drivers that led to these changes are essential to the design and evaluation of farm health and safety initiatives and programs. However, there is a lack of comprehensive data on the topic, with most cross-sectional studies focusing on small sample populations, as described in the Literature Review.

The Australian Centre for Agricultural Health and Safety (ACAHS) undertook to establish a longitudinal study of farm enterprises initially throughout NSW, to be later expanded into other states, in order to derive better data on the changes being made on Australian farms, the reasons for change, and to establish how these changes relate to farmer perceptions.

This doctoral research involved the design, recruitment and collection of data, as well as analysis of the baseline results. Recruitment into the longitudinal study is continuing, with a second phase currently under development.

This chapter presents the second component of the research, the methodology relating to the farm health and safety study, including the recruitment of farm enterprises, sample size, questionnaire design and structure, scoring of results and quantitative and qualitative analyses.

6.1 Recruitment

To ensure variation in industry and scale of study participants, five New South Wales (NSW) Statistical Divisions (SDs) were selected for inclusion into the study: Northern, North Western, Richmond Tweed, Mid-North Coast and Central West. These divisions represented a wide range of agricultural industries, from small scale, family owned intensive production in the coastal regions, right through to large, extensive, corporate owned enterprises in western and northern regions of NSW. The study aimed to recruit participating enterprises across a range of industries, with strong responses from farm enterprises in each of the following industries: grains, beef cattle, sheep and wool and cotton production.

A table of random numbers was used to select ten Statistical Local Areas (SLAs) from the five SDs for inclusion into the study. The randomly selected SLAs were:

- Northern: Dumaresq (Armidale), Gunnedah, Yallaroi (Warialda) and Moree Plains,
- North Western: Cobar and Warren,
- Richmond Tweed: Richmond River (Casino),
- Mid-North Coast: Maclean, and
- Central West: Weddin (Grenfell) and Cowra.

The Australian Electoral Commission (AEC) was approached to obtain the addresses of all enrolled voters aged 18 to 100 within these SLAs. Data provided by the AEC for medical research is at Electoral Divisions (ED) level; therefore the EDs of Gwydir, New

England, Parkes, Page, Cowper and Calare were requested. The EDs were then to be filtered by postcodes to ensure only the randomly selected SLAs were included into the study.

Once these postcodes had been filtered, the data was processed in Microsoft Excel and the statistical package, SPSS (Graduate Package, Version 16.0), to remove duplicate addresses, urban addresses, police stations, post offices, bank and school residences, communes, hospitals and nursing homes.

A limitation of this approach was that electors living on hobby farms and house blocks that used a '*habitation name'* in their enrolled address were unable to be distinguished from farm enterprises. As a result, it was expected that a significant proportion of the rural addresses extracted from the AEC data would not derive income or production from agriculture.

All selected rural addresses were sent an information package containing the following:

- Letter of invitation,
- An important note detailing the benefits of the study,
- Participant Information Sheet, in line with University of Sydney Ethics requirements,
- Consent form, and
- Reply paid envelope.

In total, 6272 information packages were sent out to rural addresses identified using the AEC data. A copy of the information package is contained in Appendix 2A.

An important consideration of the study was the recruitment of a significant number of farm enterprises involved in the five key agricultural industries; grains, beef cattle, sheep and wool and cotton. Due to concerns that there would be a shortfall in reaching the cotton enterprise quota, the Cotton Cooperative Research Centre (CRC) was approached about potential access to their database of all cotton growers in NSW. Privacy legislation prohibited direct access, however, address labels were supplied for use in another bulk mailout. It is estimated that there are 260 cotton growers in NSW (Cotton Australia, 2006).

This combined recruitment approach led to 314 farm enterprises agreeing to participate in the study. These enterprises were then sent a copy of the questionnaire and a reply paid envelope. By July 2007, 225 completed questionnaires had been returned. It was therefore decided to expand the study by engaging in another round of recruitment.

The second recruitment approach involved revisiting the AEC data to utilise the remaining electors in the ED that did not fall into the randomly selected SLAs. This resulted in the mailing out of a further 2,608 information packages.

As a result of these combined approaches, 335 farm enterprises returned completed questionnaires and were recruited into the first phase of the longitudinal study. While this figure may appear low in comparison to the number of information packages sent out, Australian Bureau of Statistics (2003a) estimates of the number of agricultural enterprises in the study areas (n=3,496) suggest an initial participation rate of 9.6 per cent of agricultural enterprises into the longitudinal study. The longitudinal nature of this research, as opposed to a cross-sectional study would have contributed to lower response rates. Further enterprises are continuing to be recruited into the study, but these enterprises are beyond the scope of this research.

While the random recruitment of farm enterprises in this manner resulted in lower response rates, the key advantage of the approach was that the invitation to participate was open to all rural addresses in the random SLAs that were selected for inclusion into the study, and hence free of the bias that may have occurred if organised groups, such as state and national farmer organisations, were involved.

6.2 Sample Size

There are several key factors in determining sample size including confidence level, population variability, population parameters, acceptable level of precision, the sampling method and the statistical analyses to be applied to the population (Hair, 1995). If the sample size is too low, the study will lack the power to provide reliable results, too high and the study is inefficient. Power refers to the probability of detecting a '*true'* effect when it exists.

The software program G*Power (Faul et al., 2007) estimates the minimum sample size required by entering confidence levels, desired precision, effect size (the strength of the relationship between two variables in the statistical population) and the number of groups. Using the conventional values of $\alpha = 0.05$ and power = 0.8 (Cohen, 1992), and a moderate effect of 0.25, the minimum required sample size for the study is 216. Therefore, the actual sample size of 335 is adequate for this analysis.

6.3 Baseline questionnaire design

The questionnaire was made up of four key sections: demographics and farm enterprise overview, safety benchmarking, free text questions relating to risks and changes on their farm, and injury reporting. A sample survey is contained in Appendix 2B.

6.3.1 Demographics

Section 1 of the questionnaire contained basic demographic questions about the informant and the farming enterprise with which they are involved.

Informant demographics included:

- Sex,
- Position on Farm, and
- Age Group (18–19 years, and then five year age brackets until the final age group of 65 years plus).

Farm enterprise demographics included:

- Farm Enterprise mix (grains, cattle, sheep, cotton, cane, dairy, horticulture, other),
- Number of full-time employees,

- Number of full-time employees that are family,
- Number of part-time employees (over a 12 month period),
- Number of part-time employees that are family members,
- Best estimate of total number of days worked annually by part-time employees,
- Number of contractors,
- Number of households on property, and
- Whether children under 15 reside and/or regularly visit the farm.

6.3.2 Benchmarking questions

Farmers increasingly want to know how they are performing from a workplace health and safety perspective, particularly in regard to meeting requirements of work safety authorities and minimising the risk of prosecution. Whilst it is not possible for the study to be able to satisfy this request, it does enable enterprises to compare their scores against averages for the study population as a whole, as well as those in their region and industry.

As discussed in the Literature Review, the questionnaire formed the basis of the final year audit review for participants in the WorkCover NSW Cotton Premium Discount Scheme, administered by ACAHS. Sections 2, 3 and 4 of the questionnaire related to benchmarking and contained questions on Safety Climate, Safety Management Systems and Control of Major Hazards, based on Williamson et al. (1997), Temperley (2005) and key safety priorities of Farmsafe Australia.

The benchmarking questions had two dimensions; Safety Climate questions covered the perceptions of the informant completing the questionnaire as a representative of the farm enterprise, while the Safety Management Systems and Control of Major Hazard questions were related to actual processes and practices on the farm enterprise.

6.3.2.1 Safety Climate

The perceptions of safety within an organisation or business are commonly referred to as the safety climate, of which there are five recognised dimensions:

- *Personal motivation for safety*: factors that would promote safer behaviour,
- *Positive safety practice*s: reflecting safety activity within the workplace,
- *Risk justification*: instances or reasons why an individual worked unsafely or took known risks,
- *Fatalism*: the concept that accidents are natural consequence of the working environment, and
- *Optimism*: reflecting a favourable view of personal accident or safety risk (Williamson et al., 1997).

Safety Climate, Section 2 of the questionnaire, contained 20 questions, to which the informant could respond *'Yes', 'To some extent', 'No'* or *'Not sure'.* These answers were based on the perceptions of the informant and may not reflect the perceptions of all parties involved in the farming enterprise.

Table 6.1: Safety Climate questions, by dimension

Dimension	Question
Personal motivation for safety	It costs too much to be committed to farm safety
	It takes too much time out from work to be committed to farm safety
	Farm safety is too difficult and complicated for us to tackle
	Farm safety improves farm productivity
	Farm safety helps employees become more responsible in their work
Positive safety practices	We provide adequate safety training for workers on our farm
	The effectiveness of farm safety lies mainly with our workers
	Managing safety on our farm is as important as profit
	Everybody works safely on our farm
	The owners, managers and/or partners all play a part in farm safety
Risk justification	I have not worked safely because machinery was not fitted with the right safety features
	I have not worked safely because I didn't know the risks involved at the time
	I have not worked safely because safety was not part of my farm training or upbringing.
	I have not worked safely because I needed to get the job done quickly
	I have not worked safely because replacing the guard was a hassle
Fatalism	If I worried about safety all the time I would not get my job done
	I cannot avoid taking risks in my job
	Accidents will happen no matter what I do
Optimism	Not all accidents are preventable, some people are just unlucky
	People who work to safety procedures will always be safe

These questions were based on Williamson et al. (1997), but slightly reworded, in order to reflect the farming nature of the workplace and also to ensure that a response of '*Yes*' was not always the correct answer. There was no change to the intent or outcome of the original Williamson questions.

There were five questions each on personal motivation for safety, positive safety practices and risk justification, three questions on fatalism, with the final two questions on optimism. These questions are contained in Table 6.1.

6.3.2.2 Safety Management Systems

Temperley (2005) developed a series of questions relating to safety management systems on farms that were validated and included in the audit process for participants in the WorkCover NSW Cotton Premium Discount Scheme. These questions reflected the key dimensions of managing farm safety, including:

- The engagement of workers and management in safety on the farm,
- Assessment of hazards and risks,
- Safety plans and actions,
- Information, training and resources on workplace safety and systems, and
- Monitoring and recording of health and safety incidents, situations and processes (Temperley, 2005).

There were 35 questions in the Safety Management Systems section (Section 3), to which farm enterprises could select *'Yes', 'To some extent', 'No'* or *'Not sure'.* These questions are contained in Table 6.2.

Table 6.2: Safety Management System questions, by dimension

Dimension	Question
Engagement of workers and management	This farm allocates resources to safety
	On this farm, the routine monthly per cent allocation of time to safety is…
	All individuals who work on the farm know their responsibilities for safety
	Safety responsibilities of the business partners and managers are clearly defined and understood
	Safety responsibilities of employees are included in duty statements
	Responsibility for supervision of safe work is specified
	All employees AND contractors receive safety induction before starting work
	All employees receive safety induction to all hazardous jobs before starting that job on the farm
	All those who work on the farm are actively involved in the farm's safety program
	Safety is on the agenda of regular meetings held between employer and employees
	Training has been undertaken for all current workers in safety risk management
Assessment of hazards and risks	All those who work on the farm actively report unsafe situations and unsafe acts to the employer or manager of the workplace
	Action is taken following all reports of unsafe situations and unsafe acts reported
	Regular hazard inspections are undertaken for all parts of the farm workplace
	Hazard inspections are scheduled for ensuring the safety of workers before key seasonal activity begins
	Safety risk assessment is a key part of the investigation of all new equipment for the farm
Assessment of hazards and risks	A farm safety business plan is in operation with clear timelines and budget
	Short term and long term plans are included in the action plan
	Safety risks on the farm are managed mostly by rules for doing the job safely.
	Engineering solutions can mostly be found to manage safety risk

Continued

Table 6.2 (Continued): Safety Management System questions, by dimension

Dimension	Question
Safety plans and actions	There are safety rules for keeping guards in place and in good condition
	The personal protective equipment (PPE) that is necessary for safe work is available for all relevant jobs on the farm
	Helmets are always worn when any worker rides the ATV, farm motorcycle or horse
	Ear muffs or plugs are always worn in the workshops when noisy work is being done
	All family members, workers and contractors are aware of the emergency arrangements on the farm, including phone numbers
	Arrangements for regular communication between farmers and workers during the day are in place
Information, training and resources	Safety information is available for all hazardous jobs on the farm
	All workers can access the Operators Manual for all plant and equipment in use on the farm
	Relevant safety training has been provided for all workers
	Training has been undertaken by all workers engaged in pesticides application
	Training has been undertaken by all current workers in safe ATV, motorcycle and tractor operation
Monitoring and recording	Day-to-day records of reports of unsafe situations and unsafe acts are kept for planning action
	Up-to-date records are available of pesticides held and used on the farm
	Up-to-date records of worker and contractor safety induction are available
	Up-to-date records of machine and equipment maintenance are available
	Records of injury and near-miss accidents are kept and used to plan safer systems of work

6.3.2.3 Control of Major Safety Hazards

The final set of benchmarking questions related to major safety hazards and their control (Section 4). The major safety hazards selected have all been the subject of media and industry campaigns, having been identified by Farmsafe Australia as key priorities in their safety promotion and awareness activities, due to the potential high risk of serious injury and/or death stemming from their use. Each hazard also has a control measure available, to reduce the level of risk associated with its use. The Safety Management System questions, detailed in Table 6.3, were also validated and included as part of the audit process for the WorkCover NSW Cotton Premium Discount Scheme.

Table 6.3: Control of Major Safety Hazard questions

Hazard	Question
Tractors	All tractors on the farm are fitted with a ROPS that meets Australian standards
	How many tractors are in operation on the farm?
	How many are fitted with a ROPS that meets Australian standards?
Machinery guarding	All tractors on the farm are fitted with a tractor PTO masterguard
	How many are fitted with an undamaged tractor PTO masterguard?
	All PTO shafts on tractor powered equipment are protected by an undamaged PTO shaft guard
	How many PTO powered items of equipment are in use on the farm?
	How many are fitted with undamaged PTO shaft guards?
	Intakes of all grain augers are effectively guarded so that hands or feet cannot be caught in the flight
Workshop Safety	Bench grinders in the farm workshop are all fitted with undamaged guards
	A Residual Current Device is fitted into the electrical system of the farm workshop
	Ear muffs or plugs are always worn by workers and others when noisy work is undertaken in the workshop
	Eye goggles are always used by people using grinders in the workshop
Chemicals	Chemicals are stored in a separate locked area of the farm workplace, with access only by designated people
	People handling pesticides on the farm always wear the PPE advised on the label
Vehicle and road safety	Roads that are used by farm and contractor vehicles are in safe condition have set speed limits
	It is an established and accepted rule that all adults and children must be properly restrained in any vehicle on the farm
Helmets	It is an established and accepted rule that no adult or child is to ride an ATV, motorcycle or horse without wearing a correctly fitted helmet
Working from heights	All silos have systems that effectively prevent injury from falling from a height
Child safety	There is a securely fenced and gated play area around the home to protect children from injury in the farm workplace

6.3.3 Free text questions

Three free text questions were included in Section 5 of the questionnaire to enable informants to report changes to farm safety that had occurred on their enterprise over the past 12 months, as well as note comments and experiences of the practical aspects of management, systems and processes.

The first of the questions, *'What changes have you made on your farm in the past 12 months to improve farm safety?'* was included in the questionnaire to establish data, facts, experience and perceptions to counteract the approach to farm safety commonly portrayed in the media as to why farmers are *not* implementing farm health and safety systems on their farms. Reasons such as '*it's too costly*', '*too time consuming'* or '*too much paperwork*' are frequently given as reasons, but there are farms making significant changes to their management systems and processes and it is important for promotion and awareness initiatives to have an understanding of these changes to effectively target their campaigns.

ACAHS, Farmsafe Australia, work safety authorities, industry, research and development organisations and farmer groups have all invested a significant amount of resources in not only raising the awareness of key hazards on farms, but also in developing practices and systems to minimise these risks. But how effective have these programs been and are they in line with what farmers assess as the major risks on their farms? These questions prompted the inclusion of the two other free text comment boxes, *'What prompted you to make these changes'* and '*What do you see as* *the current safety risks or issues on your farm?'* Data generated by these two questions may be useful in evaluating the effectiveness of farm safety campaigns, as well as in highlighting emerging risk and hazards areas that may warrant further research and priority.

6.3.4 Injury reporting

An injury reporting sheet was designed to collect information on each farm injury that occurred on the farm over the past 12 months that required either:

a) Medical attention at a hospital, GP or allied health service, or
b) One full day off work or school.

The key attributes sought on the injury reporting sheet were:

- Demographics of the injured: age, gender, position on farm,
- Hospitalisation and/or time off work: to assess the seriousness of the injury and the potential cost to the production system,
- The bodily location and type of injury: to develop a profile of the most common type of injuries reported on participating farms, coded using the Farm Injury Optimal Dataset (Fragar, Franklin and Coleman, 2000),
- Injury agent: coded using the Farm Injury Optimal Dataset (Fragar, Franklin and Coleman, 2000), and
- Three injury questions of causal factors involved in each accident; what was the person doing; what went wrong; and what actually caused the injury?

6.4 Scoring of questionnaire results

It was decided that each of the three questionnaire sections; Safety Climate, Safety Management System and Control of Major Safety Hazards; were of equal importance in their role in improving farm safety. Therefore, each section was deemed to be worth one hundred points, with a total questionnaire score of three hundred.

The individual scoring of questions in each section differed slightly, as detailed in the following sections. However, there was one common element; an answer of '*Not sure'* was given a score of zero, as it was deemed that to have no knowledge or understanding about a particular element of farm safety and its application and management was as critical as not having a control system in place or not having a positive safety attitude. Appendix 2C details the scoring for all of the questions.

6.4.1 Section 2 – Safety Climate

The 20 questions within the Safety Climate section were each weighted equally to be out of five points, with a section total of one hundred. As previously discussed, the statements were worded in such a way that the correct answer was not always '*Yes'*. In fact, of the 20 questions, there were only six that scored full marks with an answer of '*Yes'*. The most correct response was worth five points; a partially correct response was worth 2.5 points; while the most incorrect response or a '*Not sure*' received a score of zero.

To ensure reliability of the questionnaire, Cronbach's Alpha was applied to the farm enterprise scores using the statistics package, SPSS (Graduate Package 16.0).

Cronbach's Alpha is a statistic that investigates the internal consistency of a questionnaire. If the scale shows poor reliability, then individual items within the scale must be re-examined and modified or completely changed. The generally accepted value of reliability is 0.7 (Santos, 1999). The alpha value (α) for Section 2 was estimated to be 0.73, and therefore a reliable measure of Safety Climate.

6.4.2 Section 3 – Safety Management Systems

The scoring system for Section 3 was a little more complex, as there were 35 statements involved that still must total one hundred. Each statement was therefore given a weighting, based on its relative importance in farm safety management and systems. Fifteen of the statements judged to be most important were given a score out of four, with the remaining 20 statements awarded two points. In all cases, a response of '*Yes'* was the most correct answer, '*To some extent'* was half points, whilst a '*No'* or '*Not sure*' response was worth zero points.

Cronbach's Alpha was calculated using farm enterprise scores; with the set of Section 3 questions found to be a reliable measure of Safety Management Systems (α=0.93).

6.4.3 Section 4 – Control of Major Safety Hazards

As with Section 3, Safety Management Systems, Section 4 also uses a weighting system to achieve a total score of one hundred. Five statements of the 15 are priority farm safety initiatives and therefore, have been weighted to be worth 10 points. The remaining ten statements have been scored out of five points. An answer of '*Yes'* to any of the statements results in full marks, half marks are awarded to a '*To some* *extent'* response, with '*No'* or '*Not sure'* again being worth a zero score. This section also has the additional response of '*Not Applicable'*. In these cases, a value of zero was recorded and the assigned value of the question was deducted from the total of one hundred points. For example, an enterprise citing a '*Not Applicable'* to the questions of *'Intakes of all grain augers are effectively guarded so that hands or feet cannot be caught in the flight' (worth ten points)* and *'All silos have systems that effectively prevent injury from falling from a height'* (worth five points) would have their Section 4 result scored out of a possible 85 instead of a maximum of 100.

Cronbach's Alpha was calculated using enterprise scoring; with the set of Section 4 questions found to be a reliable measure of Control of Major Safety Hazards (α=0.73).

6.4.4 Total scores

To ensure that enterprises with '*Not applicable*' responses in Section 4 were not penalised, each section total was converted into a percentage. Sections 2 and 3 were out of a possible 100, while Section 4 involved the enterprise score divided by the adjusted total for that Section, due to the option of *'Not Applicable'*. Using the example in the previous section, this would mean that the enterprise would have their Section 4 score divided by 85 instead of 100. Likewise, for the overall score for the entire questionnaire, the three section totals were summed and divided by 200 plus the adjusted possible total for Section 4. Therefore, continuing the previous example, their enterprise score would be a percentage out of a possible 285.

Cronbach's Alpha was calculated using informant/enterprise scoring on questions from all three of the questionnaire sections. The alpha co-efficient was estimated to be 0.91 for the entire suite of questionnaire items, indicating strong internal consistency and hence, reliability.

6.5 Quantitative analysis

The questionnaire results were entered into a Microsoft Access database form, the table of which was then imported into Microsoft Excel. A series of *IF* statements were used to convert the responses to numerical values and to establish the scores, adjusted totals and percentages for each of the sections, and the questionnaire as a whole.

The numerical values were then imported into SPSS (Graduate Package 16.0) for manipulation and statistical analyses using a general linear model to determine the significance of age group, gender, enterprise and location variables on section scores. First order interactions were also assessed, with non-significant interactions sequentially deleted. Main effects were all retained in the model as the degrees of freedom consumed were only small. Correlation of section scores were also analysed to determine significant relationships between sections.

6.5.1 Assumptions

There are two dimensions to the benchmarking questions, with Safety Climate relating to the perceptions of the informant completing the questionnaire, and Safety Management Systems and Control of Major Hazards relating to the actual farm enterprises.

While it is recognised that the perceptions and attitudes of the informant may not necessarily represent those of the entire farming enterprise, for the purpose of the study, it is assumed that the beliefs of the individual informant impact on the overall ideology of the farming enterprise.

As Safety Climate scores relate to the perceptions of the informant, age and gender associations were therefore deemed to be statistically relevant.

For the Safety Management Systems and Control of Major Safety Hazards sections, it is acknowledged that the informant is completing the questionnaire on behalf of the enterprise and it is not possible to ascertain whether the informant was the primary decision maker on the farming enterprise and therefore responsible for the practices and systems in place, or lack thereof. However, as 70.1 per cent of informants nominated their position on the farm as Owner and/or Manager, age and gender were deemed relevant factors for analysis.

6.6 Qualitative analysis

The three free text questions were also entered into a Microsoft Access form. Due to the varying nature of responses, and their level of detail, the Access table was imported into Excel, where it was reviewed and manually coded into a series of categories and sub-categories. The sub-categories were developed based on a frequency of response, and aimed to be specific enough that detail of the response was not lost, but also broad enough that that single frequencies were not allocated their own sub-category. These sub-categories were then grouped into higher, more generic categories, based on similar attributes. Additionally, for the question relating to recent changes on farm, the sub-categories and categories were also assigned a level, based on the *hierarchy of control*. The hierarchy, discussed in greater detail in the Literature Review, involves five levels ranging from best practice (elimination of the hazard) down to changes involving reliance and changes to human behaviour. Once the free text questions were categorised, they were imported into the statistical program, SPSS (Graduate Package 16.0), to conduct a frequency analysis and evaluation.

As with the other data collected in the questionnaire, the injury reporting sheets were entered into a Microsoft Access form. The questionnaire and Access form were designed to utilise the Farm Injury Optimal Data Set (Fragar, Franklin and Coleman, 2000) to code the bodily location and type of injury, as well as the agent involved in the injury. Once data entry was completed, the Access table was imported into Excel, where it was validated and summarised. Finally, the summarised data was imported into SPSS (Graduate Package 16.0) for frequency analyses to assess the number, type and seriousness of the incidents reported.

6.7 Summary

The farm health and safety study is a longitudinal study that aims to derive more comprehensive data on the changes being made on Australian farms, what prompted the changes to be made and to establish how these changes relate to farmer perceptions.

There have been 335 farm enterprises recruited into the study throughout NSW. This research comprises of the baseline data collected for the longitudinal study through postal questionnaire, comprising of six sections.

The questionnaire collected data on the demographics of the informant completing the questionnaire and the farm enterprise they represent. Additionally, it assessed the Safety Climate, Safety Management Systems and Control of Major Hazards associated with the farming enterprise. Finally, it recorded changes made to health and safety on farms, drivers for safety changes, the perceived risks on participating farms and reporting of injuries that occurred on farm. Quantitative and qualitative analyses will be applied to the baseline data.

7. Farm health and safety study – Results and Discussion

The baseline questionnaire sent to farm enterprises as part of the longitudinal farm health and safety study was well answered by informants on behalf of their enterprises; of the possible 1,675 individual sections associated with the questionnaire, only four remained unanswered.

This chapter analyses the informant and enterprise responses to the six sections of the questionnaire (contained in Appendix 2B) and also quantitative analyses on their scores. The sections of the questionnaire included:

- Section 1 – Demographics: basic questions relating to age, gender and role on farm of informant, as well as enterprise demographics relating to industry, employees and contractors, households and children on farm.
- Section 2 – Safety Climate: 20 questions relating to the perceptions of the informant to farm health and safety, to which they could answer *'Yes', 'No', 'To some extent'* or *'Not sure'.*
- Section 3 – Safety Management Systems: 35 questions relating to the management of health and safety on participating farm enterprises, to which the informant could select *'Yes', 'No', 'To some extent'* or *'Not sure'.*
- Section 4 – Control of Major Safety Hazards: 15 questions relating to the management of priority hazards identified by Farmsafe Australia on participating farm enterprises. Informants could answer *'Yes', 'No', 'To some extent'* or *'Not sure'.*

- Section 5 – Free text questions: Three questions relating to *'What changes have you made on your farm in the past 12 months to improve farm safety?', 'What prompted you to make these changes?'* and *'What do you see as the current safety risks or issues on your farm?'*
- Section 6 – Injury reporting: questions relating to injuries that occurred on the farm and required medical attention and/or time of work or school. Information was requested on the nature, bodily location and agent of injury, as well as free text descriptors on where the accident took place, what the injured person was doing, what went wrong and what actually caused the injury.

Sections 2, 3 and 4 were recorded as percentage scores, which enabled a total score to be calculated. Further details on the scoring system are provided in Chapter 6.

A general linear model was applied to Sections 2, 3 and 4, as well as the total score, to determine whether variables, such as age, gender and enterprise, influenced the score received by the informant. A correlation analysis was performed to establish whether there was any relationship between informant scores in the different sections.

7.1 Demographics

7.1.1 Informant demographics

There were 335 enterprises recruited into the study. An analysis of the demographics of the informants revealed 78.5 per cent (n=263) were male. The informants ranged in age from less than 25 years, though to 65 years plus, with the most common age grouping being 45–54 years (Figure 7.1).

The vast majority of informants nominated their role on farm as Owner and/or Manager (70.1 per cent), with a further 12.8 per cent nominating their role as a Partner of the farming enterprise (Table 7.1).

Figure 7.1: Study informants, by age and gender

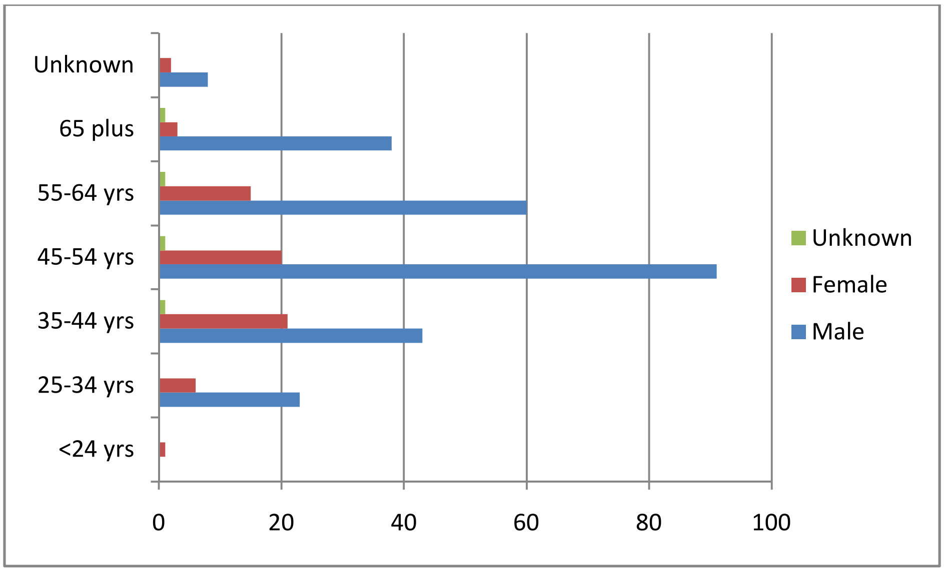


Table 7.1: Role on farm of informants

	Frequency	Per cent
Owner and/or Manager	235	70.1
Partner	43	12.8
Family/Spouse	5	1.5
Farm Secretary	5	1.5
Farmhand	5	1.5
Director	4	1.2
OHS Coordinator	4	1.2
Assistant Manager	3	0.9
Share farmer	1	0.3
Unknown	30	9.0
Total	**335**	**100.0**

7.1.2 Enterprise demographics

The farm enterprises were well distributed throughout the surveyed area, with the exception of the Maclean/Richmond River Statistical Local Areas (SLAs), which were under-represented with just 6.0 per cent of study enterprises (Table 7.2). This was not unexpected, as there are a high number of hobby farmers in the area, with a smaller number of commercial agricultural operations.

Table 7.2: Statistical Local Area (SLA) of farm enterprises

SLA	Frequency	Per cent
Warren/Cobar	85	25.4
Weddin/Cowra	68	20.3
Gunnedah/Manilla/Coolah	63	18.8
Dumaresq	52	15.5
Moree Plains/Yallaroi	46	13.7
Maclean/Richmond River	20	6.0
Unknown	1	0.3
Total	**335**	**100.0**

The farm enterprises recruited were involved in a range of agricultural industries; 65.4 per cent (n=219) were involved in more than one industry, with 31.9 per cent involved in a single industry. Grains and livestock were the most frequently reported industry mix (n=63, 18.8 per cent), followed by cattle (n=58, 17.3 per cent) and cattle and sheep farmers (n=49, 14.6 per cent). A detailed breakdown of the enterprises involved in the study is contained in Table 7.3.

Table 7.3: Farm enterprises, by industry

	Frequency	Per cent
Single Enterprise	**107**	**31.9**
Cattle	58	17.3
Sheep	18	5.4
Grains	16	4.8
Horticulture	10	3.0
Cotton	2	0.6
Dairy	2	0.6
Cane	1	0.3
Mixed Enterprise	**219**	**65.4**
Grains and Livestock	63	18.8
Mixed Livestock	49	14.6
Grains and Sheep	38	11.3
Grains and Cattle	34	10.1
Grains and Cotton	15	4.5
Grains, Cotton and Cattle	12	3.6
Grains, Cotton and Livestock	5	1.5
Grains, Cotton, Sheep	2	0.6
Grains and Cane	1	0.3
Unknown/Other	**9**	**2.7**
Total	**335**	**100.0**

7.2 Total scores

Each enterprise had their scores for each of the three farm health and safety sections combined and converted into a percentage in order to gain an overall score and assessment for their perceptions, attitude and management of farm health and safety as a whole.

The average total score was 61.4, with scores ranging from a low of 20 through to a high of 95 (Table 7.4). The distribution of scores implied negative kurtosis, as the absolute ratio of kurtosis to its standard error was greater than two (kurtosis statistic = -0.583, kurtosis standard error = 0.266). Therefore, there was a flatness of the distribution across scores, rather than the traditional bell shaped distribution associated with normality. This flatness is clearly demonstrated in Figure 7.2. There was no evidence of skewness, as the absolute ratio of skewness to its standard error was less than two (skewness statistic = -0.182, skewness standard error = 0.133).

Figure 7.2: Distribution of section scores

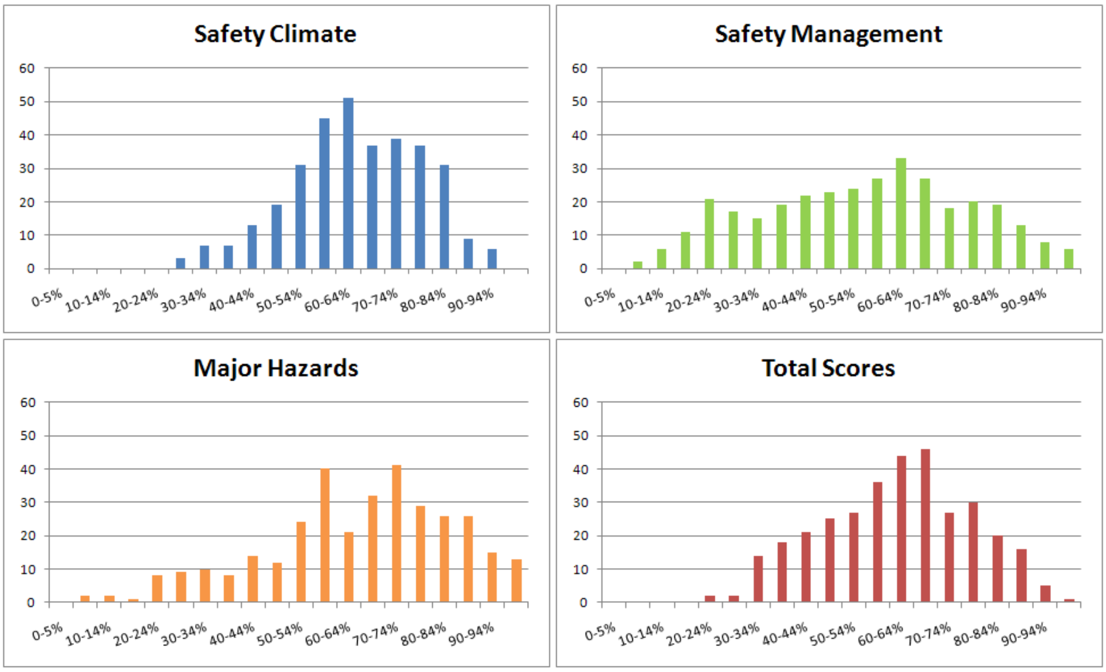


Table 7.4: Descriptive statistics, by section

	N	Range	Minimum	Maximum	Mean	Standard Error	Standard Deviation
Section 2	335	65	28	93	65.2	0.8	14.4
Section 3	332	95	5	100	54.6	1.2	21.8
Section 4	334	95	5	100	65.3	1.1	20.2
Total	335	75	20	95	61.4	0.9	15.7

A general linear model was used to determine the impact of age group, gender, enterprise and location on total scores ($r^2 = 0.164$). There was found to be a significant difference between total score means in cotton enterprises (p = 0.012, Table 7.5), with enterprises involved in cotton production scoring significantly higher than those enterprises not involved growing cotton (Table 7.6).

First order interactions were also assessed, with non-significant interactions sequentially deleted. Main effects were all retained in the model as the degrees of freedom consumed were only small. Significant interactions (Table 7.5) were observed between:

- Gender and grains (p = 0.009): females involved in the production of grains scored significantly higher than those not involved in grains, as well as male informants both from grain and non-grain enterprises.
- Age group and grains (p = 0.003): informants aged 55 years and over scored significantly higher when not involved in grain production. However, the reverse applied for informants aged under 55 years, where those involved in the production of grain scored significantly higher. For non-grain enterprises, informants aged 55 years and over scored significantly higher than those aged under 55.
- Cattle and sheep enterprises (p = 0.017): informants not running sheep or cattle scored significantly higher. The lowest mean from this interaction came from enterprises not involved in cattle, but running sheep (Table 7.6).

Possible reasons behind these significant results are discussed in detail in the following three sections.

Table 7.5: Significance of variables, total score

Variable	Df[1]	Sums Squares	F ratio	P value	Significance
Main effects					
Location	5	2047.91	1.88	0.098	
Gender	1	553.92	2.54	0.112	
Age Group	1	303.12	1.39	0.240	
Horticulture	1	151.10	0.69	0.406	
Cattle	1	44.81	0.21	0.651	
Sheep	1	198.34	0.91	0.341	
Grains	1	63.34	0.29	0.590	
Cotton	1	1398.46	6.41	0.012	*
Other	1	433.41	1.99	0.160	
1st Order Interactions					
Gender*Grains	1	1494.69	6.85	0.009	**
Age Group*Grains	1	1915.88	8.78	0.003	**
Cattle*Sheep	1	1246.02	5.71	0.017	*

[1] Degrees of freedom
Significance: *p<0.05, **p<0.01, *** p<0.001

Table 7.6: Significant main effect variables and first order interactions, total score

		Adjusted Means	Relative Standard Error
Main effects			
Cotton		71.39	4.10
Non-Cotton		62.55	2.23
1st order interactions			
Gender*Grains	Female, Grains	71.98	3.93
	Female, Non-Grains	65.22	3.55
	Male, Grains	63.34	3.12
	Male, Non-Grains	67.33	2.94
Age Group*Grains	Over 55, Grains	66.06	3.77
	Over 55, Non-Grains	69.95	3.21
	Under 55, Grains	69.26	3.15
	Under55, Non-Grains	62.60	3.13
Cattle*Sheep	Cattle, Non-Sheep	65.96	3.20
	Cattle, Sheep	67.11	3.85
	Non-Cattle, Non-Sheep	71.24	2.71
	Non-Cattle, Sheep	63.55	4.21

7.3 Section 2 – Safety Climate

Safety climate refers to an individual's perception of the safety consciousness within their business or organisation, and as such, the questions in the study were designed to evaluate responses in relation to personal motivation for safe behaviour, positive safety practice, risk justification, fatalism and optimism. A high score was associated with a positive perspective on farm health and safety, while a lower score demonstrated a lack of commitment and belief in on-farm OHS management.

All informants completed the Safety Climate questions, with an average score of 65.2. The scores, out of 100, ranged from a low of 28 to a high of 93 (Table 7.4). The distribution was slightly negatively skewed, as the absolute ratio of skewness to its standard error was greater than two (skewness statistic = -0.310, skewness standard error = 0.133), implying there was a greater number of higher scores than lower scores. There was no evidence of kurtosis, as the absolute ratio of kurtosis to its standard error was less than two (kurtosis statistic = -0.518, kurtosis standard error = 0.266).

It must be emphasised that these scores are related to the informants completing the questionnaire and may not be indicative of other parties involved in the farming operation.

7.3.1 Results

A general linear model was used to determine the impact of age group, gender, enterprise and location on Section 2 scores (r^2 = 0.141). There was found to be a significant difference in the Section 2 means (Table 7.7) based on:

- Gender (p = 0.012): female informants scored significantly higher than male informants.
- Sheep enterprises (p = 0.000): enterprises not involved in sheep production scored significantly higher than sheep production enterprises (Table 7.8).

As with total scores, first order interactions were also assessed, with non-significant interactions sequentially deleted. Main effects were all retained in the model as the degrees of freedom consumed were only small. Significant interactions (Table 7.7) were observed between:

- Age group and grain enterprises (p = 0.007): informants aged 55 years and over scored significantly higher when not involved in grain production. For non-grain enterprises, informants aged 55 years and over scored significantly higher than those aged under 55.
- Cattle and sheep enterprises (p = 0.022): informants not involved in either cattle or sheep scored significantly higher. The lowest mean from this interaction came from enterprises running sheep, but not cattle (Table 7.8)

7.3.2 Discussion

Of particular interest in analysis of Safety Climate scores was the significant difference in the means of key variables. On average, female informants scored higher than males, informants aged 55 and over scored higher than those aged under 55 and informants without sheep on their property scored significantly higher than those with a sheep enterprise.

Table 7.7: Significance of variables, Section 2 scores

Variable	Df[1]	Sums Squares	F ratio	P value	Significance
Main effects					
Location	5	749.03	0.81	0.545	
Gender	1	1186.37	6.39	0.012	*
Age Group	1	582.42	3.14	0.077	
Horticulture	1	18.69	0.10	0.751	
Cattle	1	95.41	0.51	0.474	
Sheep	1	3693.03	19.90	0.000	***
Grains	1	585.04	3.15	0.077	
Cotton	1	422.86	2.28	0.132	
Other	1	486.32	2.62	0.106	
1st Order Interactions					
Age Group*Grains	1	1349.15	7.27	0.007	**
Cattle*Sheep	1	981.54	5.29	0.022	*

[1] Degrees of freedom
Significance: *p<0.05, **p<0.01, *** p<0.001

Table 7.8: Significant main effect variables and first order interactions, Section 2 scores

		Adjusted Means	Relative Standard Error
Main effects			
Female		69.08	2.82
Male		64.30	2.48
Sheep		62.42	2.93
Non-Sheep		70.93	2.35
1st order interactions			
Age Group*Grains	Over 55, Grains	66.12	3.31
	Over 55, Non-Grains	72.13	2.83
	Under 55, Grains	65.65	2.71
	Under55, Non-Grains	64.85	2.79
Cattle*Sheep	Cattle, Non-Sheep	69.60	2.85
	Cattle, Sheep	65.02	2.96
	Non-Cattle, Non-Sheep	72.26	2.46
	Non-Cattle, Sheep	59.88	3.33

From a gender perspective, it may be suggested that women are more cautious in their nature and therefore, are more likely to have a positive attitude towards farm safety, while males are more likely to accept the risks and hazards as part of the job and as a consequence, score lower in these areas.

Gustafson refers to three key areas where risk perceptions differ between gender; males and females often express different levels of concern about the same risks; they differ in their ideas of what constitutes a risk; and they differ in the meaning and interpretation that they apply to the same risks.

The explanation as to why these gender differences occur has been debated by Davidson and Freudenburg (1996). The explanation that receives the most consistent support is related to social roles and everyday activities. It implies that the role as nurturer and care provider, a role largely performed by women, is associated with a greater concern about health and safety issues in general.

Durey and Lower (2004) also observed significant gender differences in the perception of risks and hazards on Australian farms, with women focusing more on home, family and environmental risks.

Informants aged 55 years and over scoring higher in Safety Climate than those aged under 55 years was an unexpected result. Many have assumed that the younger farmers are more progressive in their management, open to new ideas, practices and mechanisation, more likely to have higher education and safety training and to have spent some time working off-farm, and therefore would be more familiar and committed to the idea of health and safety in the workplace (Macfarlane et al., 2008; Reisenberg and Bear, 1980; Schenker, Orenstein and Samuels, 2002). This theory would therefore suggest older farmers are more set in their ways, unwilling to make changes and accepting that the risks and hazards are just part of the job (Fiedler et al., 1998).

Therefore, the unexpected higher scoring of older farmers in comparison to their younger counterparts is an important finding of the study, and suggests that those in the promotion and extension of farm safety material may need to review and adapt their approaches and interventions.

The significant difference in average scores between those informants that run sheep on their property and those that do not was not unexpected; however, some of the reasoning behind this theory does not hold. Sheep informants were amongst the highest average age of all informants surveyed, and based on what the data suggests may be a misconception, it was therefore assumed that this higher average age would transpose to a lower performance in the Safety Climate section, for the reasons outlined in the previous paragraph.

The sheep industry is a hazardous industry; the annual number of workers' compensation claims that arise among sheep shearers is almost six times higher than any other industry at a rate of 150 claims per 100,000 workers, compared with 26 per 100,000 workers in all other industries (WorkCover NSW, 2003b). The most common injuries associated with shearing and crutching are manual handling related, for example, back injuries from sheep handling and chronic muscular and skeletal conditions of the hands and arms from the shearing equipment (WorkCover NSW, 2002).

One reason for the lower scores in Safety Climate by sheep informants may be the impact of low productivity gains by the industry. Total factor productivity (TFP), a measure which enables productivity to be compared across industries and regions, clearly demonstrates that over the period 1977–78 to 2006–07, the sheep industry had the lowest TFP of any industry, at just 0.3 per cent per annum. Dairy was the next closest industry with an annual TFP of 1.2 per cent, while beef was 1.5 per cent. Cropping was the most progressive of all industries, gaining 2.5 per cent per annum. An analysis of the use of farm inputs on sheep enterprises, from which TFP is partially derived, reveals a decline of 1.8 per cent over the same period (Australian Bureau of Agricultural and Resource Economics, 2009).

This decline suggests sheep farmers may not able to make the necessary changes to practices and systems on farm, as they are financially constrained. This may then lead to a prevalence of *fatalism* (that accidents are natural consequence of the working environment) and *risk justification* (instances or reasons why an individual worked unsafely or took known risks). Furthermore, the issue relating to the costs of improving farm safety may have impacted on the *personal motivation for safety*, all three of which would combine to result in a lower Safety Climate score.

The high numbers of claims within the sheep industry, coupled with the nature of sheep farming, may have a substantial impact on the perceptions of informants and their Safety Climate score. The manual handling in yards and when shearing and crutching may also result in a degree of *fatalism* and *risk* justification by farmers. The small size of sheep relative to cattle means that farmers will lift, drag and manoeuvre the animals physically themselves, which invariably leads to musculoskeletal injuries.

Cattle farmers, on the other hand, are not subjected to this level of risk, as once their stock gets to weaning age, it is no longer possible to manhandle them in the same manner, due the sheer weight and bulk of the animal. Therefore, whilst a farmer may recognise that manual handling of sheep is hazardous, they may continue the practice because they physically can, and because they feel they have to.

There was also an interaction between age category of informants and grain farming. Informants aged 55 years and over who did *not* grow grain crops on their properties scored significantly higher than those informants aged 55 years and over who did run a grain enterprise. This result was surprising, as grain growers are generally quite progressive in their management, particularly in regard to technology, so to have them score lower on average than those without grains was an unexpected result. A potential reason for this scoring may be that farmers associate tractors having cabins and newer machinery with a reduction in their exposure to risk, and may therefore view farm safety as a lower priority on their farms.

7.4 Section 3 – Safety Management Systems

Safety management referred to the systems and processes in place to manage health and safety on farms. Enterprises were assessed on how they engage workers and management on farm health and safety, their appraisal of hazards and risks, the implementation of safety plans and actions, the provision of information, training and resources on workplace safety and systems, and the systems in place for the monitoring and recording of health and safety incidents, situations and processes.

7.4.1 Results

All but three enterprises completed the Safety Management System questions, with an average score of 54.6; the lowest of the three sections. The scores, out of 100, ranged from a low of just five to a perfect score of 100 (Table 7.4). The distribution of scores implied negative kurtosis, as the absolute ratio of kurtosis to its standard error was greater than two (kurtosis statistic = -0.839, kurtosis standard error = 0.267). Therefore there was a flatness of distribution across scores, rather than the traditional bell shaped distribution associated with normality. This flatness is clearly demonstrated in Figure 7.2. There was no evidence of skewness, as the absolute ratio of skewness to its standard error was less than two (skewness statistic = -0.082, skewness standard error = 0.134).

A general linear model was used to determine the impact of age group, gender, enterprise and location on Section 3 scores (r^2 = 0.147). There was found to be a significant difference in the Section 3 means (Table 7.9) based on cotton production (p = 0.017), with enterprises involved in the production of cotton scoring significantly higher than non-cotton producers (Table 7.10).

Table 7.9: Significance of variables, Section 3 scores

Variable	Df[1]	Sums Squares	F ratio	P value	Significance
Main effects					
Location	5	2308.82	1.08	0.372	
Gender	1	780.97	1.82	0.178	
Age Group	1	1100.33	2.57	0.110	
Horticulture	1	77.71	0.18	0.670	
Cattle	1	43.43	0.10	0.750	
Sheep	1	1158.35	2.70	0.101	
Grains	1	137.56	0.32	0.571	
Cotton	1	2448.09	5.72	0.017	*
Other	1	342.22	0.80	0.372	
1st Order Interactions					
Gender*Horticulture	1	2563.22	5.98	0.015	*
Age Group*Sheep		1684.45	3.93	0.048	*
Age Group*Grains	1	3598.75	8.40	0.004	**

[1] Degrees of freedom
Significance: *p<0.05, **p<0.01, *** p<0.001

First order interactions were also assessed, with non-significant interactions sequentially deleted. Main effects were all retained in the model as the degrees of freedom consumed were only small. Significant interactions (Table 7.9) were observed between:

- Gender and horticultural enterprises (p = 0.015): male informants involved in horticulture scored significantly higher than other gender/horticultural interactions. Female informants involved in horticulture had the lowest average score, however the high standard error suggests this finding is unreliable.

- Age group and sheep enterprises (p = 0.048): informants aged under 55 years and involved in sheep production scored significantly lower than other age group and sheep interactions.
- Age group and grains enterprises (p = 0.004): grain informants aged under 55 years scored significantly higher than grain informants aged 55 years and over. Informants aged under 55 years, not involved in grains production, scored lower than other age group/grains enterprise interactions. (Table 7.10).

Table 7.10: Significant main effect variables and first order interactions, Section 3 scores

		Adjusted Means	Relative Standard Error
Main effects			
Cotton		66.15	5.27
Non-cotton		55.75	3.33
1st order interactions			
Gender*Horticulture	Female, Horticulture	50.09	10.89
	Female, Non-Horticulture	63.17	3.58
	Male, Horticulture	74.58	6.67
	Male, Non-Horticulture	55.97	2.82
Age Group*Sheep	Over 55, Non-Sheep	62.75	4.51
	Over55, Sheep	63.20	4.73
	Under55, Non-Sheep	63.64	3.99
	Under55, Sheep	54.23	4.50
Age Group*Grains	Over55, Grains	60.22	5.02
	Over55, Non-Grains	65.73	4.35
	Under55, Grains	63.45	4.18
	Under55, Non-Grains	54.42	4.41

7.4.2 Discussion

Cotton enterprises scored higher in Safety Management Systems than their non-cotton counterparts. Additionally, male horticultural informants scored significantly higher than other gender/horticulture interactions. This is most likely due to the Best

Management Practice and quality assurance systems in place, which have a strong emphasis on training, record keeping and safe practices. These elements are key components of Safety Management Systems, and would therefore result in higher scoring for this section.

There were also some interactions between the age of the informant and their enterprise industry. While older grain informants scored higher than younger grain informants in their perceptions and attitudes to farm health and safety (Safety Climate), this did not carry through to their Safety Management Systems, with younger informants aged under 55 scoring higher than their older counterparts.

This was one of the more significant findings of the health and safety study, as it raises the question of why do older informants who have a positive commitment and belief to health and safety on farm not necessarily put systems and management processes in place to actually improve health and safety on their farm enterprises. It effectively means the health and safety message has been accepted and there is a level of awareness and safety consciousness, but they have failed to act on and implement their own beliefs. This is a key challenge to developing future farm health and safety intervention approaches.

There was also an interaction between gender and sheep enterprises, with informants under 55 years who did not run sheep scoring significantly higher than informants aged under 55 years who were involved in sheep enterprises. When comparing average scores of sheep enterprises by the age category of their informants, it was the older informants who scored significantly higher than the younger informants.

Therefore, it is clear that within the baseline longitudinal study population, age and industry impact upon the presence of adequate management systems and processes to improve the health and safety on farms.

7.5 Section 4 – Control of Major Safety Hazards

The Control of Major Safety Hazards section refers to how enterprises actively manage the key priorities identified by Farmsafe Australia, relating to tractors, PTOs, augers, residual current devices (RCDs), chemicals, silos, safe play areas for children, vehicle safety, helmets and PPE.

7.5.1 Results

The average score for the Control of Major Safety Hazards section was 65.3, with all but one enterprise completing the section. The scores, out of 100, ranged from a low of just five to a perfect score of 100 (Table 7.4). The distribution of scores implied negative skewness, as the ratio of skewness to its standard error was greater than two (skewness statistic = -0.531, skewness standard error = 0.133), suggesting that the scores are weighted to the higher end of the scale. There was no evidence of kurtosis, as the ratio of kurtosis to its standard error was less than two (kurtosis statistic = -0.244, kurtosis standard error = 0.266).

A general linear model was used to determine the impact of age group, gender, enterprise and location on Section 4 scores (r^2 = 0.154). There was found to be a significant difference in the Section 4 means (Table 7.11) based on location (p = 0.034), with enterprises based in Weddin/Cowra and Maclean/Richmond River scoring significantly higher than other regions, with Gunnedah/Manilla/Coolah averaging the lowest of all regions (Table 7.12).

Table 7.11: Significance of variables, Section 4 scores

Variable	Df[1]	Sums Squares	F ratio	P value	Significance
Main effects					
Location	5	4513.01	2.44	0.034	*
Gender	1	17.32	0.05	0.829	
Age Group	1	570.69	1.54	0.215	
Horticulture	1	4.45	0.01	0.913	
Cattle	1	346.51	0.94	0.334	
Sheep	1	581.17	1.57	0.211	
Grains	1	1075.68	2.91	0.089	
Cotton	1	184.70	0.50	0.480	
Other	1	595.24	1.61	0.206	
1st Order Interactions					
Gender*Cattle	1	1430.43	3.87	0.050	*
Gender*Grains	1	2663.04	7.20	0.008	**
Age Group*Grains	1	2208.91	5.97	0.015	*
Horticulture*Sheep	1	1681.25	4.55	0.034	*
Cattle*Sheep	1	2964.46	8.02	0.005	**
Sheep*Cotton	1	1439.53	3.89	0.049	*
Grains*Cotton	1	1368.49	3.70	0.055	*

[1] Degrees of freedom
Significance: *p<0.05, **p<0.01, *** p<0.001

Again, first order interactions were also assessed, with non-significant interactions sequentially deleted. Main effects were all retained in the model as the degrees of freedom consumed were only small. Significant interactions (Table 7.11) were observed between:

- Gender and cattle enterprises (p = 0.050): male informants not involved in cattle production scored significantly higher than other gender/cattle interactions, with male cattle farmers averaging the lowest interaction score.
- Gender and grains enterprises (p = 0.008): female informants involved in grains production scored significantly higher than other gender/grains interactions, with female non-grains farmers averaging the lowest section score.
- Age group and grains enterprises (p = 0.015): informants aged both under 55 and 55 years and older involved in grains production scored significantly higher than other gender/grains interactions.
- Horticulture and sheep enterprises (p = 0.034): informants involved in horticulture and sheep production scored significantly higher than other horticulture and sheep interactions.
- Cattle and sheep enterprises (p = 0.005): informants involved in cattle production, but not sheep scored significantly lower than other cattle/sheep interactions.
- Sheep and cotton enterprises (p = 0.049): informants involved in sheep and cotton production scored significantly higher than other sheep/cotton interactions.
- Grains and cotton enterprises (p = 0.055): informants involved in grains and cotton production scored significantly higher than other grains/cotton interactions (Table 7.12).

Table 7.12: Significant main effects and first order interactions, Section 4 scores

		Adjusted Means	Relative Standard Error
Main effects			
Cotton		66.15	5.27
Non-cotton		55.75	3.33
1st order interactions			
Gender*Cattle	Female, Cattle	64.71	6.06
	Female, Non-Cattle	62.03	6.32
	Male, Cattle	58.53	5.56
	Male, Non-Cattle	66.89	5.19
Gender*Grains	Female, Grains	73.56	5.21
	Female, Non-Grains	53.17	8.70
	Male, Grains	65.59	4.18
	Male, Non-Grains	59.82	8.00
Age Group*Grains	over55, Grains	68.59	5.04
	over55, Non-Grains	61.21	8.41
	under55, Grains	70.57	4.28
	under55, Non-Grains	51.79	8.22
Horticulture*Sheep	Horticulture, Non-Sheep	53.11	7.79
	Horticulture, Sheep	72.37	9.79
	Non-Horticulture, Non-Sheep	64.80	4.19
	Non-Horticulture, Sheep	61.86	5.73
Cattle*Sheep	Cattle, Non-Sheep	54.02	6.13
	Cattle, Sheep	69.21	6.90
	Non-Cattle, Non-Sheep	63.89	5.21
	Non-Cattle, Sheep	65.02	7.33
Sheep*Cotton	Non-Sheep, Cotton	51.70	8.80
	Non-Sheep, Non-Cotton	66.21	3.44
	Sheep, Cotton	68.54	11.41
	Sheep, Non-Cotton	65.70	4.42
Grains*Cotton	Grains, Cotton	73.87	5.72
	Grains, Non-Cotton	65.29	3.81
	Non-Grains, Cotton	46.36	15.36
	Non-Grains, Non-Cotton	66.63	2.99

7.5.2 Discussion

Enterprises involved in cattle production scored, on average, significantly lower than enterprises not involved in cattle production. This finding was not entirely unexpected, as there are several questions relating to tractors within this section. Enterprises involved in cropping would be expected to have newer, more up to date machinery, in order to make cost and efficiency savings with cultivation, spraying and planting. The cabins on modern tractors serve as ROPS, and as such they have eliminated this risk on their farms.

Cattle enterprises, on the other hand, rely on tractors for moving and powering equipment, for example, augering feed and carting hay bales. Older model tractors are cheaper to buy, and for their purposes, cost efficient, but leave people exposed to the hazards relating to ROPS and damaged or unguarded PTOs.

As with Safety Management Systems, the higher scores of older grain informants in Safety Climate did not carry through their management of Control of Major Safety Hazards, with younger grain informants averaging higher scores. As discussed in the previous section, this was one of the more significant findings of the health and safety study and emphasises the challenges in developing future farm health and safety intervention approaches.

An interesting interaction occurred between cotton and sheep enterprises. If a sheep enterprise was also involved in cotton production, then this appeared to negate the effect of sheep enterprises resulting in a lower Control of Major Hazards score. The same applied to running horticulture and sheep. This is most likely due to the modernisation of machinery involved in the production of cotton and horticulture, and the elimination of key hazards as a result of the technology improvements.

7.6 Interactions of section scores

An analysis was undertaken to determine if there was a statistically significant relationship between scores received in each section. For example, does a high score in Safety Climate transpose to a high score in Safety Management Systems? To conduct this analysis, a correlation analysis were performed using the statistical package, SPSS (Graduate Package 16.0).

There was found to be moderate positive linear correlation between Safety Climate and Safety Management Systems (r = 0.584, p<0.001), Safety Climate and Control of Major Safety Hazards (r =0.489, p<0.001) and Safety Management Systems and Control of Major Safety Hazards (r =0.560, p<0.001). This implies that, as each section score increases, so too does the section score it was correlated with.

7.7 Free text questions

Study informants were provided with writing space to answer three questions relating to their management and perceptions of farm health and safety. There were no prompts or guiding instructions, so responses were based on the individual's interpretation of the question.

7.7.1 Changes made on farms

The first free text question '*What changes have you made on your farm in the past 12 months to improve farm safety?*' was well responded to by most enterprises (n=303, 90.4 percent), with a total of 810 changes reported.

Table 7.13: Changes made on farms, by category and level of control

Type of Change	Level of Control	Frequency
Administrative and Management		**106**
Reviewed safety operating procedures and plans	Level 4	19
Awareness of responsibilities, hazards and risks	Level 4	18
OHS Meetings and discussions	Level 4	13
Hazard checks	Level 4	11
Child safety and safe play areas	Level 1	9
Improved communication access	Level 4	6
OHS Manual or plans	Level 4	6
Safety audits and record keeping	Level 4	6
Improved farm and machinery organisation	Level 4	5
Ongoing part of management	Level 4	5
Restricted access	Level 1	5
Visitor safety	Level 4	3
Employees and Contractors		**28**
Induction and training	Level 4	14
Changes to employees and contractor numbers	Level 4	7
Improved staff screening and employee management	Level 4	7
Farm Environment		**128**
Chemical safety	Level 3	53
Safety signage	Level 4	31
Clean up of farm hazards	Level 1	18
Improved fencing	Level 3	12
Irrigation channel safety	Level 3	7
Powerlines safety	Level 3	7
Machinery and Equipment		**384**
Shearing shed safety	Level 3	58
New or upgraded machinery and equipment	Level 1/2/3	47
Safer stockyards and stock handling procedures	Level 2/3	42
PTO Guards	Level 3	37
Guarding	Level 3	36
Silo safety	Level 3	35
Regular maintenance and maintenance records	Level 4	26
Residual Current Devices (RCDs) and electrical safety	Level 1	24
Fuel tank safety	Level 3	21

Continued

Table 7.13 (Continued): Changes made on farms, by category and level of control

Type of Change	Level of Control	Frequency
Machinery and Equipment (ctd)		
Auger guards	Level 3	16
Workshop safety	Level 3	15
Shed safety	Level 3	8
ROPS	Level 3	5
Pump maintenance or replacement with solar	Level 1/2/3	5
Decommission windmills	Level 1	3
Motorcycle and ATV safety	Level 3	3
Removal of motorcycles and horses	Level 1	3
PPE and Safety Equipment		**72**
Provision and access to PPE	Level 5	46
First aid kits, fire extinguishers, showers and fire alarms	Level 5	13
Helmets	Level 5	13
Procedures and Practice		**49**
Road and vehicle safety	Level 4	22
Improved lifting and loading	Level 2/3	16
Safety improvements for working at heights	Level 3	7
Improved automation	Level 1/2/3	4
Training		**32**
Chemical training	Level 5	14
Training -- unspecified	Level 5	9
Chainsaw training	Level 5	4
First aid training	Level 5	3
OHS training	Level 5	2
No Changes		**11**
Total		**810**

The responses were grouped into categories and sub-categories (Table 7.13), which were then assigned a level of control, based on the *Hierarchy of Control* model. The model, discussed in greater detail in Chapter 2, focuses on design-based solutions over a dependence on modifications to worker behaviour and practice. The five levels, in order of the effectiveness of control of the risk, are as follows:

- Level 1: Eliminate the hazard,
- Level 2: Substitute the hazard for one of lesser risk,
- Level 3: Engineer or isolate the hazard,
- Level 4: Implement administrative controls, and
- Level 5: Provision and access to PPE.

7.7.1.4 Results

The most frequently reported changes to health and safety by participating farm enterprises were shearing shed safety improvements (Level 3, n=58), improved chemical safety and handling (Level 3, n=53), purchasing new equipment or upgrading existing equipment (Levels 1, 2 and 3, n=47), greater provision and access to PPE (Level 5, n=46) and improving safety of stockyards and stock handling procedures (Levels 2 and 3, n=42).

The most effective level of control, Level 1 (Elimination of the hazard), was not frequently reported as one of the changes made in the past 12 months, with the only Level 1 changes reported including the installation of Residual Current Devices (RCDs) and improved electrical safety (n=24), cleaning up hazards in the farm environment (n=18), improvements in child safety and provision of safe play areas (n=9), restriction of access to hazards (n=5), decommissioning of windmills (n=3) and removal of motorcycles or horses (n=3).

There were some additional changes which encompassed several levels of control (Levels 1, 2 and 3) including purchasing new equipment or upgrading existing equipment (n=47), improved pump maintenance or replacement of pump with solar power (n=5) and improved automation of procedures (n=4).

Just 11 enterprises stated they had made no changes to farm health and safety in the past 12 months, while another 32 enterprises did not complete the question.

7.7.1.5 Discussion

The media commonly reports on farmers' negative perceptions of health and safety, legislation and hazards on their farm, but very little information has been reported about the 'good news' stories; that farmers are quietly making progressive and effective changes to their systems and management to improve health and safety.

The question asking enterprises about the changes they had made on their farms over the past 12 months provides the opportunity to analyse the current state of play of safety on Australian farms, rather than relying on anecdotes or general assumptions. These results will enable simple, cost effective and realistic changes to be promoted in farm health and safety interventions as solutions implemented by other farmers, as opposed to recommendations arising from researchers and work safety authority officials.

The *hierarchy of control* rates the effectiveness of practices aimed at reducing a risk or hazard. Level 1 is the most effective, in the total elimination of a hazard, while Level 5 is the least effective, using PPE.

Of the 50 changes nominated by the farm enterprises, just six were Level 1 controls, with the majority being Level 3 (engineering or isolating the hazard) and Level 4 controls (administrative controls).

While this is of concern from a risk perspective, it is not unexpected. Elimination of a hazard can be costly, time consuming or simply just not practicable or realistic, while administrative controls (systems, procedures, training and supervision) and the provision of PPE are generally both cost and time effective.

Of the 810 responses, almost half (n=384, 47.4 per cent) were related to changes to machinery or equipment. This was followed by changes to the farm environment (n=128, 15.8 per cent) and administrative and management changes (n=106, 13.1 per cent).

An analysis of the specific changes reveals the most commonly reported change to health and safety was improvements to shearing shed safety. There were 175 enterprises that nominated they were involved in sheep production, which therefore indicates that 33.1 per cent of sheep enterprises had made changes to their shearing shed safety in the past 12 months. The timing of the questionnaire followed the establishment of the NSW WorkCover *ShearSafe* program. The program involved seminars and financial incentives, with the seminars focusing on risk management, legislative responsibilities, shearing shed design, injury management and workers' compensation. The seminars took place in Armidale, Young, Cooma, Orange, Goulburn, Wagga Wagga, Barraba, Moree, Condobolin, Dubbo and Hay.

The financial incentives included a rebate for replacing pin-drive handpieces with the less dangerous wormdrive mechanism. Additionally, there was a dollar-for-dollar incentive, up to $20,000, for 11 shearing shed owners to assist them develop safer working environments. The funds were used for improvements such as guarding of grinders, replacement of electrical wiring, and better ventilation, lighting and floors. The sheds were then showcased at open days to highlight cost effective occupational health and safety practices (WorkCover NSW, 2003b).

The second highest rating change was improvements to chemical handling and storage. This management change was expected to feature highly, due to OHS legislation regarding the storage of chemicals, provision of PPE and accredited training of chemical users.

The third most frequently reported change was the purchase of new machinery or the upgrading of existing machinery. New machinery is seen as a Level 1 change, while upgrading machinery can be a Level 1 to 3 change, depending on the technology and processes of the upgraded machinery.

Guarding, both unspecific and PTOs, featured prominently, with 21.8 per cent of enterprises making some form of change to guarding on their farms. This is most likely to be directly related to the rebate scheme offered by WorkCover NSW, which commenced in 2005. The rebate covered 100 per cent of the purchase price of PTO guarding, to the value of $200, but only one rebate was eligible per farm. Additionally, Clause 136 (d) of the Occupational Health and Safety Regulation 2001 requires employers to control the risk of entanglement through guarding (WorkCover NSW, 2009).

7.7.2 Prompts for making changes

The second free text question, '*What prompted you to make these changes?*', attempted to ascertain the reasoning and drivers for the changes outlined in the previous section.

There were 467 drivers for change reported by 306 farm enterprises (91.3 per cent of all enterprises). The remaining 29 enterprises did not complete the section. The drivers for change were summarised into categories and sub-categories, and are reported in Table 7.14.

7.7.2.1 Results

OHS requirements or legislation was the standout, most frequently reported response by participating farm enterprises (n=74), followed by a increased safety awareness or consciousness (n=52), a general desire to improve safety and standards on their farm (n=42), the realisation or identification of a risk or hazard (n=39) and to gain improved efficiency or cost savings (n=21).

7.7.2.2 Discussion

To have a greater understanding of why farmers are making changes to farm health and safety management and systems offers considerable value to those working in the field of farm safety initiatives and promotion to review which strategies have been successful, and to also identify previously unrecognised motivators for instigating change.

Table 7.14: Drivers of change, by category

Driver for change	Frequency
Farm Management and Planning	**164**
Desire to improve safety and standards	42
Realisation and identification of a risk or hazard	39
Improved efficiency or cost savings	21
To stop accidents occurring or to reduce overall risk	16
Improved management	14
Damaged or aged machinery and equipment	12
New machinery, equipment or techniques	12
Finances available to make changes	5
Long term planning	3
Personal Motivations	**133**
Increased safety awareness or consciousness	52
Experienced an injury, accident or near miss	20
Health, age, activity limitations	12
To reduce the risk of an accident or injury to self	11
Children living, working or visiting the farm	10
Commonsense	10
Concerns by and for family and friends	10
Time availability or lack thereof	4
Peace of mind	2
Recognition that risk doesn't have to be part of job	2
Legislation, Insurance and Corporate	**101**
OHS requirements and legislation	74
Risk of litigation	7
Certification or accreditation	6
Company policy or OHS committee	5
Rebate	4
External audit	3
Insurance requirements	2
Training and Information	**36**
Training, education or advisor	20
Health and safety in the media	11
Industry promotion or assistance	3
Field day	2

Continued

Table 7.14 (Continued): Drivers of change, by category

Driver for change	Frequency
Employees	**22**
Employee or Contractor's input and comment	10
Observed employee practices	7
To retain or recruit staff	5
Other	**11**
Off farm employment experience	5
Supplier requirements	4
Drought enforced changes	2
TOTAL	**467**

Unsurprisingly, legislation and OHS requirements were the primary motivation for change. However, there were 36 drivers of change reported in total, with 467 responses, which is encouraging for those working in farm health and safety intervention to see that farmers are thinking beyond the 'big stick' when it comes to the reasons for making changes on their farms.

A key sign that the advertising and promotion of farm health and safety is starting to have an impact is seen in the second, third and fourth highest responses; an increased safety awareness or consciousness; a desire to improve the safety and standards on their farm; and the realisation or recognition of a hazard.

The fifth most commonly reported motivator for change was to gain efficiency or cost savings, most commonly through new and upgraded machinery and improved automation. This finding, reported in several other studies (Australian Safety and Compensation Council, 2006; Durey and Lower, 2004; Murphy, 2003), is key to the success of future farm health and safety initiatives. If improvements to productivity and profitability can be clearly demonstrated by industry, farmers may be more inclined to implement the recommendations into their farming system.

The notion that improvements to health and safety are a by-product of productivity gains can be used to challenge the widely held belief that changes to farm health and safety are 'too costly', as purchasing new or upgraded machinery was the third most commonly reported change to farm health and safety management or systems in the previous question. However, seasonal conditions and the challenging financial situation experienced by many farmers due to the prolonged drought may make this approach unsuitable in some regions or industries.

Training and education appeared equal sixth on the list, which is a positive sign for the success of the Managing Farm Safety Courses that have been run through Farmsafe Australia. To have documented evidence that farmers are taking that additional step from attending the course to actually putting the lessons learned into practice on their farms is encouraging for the future success of the program.

7.7.3 Risks on farms

The final free text question, '*What do you see as the current safety risks or issues on your farm?*', aimed to reveal what farmers actually perceive as the risks and hazards on their own farms. There were no examples or lists associated with the question, so the responses were not prompted.

Table 7.15: Perceived risks, by category

Perceived Risk	Frequency
Machinery, Equipment and Structures	**339**
Livestock handling and stockyards	57
Silos	55
Chemicals and storage	33
Machinery and equipment	27
PTOs	23
Workshop and tools	22
Shearing shed and shearing	21
Augers	19
Motorcycles	19
Tractors	14
Age of machinery and equipment	11
ATVs	11
Chainsaws	10
Fuel tanks	7
Windmills	6
Lack of safety signage around farm	4
Management, Self and Employees	**203**
Familiarity, complacency, carelessness and human error	28
Workload, fatigue and stress	22
Hazardous nature of farm work	17
Isolation and working alone	17
Lack of employee accountability and poor commitment to OHS	16
Lack of commonsense	15
Children and safe play areas	15
Finances and a lack of resources	15
Work safety authorities, reporting and compliance issues	14
Authorised and unauthorised visitors	13
Self, family and employees getting older	9
Maintaining the health and safety of employees	8
Lack of training	6
Hearing loss and eye damage	4
Staff turnover	2
Trying to pre-empt problems and risks	2

Continued

Table 7.15 (Continued): Perceived risks, by category

Perceived Risk	Frequency
Procedures and Practices	**66**
Employees not using PPE	17
Not wearing helmets on ATVS, motorcycles and horses	15
Working at heights	13
Vehicles and road safety	12
Lifting and loading	9
Environmental	**52**
Terrain of farm	11
Dams and irrigation channels	9
Dust, lightening and fire	8
Impact of drought	7
Powerlines and electricity	6
Sun and skin cancer	6
Vegetation	5
Animals	**16**
Horses	13
Snakes/Spiders	3
There are no risks on my farm	**4**
TOTAL	**680**

7.7.3.1 Results

There were 680 reported risks by 319 farm enterprises (95.2 per cent response rate), which were classified into categories and sub-categories (Table 7.15). The most commonly perceived risks by the enterprises were livestock handling and working in stockyards (n=57), silos (n=55), usage and storage of farm chemicals (n=33), a general over familiarity, complacency, carelessness and human error (n=28) and working with machinery and equipment (n=27).

7.7.3.2 Discussion

A key finding of the study was the divergence of farmers' perceptions of the risks and hazards on their farms and the incidence of fatalities.

The number one hazard on Australian farms resulting in injury death is tractors; 71 deaths occurred over the four years of the economic cost study, accounting for 18.9 per cent of all fatalities. Tractors resulted in 20 more deaths than the second most frequent agent, ATVs (n=51), yet they were rated 20th in the list of perceived risks on farms by the study enterprises. ATVs were even further down the list, at number 27 – just 11 of the 335 enterprises rated ATVs as a risk on their farms, and yet they are the second most common cause of traumatic deaths on Australian farms.

The highest ranked risk reported by farmers was livestock handling, followed by silos and chemical handling. While these agents are seen commonly in farm safety campaigns and promotions due to the legislative requirements with training and operation, with the exception of livestock handling, they do not feature highly in injury hospitalisation, and none of these three agents feature in the causation of deaths on farms. These agents do, however, all sit in the top eight changes made by farmers over the past twelve months, livestock handling at number five, chemicals at number two, and silos at number eight.

This information clearly demonstrates that farmers are overestimating the risk of agents less commonly resulting in fatal injuries, while underestimating the risks of the most frequent causes of death on Australian farms.

A study conducted in England and Wales (Knowles, 2002) observed similar findings, with farmers commonly overstating the risks for less common means of death, including contact with machinery and animal related deaths, while understating risk associated with other agents, including falling from heights. It also sought farmers' perceptions of hazards on farms, and as in Australia, the most frequently reported response was livestock. This was followed by machinery (fourth in Australia), chemicals (also third in Australia), electricity (39th in Australia) and dust (34th in Australia).

Silos did not specifically make the list of hazards reported by English and Welsh farmers, though falls from heights/ladders was rated at number nine. PTOs, rated fifth in Australia, also featured on the hazards list at number ten.

The farmer's perceptions of the risks on their farms creates a challenging situation for farm safety initiatives and promotions, in that a balance needs to be struck between awareness of the common causes of non-fatal injury and the causes of fatal injury. While fatal injuries are certainly less common than non-fatal injuries, their potential economic cost, not to mention the emotional cost, is possibly far more consequential.

7.7.4 Interaction with Sections 2 to 4

Analyses were conducted to determine whether there was an interaction between Safety Climate, Safety Management Systems or Control of Major Safety Hazard scores and the incidence of making changes to farm health and safety over the past 12 months and the reporting of risks.

7.7.4.3 Results

There was no interaction found between the number of changes made to farm safety and the Safety Climate or Control of Major Safety Hazard scores. However, there were significant differences in the means of Safety Management Systems.

Enterprises that reported one change, two to four changes or five to seven changes scored significantly higher on Safety Management Systems than those enterprises that recorded they had made no improvements to farm safety over the past 12 months. Furthermore, enterprises that noted two to four changes or five to seven changes also scored significantly higher in Safety Management Systems than those enterprises who elected not to complete the question at all ($F(4,327) = 8.615$, $p<0.05$).

A second analysis was undertaken that focused on whether or not changes were made in the past 12 months and if the question was answered, rather than examining the number of changes. Therefore, responses were simply grouped into the categories '*changes made on farm*', '*no changes made on farm*' or '*not answered*'.

This analysis found that enterprises listing they had making changes to farm health and safety over the past 12 months scored higher in their Safety Climate scores than those who elected not to complete the question ($F(2,332) = 3.38$, $p<0.05$). There was no significant difference in the scores between those who nominated changes and those enterprises that nominated that no changes had been made.

The same scenario applied with the Control of Major Safety Hazards ($F(2,331) = 4.836$, $p<0.1$), with enterprises nominating some changes to farm safety scoring higher than those who elected not to complete the question, while there was no significant difference with those enterprises nominating that no changes had been made.

In Safety Management Systems, those enterprises that nominated some changes to farm health and safety systems in the past 12 months also scored significantly higher than those who stated no changes had been made, as well as those enterprises that did not complete the question ($F(2,329) = 14.554$, $p<0.05$).

These were encouraging results for the study, demonstrating participating farm enterprises that scored well in the three sections of the study were not just selecting the most correct questionnaire response relating to their perceptions, management and control of health and safety on their farms, but that they also provided actual examples of changes they had made in the past 12 months, suggesting a genuine commitment and adoption of improved safety practices.

Age group did not impact on the likelihood of enterprises to respond to the changes on farm question, nor the number of changes they nominated. There were also no observed significant differences relating to the reporting of risks on farms.

7.8 Section 6 – Injury reporting

The final section of the questionnaire involved the reporting of any farm accidents that had necessitated medical attention or time off work or school. There were 124 incidents reported by enterprises in the study population, but this is not considered to be an accurate measure of the frequency and severity of farm accidents, due to a likely reluctance of farms to formally acknowledge on paper any incidents that had occurred over the past twelve months, despite the questionnaires being de-identified and containing no personal information.

7.8.1.1 Results

The overwhelming majority of accidents reported occurred in males (87.9 per cent), while the most commonly reported age group was between 45–54 years (Figure 7.4). Only 2.4 per cent of reported accidents related to children aged under 15 years.

The most frequently reported agent of injury was cattle (n=13, 10.5 per cent), followed by the repetitious motion of work or posture (n=11, 8.9 per cent) and tractors (n=8, 6.5 per cent). There were a large number of agents reported, 50 in total, clearly demonstrating the wide ranging and extent of occupational hazards and risks faced by farmers on a day-to-day basis (Table 7.16).

Figure 7.4: Percentage of injuries reported, by gender and age group

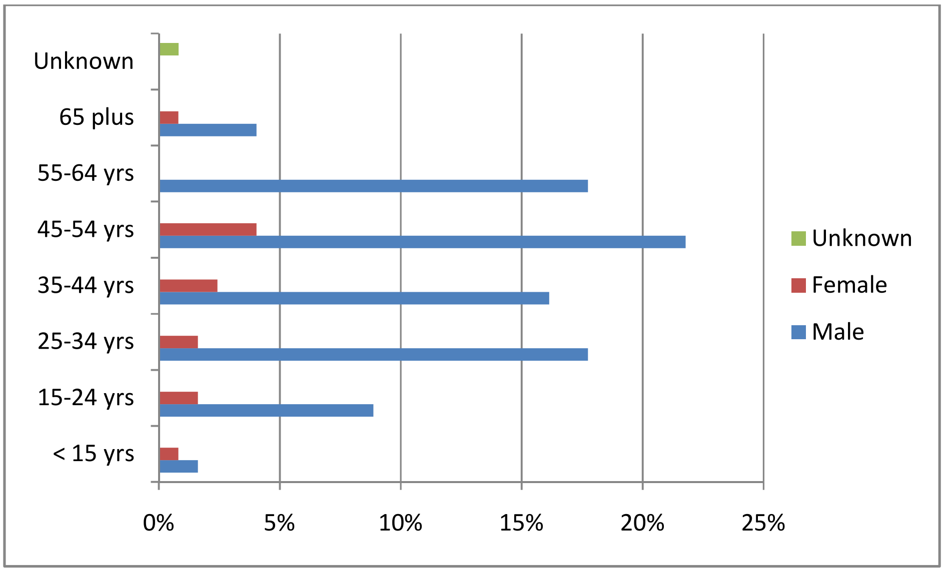


Table 7.16: Injuries reported, by agent

Agent	Frequency	Agent	Frequency
Animal	**23**	**Handtools**	**8**
Cattle	13	Hammer or hand saw	4
Horse	7	Knife	3
Dog	1	Jack	1
Sheep	1	**Materials**	**9**
Insect	1	Fence post	3
Farm Vehicle	**20**	Pipe	2
Motorcycle, nec[1].	5	Wire barbed	2
Motorcycle 2 Wheel	4	Hay bales	1
Motorcycle 4 Wheel	4	Steel	1
Truck	3	**Fixed Plant / Equipment**	**7**
Utility	2	Cotton gin	2
Car	1	Pump	2
Trailer	1	Shearing Plant	2
Mobile Machinery / Plant	**20**	Shearing handpiece	1
Tractor	8	**Workshop Equipment**	**6**
Auger	3	Grinder, NEC	2
Seeder/ planter	3	Welder	2
Harvesting machine	2	Air compressor	1
Field bin	1	Angle Grinder	1
Log handling plant	1	**Working Environment**	**5**
Module builder	1	Ground / Rock / Stump	2
Tillage/ cultivating	1	Foreign body	1
Farm Structure	**11**	Log	1
Stockyard	4	Wood	1
Hay shed	2	**Farm Chemicals**	**4**
Irrigation channel	2	Veterinary Chemicals	2
Chemical store	1	Pesticide - herbicide	1
Other shed	1	Pesticide - not specified	1
Water trough	1		
Other	**11**		
Working motion and posture	11		
TOTAL			**124**

[1]. nec: Not elsewhere classified,

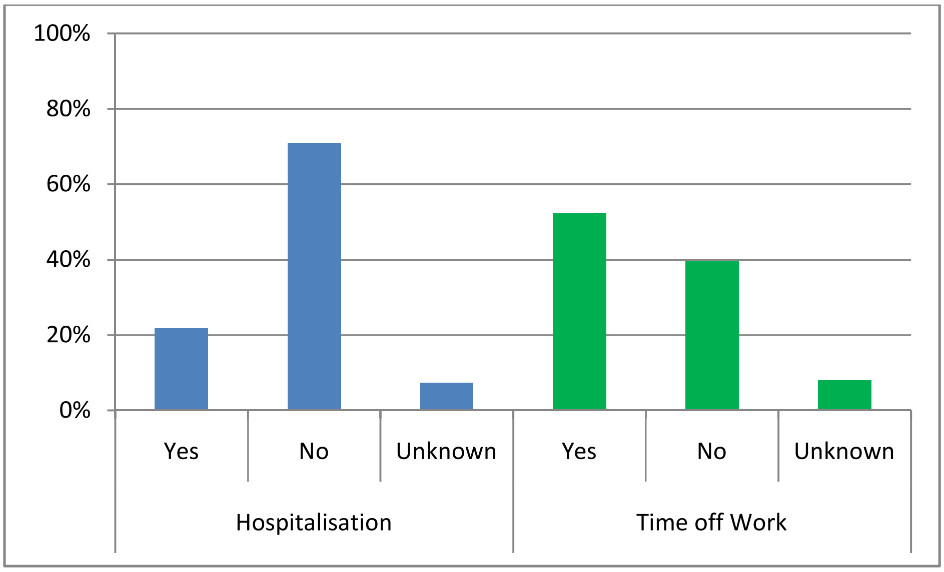
An analysis of the type of injury received (Table 7.17) reveals that sprains and strains were the most commonly reported (n=26, 21.0 per cent), followed by cuts or lacerations (n=21, 16.9 per cent) and fractures (n=18, 14.5 per cent). The location of these injuries most commonly reported were the back and spine (n=16, 12.9 per cent), reflecting the high frequency of injuries relating to manual handling, followed by the ankle (n=11, 8.9 per cent) and then fingers, shoulders and lower legs (each reporting n=10, 8.1 per cent).

Table 7.17: Injuries reported, by nature and location of injury

Nature of Injury	Frequency	Location of Injury	Frequency
Soft Tissue	**70**	**Upper Extremity**	**41**
Cut/laceration	21	Digit/phalanx	10
Haematoma / bruising	15	Shoulder	10
Inflammation/oedema/tenderness	11	Hand	9
Penetrating wound	11	Clavicle	3
Foreign body in soft tissues	5	Forearm	3
Crushing injury	4	Wrist	3
Burn, partial thickness	2	Arm, nec	2
Amputation	1	Not specified	1
Bone, Tendon or Joint	**49**	**Lower Extremity**	**36**
Sprain/strain	26	Ankle	11
Fracture	18	Lower leg, nec	10
Tendon tear	4	Foot/ digit/phalanx	7
Dislocation	1	Knee	6
		Upper leg, nec	2
Systemic and Special Injury	**5**	**Trunk**	**24**
Poisoning	4	Back/Spine	16
Allergic reaction	1	Abdomen	4
		Rib(s)	3
		Pelvis	1
		Head / Neck	**22**
		Eye	9
		Face/cheek/forehead/scalp	8
		Neck	3
		Mouth	1
		Nose	1
		Systemic and Special Injury	**1**
TOTAL	**124**		**124**

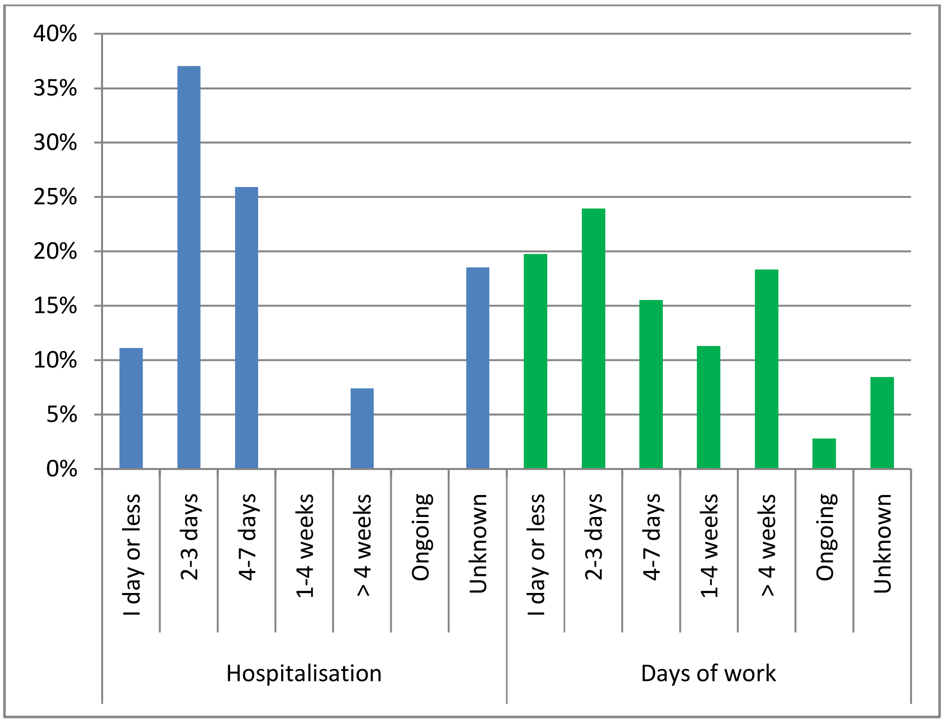
The majority of accidents reported (Figure 7.5) did not involve any form of hospitalisation (n=88, 71.0 per cent). Of the 27 incidents that did require hospitalisation, the most frequently reported duration of stay was 2–3 days (37.0 per cent), followed by 4–7 days. There was a relatively high reporting of 'unknown' duration of stay; 18.5 per cent of all hospitalisations (Figure 7.6).

Figure 7.5: Percentage of injuries reported, by hospitalisation and time off work



Just over half (n= 65, 52.4 per cent) of all the accidents reported necessitated some time off work or school (Figure 7.6). The most frequently reported duration was 2–3 days (23.9 per cent), followed by one day or less (19.7 per cent) and greater than four weeks (18.3 per cent). Two enterprises reported having a farm accident that resulted in permanent or ongoing time off work.

Figure 7.6: Percentage of injuries reported, by duration of hospitalisation and time off work



7.9 Limitations of study

As with many qualitative studies, there is a risk of selection bias. There are three key areas where this bias may have arisen; under representation within the sample, non-response bias and voluntary response bias (Craigmile, 2007).

Under representation occurs when some populations are inadequately represented in the sample. A review of the demographics reveals that some single enterprise (sheep, grains, horticulture, cotton and dairy) and mixed enterprise groups (grains/cotton and grains/cotton/cattle), as well as the Maclean/Richmond River SLAs may be under-represented in the study population. However, across the baseline study population, there is an array of different production systems and localities, as well as an age profile in line with the age structure of Australia's farming population.

Non-response bias refers to the unwillingness or inability of randomly sampled individuals to participate in the study. With farm health and safety being a contentious and frustrating issue for many farmers, those who deem it as *'over legislated'* and a *'waste of time'* may not have participated in the study, and as such, may have recorded a significantly different set of scores than those farms that did elect to participate in the study.

Voluntary response bias is at the other end of the spectrum to non-response bias and suggests that participants were self selected, by deciding to participant in the study voluntarily. This self selection may result in over-representation of participants holding strong views on farm health and safety being recruited into the study.

Another common issue in questionnaire based research is the desire of participants to give what they perceive is the right answer, as opposed to the answer which adequately describes their perceptions and management practices. This may lead to a higher than expected score in each of the sections.

As with many longitudinal studies, baseline data was used for cross-sectional association. This creates a further set of limitations, typically associated with cross-sectional analyses, as studies only record a response to an exposure or outcome at a single point in time. It is possible that performance on the questionnaire would have differed from another random sample, as other participants may have experienced different events, triggers or motivators. Therefore, observed differences may be due to these explanations rather than systematic individual change (British Medical Journal, 2004; Levin, 2006; Singer and Willett, 2003).

Furthermore, the scores for Safety Climate were based on the perceptions of the informant, and these may not be indicative of the perceptions and attitudes of other workers or managers on the farm.

Likewise, Safety Management Systems and Control of Major Safety Hazards were also based on the answers of the informants, and these may not be an accurate representation of what management systems and processes are in place on the particular enterprises. Results may reflect a lack of knowledge or understanding about farm health and safety systems, as opposed to the systems not being in place.

The quality, accuracy and completeness of the injury reporting data is certainly questionable. Work safety authorities and legislation are at the forefront of farmers' minds; 81 enterprises in the study reported OHS requirements or fear of litigation as a motivating factor for making changes on their farms. Acknowledging an accident took place on the farm, by writing down the details and sending the information on the incident to a research institution, may be seen to be too much of a risk to some enterprises, worried that the information may end up in the hands of work safety authorities for investigation and potentially, prosecution.

7.10 Summary

The baseline data of the longitudinal data revealed some significant interactions and relationships between the scoring of sections and also demographics relating to the age and gender of the informant, as well as the industry involvements of the enterprise.

Age, gender and enterprise were seen to impact on Safety Climate scores, with older informants scoring higher than younger informants, female informants scoring higher than male informants, and sheep enterprises scoring lower than other enterprises.

Industry had a demonstrable effect on Management of Safety Systems, with horticulture and cotton on average scoring higher than other enterprises involved in the study.

Interesting results were also found in Control of Major Safety Hazards, with enterprises involved in the production of cattle on average scoring lower than those enterprises without cattle.

Furthermore, while older informants scored higher in their Safety Climate scores, this did not apply to Management of Safety Systems or Control of Major Safety Hazards, suggesting a disconnect between perceptions towards health and safety and implementation measures to improve safety of key risks and hazards.

The most frequently reported changes to health and safety on participating farm enterprises were shearing shed safety improvements, improved chemical safety and handling, purchasing new equipment or upgrading existing equipment, greater provision and access to PPE and improving safety of stockyards and stock handling procedures.

When asked about the drivers for making these changes, OHS requirements or legislation was the most frequently reported response by participating enterprises, followed by a increased safety awareness or consciousness, a general desire to improve safety and standards on their farm, the realisation or identification of a risk or hazard and to gain improved efficiency or cost savings.

The most commonly perceived risks by participating enterprises were livestock handling and working in stockyards, silos, usage and storage of farm chemicals, a general over familiarity, complacency, carelessness and human error and working with machinery and equipment. These risks nominated by participating enterprises were not in alignment with the most common agents involved in Australian farm-related fatalities; tractors, ATVs, drownings, utilities and motorcycles.

8. Implications of research and conclusions

This research has involved two separate, but related components; the economic cost of farm-related fatalities and baseline data from the farm health and safety study, a qualitative, longitudinal study into farmer perceptions and behaviour relating to farm safety. The two components are brought together in this chapter, which details the impact of the economic cost of farm-related fatalities and the importance of capitalising on the findings of the farm health and safety study to improve the effectiveness and efficiency of future health and safety initiatives and interventions to reduce the incidence of farm-related fatalities and hence the considerable economic burden on the Australian economy.

8.1 Economic cost of farm-related fatalities

Farm-related fatalities are a very real problem for Australian agriculture. Over the 2001–04 study period, there were 404 fatalities that occurred on Australian farm workplaces. There was no common element to the fatalities – they were children, middle aged, the elderly, visitors, residents and workers, experienced and not experienced in the hazards, risks and complexities associated with farming and the agricultural machinery and processes entailed. Even the agent of injury varied substantially; while tractors and ATVs accounted for almost one third of fatalities, the other agents involved were as diverse as dams, vehicles, animals, powertools and materials.

An estimation of the direct and indirect costs arising from these fatalities concluded that farm-related fatalities cost the Australian economy $650.6 million in 2008 dollars, which equated to approximately 2.3 per cent of farm GDP in that year.

This estimate included direct and indirect costs involved in a fatality, including ambulance, police, hospital, premature funeral, coronial and work safety authority investigation, death compensation costs, friction costs to replace employee, lost future earnings and lost household production.

It could be suggested that the economic cost of $650.6 million is a conservative estimate, as the included costs are by no means an exhaustive list of the costs associated with a fatality. There are many other costs, some of which are unquantifiable (grief, emotional loss, pain and suffering), while others lack readily available and accurate data sources (loss of farm production, production delays, machinery/equipment damage, insurance, taxation and community losses). If these costs were able to be measured and incorporated into the model, the true cost would be far higher.

Furthermore, it must be emphasised that the estimated economic cost only includes farm-related fatalities, and that injuries that did not result in death were not included in the study. Long-term, permanent injuries and serious injuries requiring hospitalisation would add to this figure substantially through costs associated with hospitalisation, rehabilitation, carers, modification to housing, vehicles and machinery, time off work, workers' compensation and pharmaceuticals. Less severe and hence lower cost, but more frequently occurring injuries, such as musculoskeletal injuries, would further increase this figure.

To ascertain the economic cost of farm-related injuries is a very challenging proposition, for reasons primarily relating to the purpose of injury data collected. The available data for injury analysis primarily includes hospital and workers' compensation data. However, these recording systems were set up for the purpose of record management and are flawed in their suitability for injury research for several reasons.

Hospital data is particularly problematic. In the first instance, it relies on the patient or accompanying person(s) nominating the cause of injury as being on or related to a farm. Secondly, the treating practitioner must record it on the case notes, and finally, when the notes reach the coding department, they must then be included in the hospital's records system. While essential in the field of injury prevention and research, details relating to the agent or place of injury are not viewed with the same importance in a medical records environment, where details relating to treatment and the injury itself are paramount.

Workers' compensation data is also very limited in its coverage, as the self-employed nature of many Australian farms leaves them outside the reach of legislation, and also, many farm-related accidents and injuries go unreported for fear of financial penalties, prosecution and insurance issues.

There are also the injuries not seen by the hospital system, such as general practitioner, physiotherapy, chiropractic, pharmacy and other allied health cases.

These cases may be more minor in their presentation and symptoms, but this does not mean their costs are insignificant as, while the overall cost per case may be low, the potential number of these cases can transform the cost into a considerable economic expense.

This research demonstrates that farm-related fatalities are a very significant cost to the Australian economy, and from a farm injury perspective, they are just the tip of the iceberg. On average, 100 people are killed on Australian farms each and every year.

Policymakers, Farmsafe Australia, industry groups, work safety authorities and researchers need to review the intervention approaches of the past, re-evaluate them and determine the most appropriate and effective injury prevention strategies and initiatives for the future, as with the aging of Australia's farming workforce, increased financial pressure, and the increasing reliance on machinery and equipment, the risk factors associated with farming and agriculture will only increase.

8.2 Farm health and safety initiatives and interventions

The farm health and safety study revealed some new and valuable insights into the perceptions and behaviour of farmers in relation to health and safety on their farms. Information on attitudes, management systems and practices, hazard and risk perception, changes being made on farms and the drivers of those changes offers work safety authorities, industry, Farmsafe Australia and health practitioners an opportunity to evaluate their approaches and initiatives to farm safety, based on actual farmer responses and practices, as opposed to hypotheses and historical initiatives.

8.2.1 Safety Climate

The differences in Safety Climate scores between informants aged over and under 55 years was against the perceptions held by many in farm health and safety promotion; that the younger farmers are more receptive to health and safety issues, while older farmers are more set in their ways and more difficult to change in their attitudes, perceptions and management. In fact, on average it was younger informants who had the more negative attitudes towards farm safety.

There may be many hypotheses why this is the case; younger farmers believing themselves invincible or not as knowledgeable about some of the potential risks and hazards associated with farming, older farmers having experienced accidents or near misses themselves, or knowing someone who had, older farmers showing concern for their children and grandchildren becoming actively involved in the farm. However, these hypotheses are not the priority of this finding.

These differences in age-related scoring suggest that future initiatives may need to take different approaches to the two groups. For younger farmers aged under 55 years, the safety message needs to initially focus on improving the attitudes of this group towards farm health and safety. Approaches that can challenge the notion of risk justification; instances or reasons why an individual may have worked unsafely; and fatalism; that accidents are a natural consequence of the working environment; need to be developed. These can then be integrated with initiatives aimed at fostering greater personal motivation for safety, positive safety practices, and a general perception of optimism towards health and safety on their farm.

Only once perceptions towards farm safety have improved, in that younger farmers have a more positive belief and commitment to health and safety (which would be demonstrable in Safety Climate scores) should the initiative be moved to a management-related focus, as without a greater safety consciousness and awareness, promotion is unlikely to result in a change to management and systems.

Unlike age-related scores, the higher scoring of females in Safety Climate than males was not an unexpected result. However, it does raise the question of more actively targeting women in farm safety initiatives. Female scoring in Safety Climate suggested health and safety was an important feature of their farming life and business. Therefore, can this positive attitude be capitalised upon to introduce ideas and in time, implement systems that improve safety on farms? An obvious approach would be hazards associated with children. As women are generally the primary caregivers, initiatives targeting the major hazards of helmets, restraints in vehicles, safe play areas and road safety and promoted directly to women, in their roles as mothers and grandmothers, may result in some positive safety practices.

The emotional commitment of women to farm safety, demonstrated by their Safety Climate scores, suggests that they do not need to be convinced of its role and importance. However, they may need assistance in understanding and developing practical approaches, systems and management to minimise risks on their farms. The development of a '*women's safety workshop*' may be a viable means for introducing these ideas and demonstrating simple, cost efficient, effective systems and processes that can be readily implemented on their farms.

A challenge to the further improvement of health and safety on farms, were the relatively lower Safety Climate scores of those informants engaged in sheep production. As discussed in Chapter 7, undoubtedly the lower total factor productivity rates experienced by the sheep industry would have a considerable impact on farmer perceptions, with the restricted financial situation being viewed as a risk justification. Furthermore, the high rate of injuries experienced within the industry would add to the general feeling of fatalism, and that injury is just part of running a sheep enterprise.

Sheep enterprises have a unique set of risks, mostly relating to the manual handling of their animals, shearing and crutching and in many cases, aged equipment and machinery, particularly shearing shed structures and tractors. A farm safety initiative directly aimed at sheep enterprises, acknowledging the difficulties involved in the enterprise, both from production and capacity for change perspectives, and promoting cost effective, time efficient systems and processes, may assist in the realisation that there are farm health and safety changes that can be made, that do not require significant capital or labour outlay, and that can bring about significant improvements in the safety and operation of the farm enterprise.

8.2.2 Safety Management Systems

The strong performance of cotton and horticultural enterprises in Safety Management Systems was an interesting observation of the study, although given their quality assurance systems; it was not an entirely unexpected result.

Cotton production requires a high level of inputs, including fertilisers, herbicides and insecticides and specific harvesting equipment. The industry has a reputation for the rapid adoption of new technologies; it was the first major Australian agriculture industry to move successfully to the commercial use of biotechnology (Cotton CRC, 2005). In 1996, the cotton industry developed its first Best Management Practice (BMP) manual. While originally devised to guide farmers in sustainable cotton production, with a strong focus on pesticide management, it has evolved to include all aspects of production, including water and chemical use, soil health, accountability, traceability, ethical employment and farm safety.

While it is a voluntary program, it has achieved widespread adoption as farmers seek to ensure the sustainability of their farms, and protect themselves against the risks associated with chemical use and its effects, particularly drift and residues. This aspect of the program is critical to its success, the benefit to the grower of participation is demonstrable, and therefore adoption of the program is high. The BMP model of the cotton industry may be an excellent starting point for other industries, and may result in an increase in the priority and management of safety on farms, as a by-product of program compliance.

The farm safety component of BMP includes the correct and safe storage and application of chemicals, the use of protective equipment and safe handling technology, safety information and training, safe ladders and handholds for any climbing, and emergency procedures in place and well understood (Cotton Australia, 2010).

Horticulture, meanwhile, has a large number of food safety and quality assurance program in place. Some of these are tied in with major resellers (Coles, Woolworths and McDonalds), while others are overseen by commodity groups (Freshcare) or the Department of Agriculture Forestry and Fishing (EUREPGAP® – accreditation to international certification principles for Good Agricultural Practice).

An essential component of these programs is record keeping, training and OHS principles, which feature heavily in the Safety Management Systems section of the questionnaire. For example, EUREGAP®, a standard that aims to certify safe and sustainable agricultural practices, requires compliance in the following areas: record keeping, risk assessments and action plans, employee training, hazard warnings and emergency plans, crop protection and product handling, protective clothing, employee welfare, and visitor safety (McBride, 2004).

Cattlecare and Flockcare, quality assurance programs for the livestock industry, were devised with a view of being able to market a differentiated, higher quality product. However, producer involvement and accreditation never really took hold, as the market was not prepared to pay higher prices for a quality assured product, and as a result, there was no incentive for participation in the program.

In horticulture, on the other hand, accreditation in a registered food safety and quality assurance program is demanded by the market. It is not about being paid a premium price for an accredited product, rather if you do not have compliance; it is very difficult to sell a product in any market. This market demand has been the key to the successful adoption of accreditation programs.

Therefore, for other industries to establish health and safety as part of a quality assurance program, they would first have to get commitment and action from the market that they are either willing to pay a premium for a compliant product or they are unwilling to continue to purchase a product unless it is accredited. This is a challenging and difficult obstacle to overcome, but without it, quality assurance programs will not see widespread adoption in agriculture.

A final observation of the scoring of Safety Management Systems was the role of age within grain farming enterprises. As this effect was also a key feature of Control of Major Hazards, it is discussed in detail in the following section.

8.2.3 Control of Major Hazards

The lower scoring of cattle enterprises in the Control of Major Safety Hazards section of the questionnaire demonstrates that there needs to be considerable improvements to tractors, machinery guarding, workshop safety, chemical safety, vehicle and road safety, helmets, working from heights and child safety in the beef sector. These are all priority hazards for Farmsafe Australia.

Tractors and augers are an essential part of a cropping system. The high workload demand placed on machinery during peak periods has resulted in farmers upgrading machinery, seeking higher throughput, improved automation, and an ability to sow or spray larger areas in less time. The cattle industry, on the other hand, has a different level of demand, with tractors more likely to be used for moving products and equipment, such as hay bales and feed bins, and for powering augers and other machinery. Likewise augers are used for delivery and access to stock feed, as opposed to storage and transportation of large volumes of harvested grain yields.

The cattle industry have also seen lower total factor productivity gains than the cropping industry, and as discussed previously, the financial constraints resulting from these lower productivity gains inhibit the ability of the farmer to upgrade machinery and increase their asset base.

The purpose of machinery and equipment and the financial position of the farmer will govern the level of risk involved. If efficiency and throughput are paramount, and the financial situation allows, then newer, more updated machinery is likely to be in place. A newer tractor will have a cabin, which reduces the risk of rollovers to the farmer as it effectively serves as a rollover protective structure (ROPS). Newer machinery is less likely to have damaged guarding, again reducing the risk to the farmer. Additionally, improvements to design and technology may mean that throughput is no longer restricted by guarding, reducing the temptation of the farmer to remove or adapt the guarding to improve efficiency.

However, it is not just older machinery and therefore increased risk exposure that has resulted in cattle farmers having fewer systems in place to manage major hazards. There are many changes that will improve performance in Safety Management at relatively low cost. Workshop safety, chemical safety, vehicle and road safety, helmets, working from heights and child safety can all be improved with little financial and labour outlay.

Administrative controls relating to policies about PPE, seatbelts, speed limits and helmets are simple to implement, albeit it at times difficult to enforce. RCDs and guards are relatively inexpensive, and, while setting up correct chemical storage areas and ensuring there is a secure, safe play area for children may require some adaptation and modification to current arrangements, they are still by no means a significant capital outlay.

A more targeted approach to cattle enterprises that demonstrates, with actual examples, that improvements to safety systems for the major hazards on their farms are not complicated, expensive nor time consuming, may result in significant improvements to the management of major hazards on cattle enterprises.

The potential to improve health and safety is clearly evident by the interaction horticulture or cotton enterprises have on sheep production. If sheep enterprises were also involved in cotton or horticultural production, then their Control of Major Hazards

Score was, on average, higher than enterprises just running sheep. Presumably, the requirements to participate in BMP and quality assurance programs, discussed in the previous section, have resulted in a carry on effect to the sheep enterprises, due to the reporting and management systems required for accreditation.

A common element to both Safety Management Systems and the Control of Major Safety Hazards sections of the questionnaire revealed a critical finding relating to the implementation of farm safety systems. While older grain informants (aged 55 years plus) were, on average, more positive and committed to the idea and consciousness of farm safety, this did not carry through to the management of farm health and safety systems or major hazards on their farms. The reverse applied to younger grain informants, those aged under 55 years, on average had more negative attitudes towards their commitment to farm safety, and yet, had more effective systems in place for the management of farm safety and major hazards.

Essentially, this suggests that older grain farmers, on average, have good safety intentions, but poor follow through and implementation, while younger farmers are more dismissive in their attitudes towards safety, and yet have more robust systems in place for the management of major hazards.

From an intervention perspective, this raises the question of what needs to be done to encourage older farmers to take the step from a belief and theoretical commitment to farm safety to an actual management action.

Fragar et al. (2009) devised a model of safety behaviour change for Australian farms. To achieve behavioural change, there must be modifying variables in place. There must firstly be a positive attitude and a desire for change, and this desire must sit within their own values and importance, and it must be achievable under different circumstances. There must also be support, commitment and promotion by industry associations to change the social norms about farm safety.

Once this has occurred, there needs to be necessary and sufficient initiatives to instigate behavioural change. While the farmer may have the positive attitude and belief in farm safety, this must be stepped up to forming intent to change practice or behaviour. Fragar et al. (2009) reported on a number of effective drivers that prompt intent:

- Ensuring the safety outcomes to be achieved are important and valued by farmers. This involves identifying the benefits of safe work systems and practices and linking these to current constraints, such as labour shortage, financial costs and the market demand for products.
- Economics and profitability of the farm business are critical to decision making.
- A mismatch between farmers' perceptions of risk and actual risk will influence their intention to act.
- The presentation and packaging of the information, and the person presenting it, will impact on the action of farmers.

- The target of any safety program should be the decision-maker. Females should not be overlooked in this role.
- While an unpopular approach with many farmers, meeting regulatory requirements appears to be a powerful driver for adoption. However, recognition needs to be made of the difficulties in achieving compliance.

The third issue in instigating behavioural change is barriers to adoption. To overcome these barriers, they must first be identified for each specific risk or hazard, and there must also be practical information, guidelines and templates about how to implement the solution into the farm setting, with an estimate of cost and sourcing of key items. Furthermore, when the cost of improving farm safety using the most effective level of control is high, lower cost alternatives should be provided, where possible.

The final element required to encourage behavioural change is to ensure farmers have the necessary information, skills and capacity to take the recommended action.

Future initiatives in farm safety need to re-examine necessary and sufficient variables to instigate behavioural change in older farmers. The attitudes and beliefs are already present, but there is a disconnect between this point and practice change. Drivers for intent to change need to be assessed and incorporated into future initiatives, the barriers for change for the particular hazard need to be identified and managed, and skills must be provided to the farmer to ensure they are in the best position to be able to implement change.

8.2.4 Changes to farm health and safety systems

The ability to demonstrate cost and time effective and efficient changes to safety systems has been a key recommendation of this research. These changes need to be practical in their nature and seen to be realistic and cost efficient by farmers. Therefore, the promotion of actual changes made by farmers, not just research or work safety authority recommendations, will improve the credibility and potential impacts of future farm safety initiatives.

The range of changes made on farms was extensive, from administrative controls through to training and machinery and equipment changes. There was an average of 2.4 changes per enterprise, which, whilst by no means high, is certainly a step in the right direction.

The *hierarchy of control* rates the effectiveness of practices aimed at reducing a risk or hazard. Level 1 is the most effective, in the total elimination of a hazard, while Level 5 is the least effective, using personal PPE.

Of the 50 changes to farm safety practices or management nominated by informants, just six were Level 1 controls, with the majority being Level 3 (engineering or isolating the hazard) and Level 4 controls (administrative controls). This was not an unexpected result, as Level 1 controls, while more desirable and most successful at controlling risk, also tend to be not only more costly to put in place, and in many cases, just not practicable or possible.

While sheep enterprises did not perform as well as other industries in the benchmarking sections, improvements to shearing shed safety featured highly in the self reported changes made to farm safety section, and was the most frequent response, reported by 33.1 per cent of enterprises involved in sheep production systems.

The timing of the questionnaire followed the implementation of the WorkCover NSW *ShearSafe* campaign, which involved a combination of rebates to replace pin-drive handpieces, as well as education and training. The campaign was seemingly effective at instigating changes to the safety of the shearing shed, but future evaluation needs to take place to determine whether more permanent changes have occurred in the Safety Climate of sheep farmers, and how they are managing safety on their farm as a whole, not just in the shearing shed.

Another WorkCover NSW initiative just prior to the commencement of the study was a rebate scheme providing financial assistance to 5,000 farmers for PTO guarding on tractors (WorkCover NSW, 2009). Changes, specific to PTO guarding, were reported by 37 enterprises (11.0 per cent), with an additional 36 enterprises (10.7 per cent) nominating changes to unspecified guarding.

The rebates available for PTOs and shearing handpieces and the extensive publicity resulting from the two schemes had a notable effect on the changes made on participating farm enterprises, with 37 informants noting changes to PTO guarding and another 58 informants nominating improvements to shearing shed safety.

However, rebates are perhaps the most costly initiative to governments and WorkCover authorities; the PTO rebate scheme cost WorkCover NSW $1.1 million (WorkCover NSW, 2009), while the ShearSafe campaign cost them a further $800,000 (WorkCover NSW, 2003a). An earlier scheme commencing in 2001 involving a rebate for the retrofitting of ROPS on tractors resulted in 10,000 successful applications, costing the government $2.0 million (WorkCover NSW, 2008).

It is recommended that a review be conducted of major hazards within the farming environment to identify risks that may be successfully eliminated or substantially reduced through adaptation or replacement and that may be subsidised by the government. This review would need to encompass hazards associated with both fatal and non-fatal injury. While the use of rebates is a significant cost to government, this study has demonstrated the considerable economic cost farm-related fatalities have on the Australian economy. Any reduction in the number of farm-related fatalities or injuries through rebate incentives will reduce the overall cost to the Australian economy. Therefore, improving on-farm safety through the use of rebates will result in public good benefits that substantially outweigh any private good benefits associated with the rebate.

WorkCover NSW (2003) reported that within the first year of launching the ROPS rebate in August 2000, there was a 29 per cent drop in serious tractor-related trauma incidents from the preceding nine-year average. The 78 incidents in 2000-01 represented the lowest number of incidents in the past decade. It is clearly evident that an outlay of $2 million on a rebate which minimises the risk associated with a major hazard on farms will bring about far greater economic savings to the economy through injury reduction, as tractor fatalities alone cost the economy $86.7 million over 2001–04.

Chemical safety also featured highly in enterprise responses, as did new and/or upgraded machinery, provision and access to PPE and safer stockyards and stock handling procedures. While the responses were grouped into these rather broad categories for the purpose of this analysis, there was quite substantial variation in the specific changes reported by the participating enterprises. A review of these individual changes would enable a suite of examples and case studies to be established for each of these categories, which could have their implementation costed and be promoted as viable, effective changes than can be readily implemented into a range of farming systems.

Having demonstrated that farmers have indeed made noticeable and effective changes on their farm, the question then arises of what it was that prompted them to make those changes, and what does it mean for past, present and future farm health and safety initiatives.

The most frequently reported driver of change was OHS legislation and compliance. While it is not a popular driver among farmers, and at times results in great hostility, it does successfully bring about behavioural and practice change. But is it being applied in the most effective manner? Are there modifications that can be made to legislation that can make compliance more straightforward for the farmer? Are the regulations sensible, practical and realistic? How does legislation link with the major hazards identified as priorities by Farmsafe Australia? Are the standards required for low level hazards and risks too burdensome? Could high level risks be better managed and controlled?

A major review of OHS legislation that addresses these questions should be a priority task. Regulation and legislation is the most successful driver of improvements in farm safety, so it is imperative that efforts be made to determine if the present OHS requirements are optimal for inducing behavioural change, or whether further success could be achieved by increasing practicality, relevance and ease of compliance.

The prominence of an increased safety awareness or consciousness; a desire to improve the safety and standards on their farm; and the realisation or recognition of a hazard in driving change is a testament to the success of recent advertising and promotion in farm health and safety.

As discussed previously in this section, the model of safety behaviour change on Australian farms developed by Fragar et al. (2009) suggests these drivers are the first steps in actioning behavioural change, and farm safety initiatives need to take further action to capitalise on these improved associations with farm safety to build programs based on characteristics that farmers recognise as positive and achievable.

Another commonly reported motivating driver for change was to gain efficiency or cost savings, most commonly through new and upgraded machinery and improved automation. This finding has been reported in several other studies (Durey and Lower, 2004, Australian Safety and Compensation Council, 2006, Murphy, 2003), but has not been a prominent feature of past farm health and safety initiatives and campaigns.

Whether improvements in farm safety are more often a by-product of a desire to improve profitability, productivity and efficiency is not the important issue. The key outcome of any farm safety initiative and the overall vision of Farmsafe Australia is *'Productive Australian farms, free from health and safety risk'*. It is not how or why the change to safety behaviour occurs that is most important; it is the end result of achieving practice and management change; even if that change does occur as a result of other farm management priorities.

Detailed analysis needs to take place on the potential efficiency, production and financial gains that can be achieved through improvements in farm safety. Once reliable estimates have been established, these can become case study promotions in future campaigns.

While environmental and economic constraints may inhibit immediate action and implementation of efficiency gains or cost savings, the linkage of farm safety and improved farm performance may improve the social norms and emotional components of the safety behaviour change on Australian farms and in time, when pressures ease, may result in improved adoption and implementation.

The linkage between farm safety and production efficiency is already firmly in the mind of many farmers and a demonstrable reason why they are making changes to health and safety on their farms. Future initiatives need to capitalise on this momentum, and further educate farmers on the economic benefits associated with an increased focus on farm safety and improvement.

8.2.5 Perceptions of risks and hazards on farms

As with other Australian and international studies (Australian Safety and Compensation Council, 2006; Durey and Lower, 2004; Knowles, 2002; Murphy, 2003; Sandall and Reeve, 2000), the farm safety study demonstrated a disconnect between what farmers perceive as the risks on their farm and what hazards and risks cause the highest rates of fatalities.

The five most common causes of fatalities on Australian farms; tractors, ATVs, drownings, utilities and fatalities were not rated highly as perceived risks by study participants.

The emphasis placed on the installation of ROPS on tractors without cabins by work safety authorities, has resulted in farmers associating tractor risk with rollovers. While less rollovers have been occurring on Australian farms, due to the retrofitting of ROPS, the number of tractor runovers has risen, and will likely continue to do so as the farming population continues to age and farmers become less agile and steady on their feet (Pollock, 2006, unpublished). Farmers seem to be unaware that their tractor, even with its cabin or ROPS, is still a major hazard and the leading cause of deaths on Australian farms.

ATVs are seen to be a safer alternative to horses and 2 wheel motorcycles, due to their four thick-set tyres and perceived stability. However, they are often used for tasks beyond their original design limits. Lack of formal training, excessive loading (for example, spray tanks), inappropriate attachments (boom sprays, toolboxes), carrying of passengers and use by children not mature enough to control the machines, all increase the risk of ATV collision and rollover. The main causes of severe injury and death are head and neck injury; as well as crush injury and asphyxia associated with ATV rollover. The high rates of head injury are attributed to the low use of helmets (Australian Centre for Agricultural Health and Safety, 2008)

Drownings are not only associated with farm dams, but also creeks and rivers and irrigation channels. Children aged under 15 years account for 71.4 per cent of all farm-related drownings.

Farm utilities are involved in accidents colliding with an object or rolling, with unrestrained passengers or those riding in the tray of the utility being thrown from the vehicle or crushed (Australian Centre for Agricultural Health and Safety, 2008).

Farm motorcycle fatalities are most commonly seen in those aged 15–24 years. They are often the result of collision with an object, and in the majority of cases, the rider was not wearing a helmet.

These agents are all common features on Australian farms, and yet farmers are in general unaware of the potential fatal risk involved in their use. There are simple practices and policies that can be readily implemented on farms at little or no cost for each of these agents. These recommendations include, but are not limited to:

- Not alighting from tractors when moving,
- '*No go*' areas for tractors and ATVs (such as hills and slopes, dam banks or anywhere there may be higher risk of roll-over),
- Restricting ATV use by children, not carrying passengers or using unapproved attachments on ATVs,
- Restraints in vehicles,
- Wearing of helmets,
- Speed limits on farm roads and laneways,
- Not riding in trays of utilities,
- Provision of driver and rider training, and
- Establishment of safe play areas.

Farmers are living and working either in a false sense of security, that as they have a ROPS or a tractor with a cabin, as four wheels are more 'stable' than two, and utilities are a safe vehicle, there are therefore no risks associated with their use or they are accepting of an otherwise inappropriate level of risk. This imbalance of risk needs to be addressed in future farm safety interventions.

The highest ranked risk reported by farmers was livestock handling, followed by silos and chemical handling. While these agents are seen commonly in minor injuries and have featured in recent farm safety campaigns and promotions, they do not feature highly in the causation of deaths on Australian farms. They do, however, all sit in the top eight changes to farm safety made by farmers over the past twelve months, livestock handling at number five, chemicals at number two, and silos at number eight.

The challenge for farm safety interventions is therefore to reconcile farmers focusing on the risk of less common agents, while underestimating the risks of the most frequent causes of death on farms. Thought needs to be given to whether future farm safety initiatives focus on high rate, low severity injuries, such as those occurring from animal handling, or low frequency, high severity and risk of death injuries, such as those involving tractors and ATVs.

The outcomes of this research have challenged some of the preconceived ideas relating to farmers' perceptions, attitudes and practices in relation to farm safety. The challenge is now for farm safety researchers, Farmsafe Australia, work safety authorities, industry and farmer groups and health practitioners to capitalise on these findings and re-evaluate their farm safety strategies and initiatives to reduce the level of risk on Australian farms and therefore, the incidence of fatal and non-fatal injury.

8.3 Conclusions and contributions of research

This is the first study that has attempted to not only calculate the economic cost of farm-related fatalities to the Australian economy, but also examine farmers' perceptions of health and safety, what they see as the risks on their farms, what changes they are making to management and practices and how they are performing in regard to their attitudes and management of safety and major hazards compared to other farmers in their region or industry.

The first component of the study revealed the economic cost of farm-related fatalities to the Australian economy is considerable. In just four years, over the period 2001–04, the 404 farm-related fatalities cost the economy $650.6 million in 2008 dollars. That equates to 2.7 per cent of the 2008 farm GDP, at an average cost of $1.61 million per fatality.

While agriculture has always been acknowledged as a high risk industry, previous cost studies have relied on workers' compensation-based statistics, leading to a significant under-representation of the total economic costs involved in farming fatalities.

This research has resulted in a comprehensive, robust estimate of the total cost of farm-related fatalities, finally enabling the true scale of farm-related fatalities to be realised and understood. It also demonstrates that increased allocation of resources towards future farm health and safety inventions, particularly those targeting tractors, ATVs, drownings, utilities and 2-wheel motorcycles, has the potential to offer considerable cost savings to the Australian economy, as these five agents alone account for 46.7 per cent ($303.5 million) of the total economic cost of farm-related fatalities.

The farm-related fatalities data that underpinned the model is among the most comprehensive of its kind, covering all fatalities that occurred on a farm workplace throughout Australia. Previous studies into the economic cost of farm-related fatalities at the national level have utilised work-related fatalities in agriculture as their primary data source. Economic cost studies that have included all fatalities occurring on the farm workplace have either been very regional in their nature or have focused on a particular agent involved in fatality.

The second component of the research, the baseline analysis of the longitudinal farm health and safety study, analysed the perceptions of study informants towards the role and importance of health and safety on their farms. Additionally, it reviewed the safety performance of the study enterprises, focusing on their management of safety systems and processes, as well as their control of major risks and hazards on their farms.

The results of the study not only challenged some apparent misconceptions, such as older farmers having more negative attitudes towards farm safety than younger farmers, but it also identified industries from within the study population that are performing well in the management of safety and the possible reasons behind their success. Importantly, it also observed an area of disconnect between having a positive attitude towards farm safety and its role and importance, and actually implementing farm safety systems and management processes on the farm.

These findings provide evidence for the possible benefits of tailoring farm initiatives and interventions based on gender, age and industry. Furthermore, the analysis of the changes farmers had made on their farms, the prompts and drivers for making those changes, as well as the issues and risks that the farmers see as important on their own farms offers a wealth of information to health and safety researchers, Farmsafe

Australia, work safety authorities and industry bodies to direct and prioritise their research and initiatives.

The information reported by participating enterprises on the changes they have made on their farms lends itself well to be a feature of future interventions and campaigns as case studies and actual examples of farm safety practices, procedures and management that have successfully been implemented by everyday farmers.

The reported drivers and prompts for making changes on farms provides insight into what intervention approaches appear to have worked in the past and also highlight which interventions may need to be reviewed and fine tuned to achieve more widespread adoption and implementation of strategies and priorities in the future.

Finally, the information on the risks participating enterprises see as most prevalent on their farms demonstrates there is a considerable disconnect to the risks farmers are most aware and conscious of and those that are the most common cause of fatal farm injuries.

Farm-related deaths are a significant economic cost to the Australian economy. Greater resources need to be directed into farm health and safety interventions to take advantage of the new findings in this research and to reduce the exposure of risk to those visiting, residing and working on Australian farms. Only with increased resources and priority given to the importance and role of farm health and safety prevention will Farmsafe Australia achieve its vision of *'productive Australian farms, free from health and safety risk'*.

8.4 Future research

Further research should include the expansion of the longitudinal study to increase the number of farm enterprise participants, their geographic area and the range of industries involved. Future phases of the study should be designed and sent to existing farm enterprise participants to enable the analysis of changes in responses relating to Safety Climate, Safety Management Systems and Control of Major Safety Hazards over time.

Additional phases of the longitudinal study would enable the success of future farm safety initiatives and interventions to be assessed through the adoption and implementation of promoted risk minimisation strategies. The study also offers the potential to estimate the economic cost of the injuries reported over time to both the individual farm enterprises involved, and also the study population as a whole.

Ongoing monitoring of the NCIS database should continue to occur, not only to extract farm-related fatality cases as they occur, but also to monitor for cases that have had their case status updated to closed, which will allow access to more detailed case information that was not previously available. This ongoing work will result in a far more comprehensive and accurate source of fatality data.

Further work on the sourcing and access to farm-related injury and fatality data is clearly needed. While the NCIS is a very comprehensive source for fatality data, the limitations involving 'open' cases and, at times, the lack of case notes, data and the brief nature of police reports, make establishing critical elements about the activity in the lead up to death, and the agent responsible difficult to establish.

Non-fatal injury data is the more challenging of the two, as workers' compensation data will never be a true indication of the scale of the problem, due to the large numbers of Australian farms that are self-employed, and therefore, outside the reporting requirements of OHS legislation.

Hospital and allied health information offers the most potential for a detailed injury database, however, the state-based nature of collection of hospital data and the independent nature of applied health makes the possibility of an accurate and reliable injury database unlikely to ever be feasible.

However, the hospital-based data, incomplete though it may be, may lend itself to be run through the model, with additional cost categories relating to rehabilitation, carers, pharmaceuticals and medical aids and disability payments. The combination of injury and fatality cost data would offer considerable insight into the economic burden of farm-related injury as a whole, and this would no doubt be a very substantial figure.

Additionally, further work into the economic costing of farm-related injuries would be valuable to build on existing research. Data relating to on-farm losses, such as production losses, production delay losses and damage to machinery and equipment could best be estimated through interviews with those involved in the farm where the accident took place.

However, given the emotional and sensitive nature of this research, it is unlikely to take place. Other costs, such as insurance payments, penalties or farm labour replacement costs, may be more readily able to be established through government and commercial agencies.

References

Access Economics, 2004, 'Costs of workplace injury and illness to the Australian economy: reviewing the estimation methodology and estimates of the distribution of costs', National Occupational Health and Safety Commission, Canberra.

Access Economics, 2008, 'The Health of Nations: The Value of a Statistical Life', Office of the Australian Safety and Compensation Council, Canberra.

Aherin, R. A. and Murphy, D. J., 1987, 'Impact of operator training on reducing losses', American Society of Agricultural Engineers, St. Joseph, Michagan.

Aldy, J. E. and Viscusi, W. K., 2007, 'Age differences in the value of a statistical life: Revealed preference evidence', *Review of Environmental Economics and Policy,* vol. 1, no. 2, pp. 241-60.

Australian Bureau of Agricultural and Resource Economics, 2006, 'Agricultural economies of Australia and New Zealand', ABARE, Canberra.

Australian Bureau of Agricultural and Resource Economics, 2009, 'Australian Farm Survey Results 2006-07 to 2008-09', ABARE, Canberra.

Australian Bureau of Statistics, 1983, 'Year Book Australia, 1983', 1301.0, ABS, Canberra.

Australian Bureau of Statistics, 2001a, 'Employee Earnings and Hours, Australia, May 2000 ', 6306.0, ABS, Canberra.

Australian Bureau of Statistics, 2001b, 'Labour Force, Australia, Jun 2001', 6202.0, ABS, Canberra.

Australian Bureau of Statistics, 2002, 'Labour Force, Australia, Jun 2002', 6202.0, ABS, Canberra.

Australian Bureau of Statistics, 2003a, 'AgStats, 2000-01', 7117.0.30.001, ABS, Canberra.

Australian Bureau of Statistics, 2003b, 'Employee Earnings and Hours, Australia, May 2002 ', 6306.0, ABS, Canberra.

Australian Bureau of Statistics, 2003c, 'Labour Force, Australia, Jun 2003', 6202.0, ABS, Canberra.

Australian Bureau of Statistics, 2004a, 'Characteristics of Wage and Salary Earners in Regions of Australia, 2000-01', 6261.0.55.001, ABS, Canberra.

Australian Bureau of Statistics, 2004b, 'Labour Costs, Australia, 2002-03 ', 6348.0.55.001, ABS, Canberra.

Australian Bureau of Statistics, 2004c, 'Labour Force, Australia, Jun 2004', 6202.0, ABS, Canberra.

Australian Bureau of Statistics, 2005a, 'Deaths', 3302.0, ABS, Canberra.

Australian Bureau of Statistics, 2005b, 'Employee Earnings and Hours, Australia, May 2004 ', 6306.0, ABS, Canberra.

Australian Bureau of Statistics, 2005c, 'Life Tables, Australia, 2002-2004', 3302.0.55.001, ABS, Canberra.

Australian Bureau of Statistics, 2006a, 'ANZSCO - Australian and New Zealand Standard Classification of Occupations, First Edition, 2006 ', 1220.0, ABS, Canberra.

Australian Bureau of Statistics, 2006b, 'Characteristics of Wage and Salary Earners in Regions of Australia, 2002-03', 6261.0.55.001, ABS, Canberra.

Australian Bureau of Statistics, 2006c, 'Year Book Australia, 2006 ', 1301.0, ABS, Canberra.

Australian Bureau of Statistics, 2008a, 'ABS Agriculture Statistics Collection Strategy - 2008-09 and beyond, 2008-09', 7105.0, ABS, Canberra.

Australian Bureau of Statistics, 2008b, 'Agriculture in Focus: Farming Families, Australia, 2006 ', 7104.0.55.001, ABS, Canberra.

Australian Bureau of Statistics, 2009, 'Agricultural Commodities, Australia, 2007-08', 7111.0, ABS, Canberra.

Australian Centre for Agricultural Health and Safety, 2008, 'Farm Vehicles, 2 and 4 Wheeled Motorbikes', ACAHS, Moree.

Australian Government Department of Health and Ageing, 2009, 'The state of our public hospitals, June 2009', Australian Government Department of Health and Ageing, Canberra.

Australian Institute of Health and Welfare, 2005, 'Health expenditure Australia 2003-04', HWE 32, Australian Institute of Health and Welfare, Canberra.

Australian Safety and Compensation Council, 2006, 'Beyond Common Sense -- A report on the barriers to adoption of safety in the agriculture industry', ASCC, Canberra.

Australian Safety and Compensation Council, 2008, *Information Sheet: Agriculture, Fishing and Forestry*, viewed 12 December, <http://www.ascc.gov.au/NR/rdonlyres/CCA2DCED-96BB-4E88-9AF1-AC9E7BBCC891/0/Agriculture.pdf>.

Australian Safety and Compensation Council, 2009a, 'Compendium of Workers' Compensation Statistics Australia 2006–07', ASCC, Canberra.

Australian Safety and Compensation Council, 2009b, 'The cost of work-related injury and illness for Australian employers, workers and the community: 2005-06', ASCC, Canberra.

Berger, M. L., Murray, J. F., Xu, J. and Pauly, M., 2001, 'Alternative valuations of work loss and productivity', *Journal of Occupational and Environmental Medicine,* vol. 43, no. 1, pp. 18-24.

Biddle, E., Hartley, D., Starkey, S., Fabrega, V. a. and Richardson, S., 2005, 'Deriving Occupational Fatal Injury Costs: A State Pilot Study',

Biddle, E. A., 2001, 'The Economic Cost of Fatal Occupational Injuries in the United States', West Virginia University, Morgantown, West Virginia.

Biddle, E. A., 2004a, 'The economic cost of fatal occupational injuries in the United States, 1980-97', *Contemporary Economic Policy,* vol. 22, no. 3, pp. 357-69.

Biddle, E. A., 2004b, 'Estimating the Impact of Occupational Fatal Injuries on the U.S. Gross Domestic Product', West Virginia University, Morgantown, West Virginia.

Biddle, E. A., 2009, 'The cost of fatal injuries to civilian workers in the United States, 1992-2001', NIOSH, Atlanta.

Bland, J. M. and Altman, D. G., 1998, 'Survival probabilties (the Kaplan-Meier method)', *British Medical Journal,* vol. 317, no. 7172, p. 1572.

BOMEL Limited, 2004, 'Understanding and influencing farmers' attitudes', RR700, Health and Safety Executive, London.

British Medical Journal, 2004, *Longitudinal and cross sectional studies*, viewed 20 January 2010, <http://www.bmj.com/cgi/qa-display/short/bmj_el;58734>.

Brouwer, W. B. F., Koopmanschap, M. A. and Rutten, F. F. H., 1997, 'Productivity costs measurement Through quality of life? A response to The recommendation of the Washington panel', *Health Economics,* vol. 6, pp. 253-59.

Bureau of Transport Economics, 1992, 'Social cost of transport accidents in Australia', Report No. 79, Bureau of Transport Economics, Canberra.

Bureau of Transport Economics, 2000, 'Road Crash Costs in Australia', Report 102, ,

Bureau of Transport Economics, Canberra.

Cadilhac, D. A., Magnus, A., Cumming, T., Sheppard, L., Pearce, D. and Carter, R., 2009, 'The health and economic benefits of reducing disease risk factors', VicHealth, Melbourne.

Canadian Agency for Drugs and Technologies in Health, 2006, 'Guidelines for the economic evaluation of health technologies: Canada', Canadian Agency for Drugs and Technologies in Health,, Ottawa.

Canadian Agricultural Injury Surveillance Program, 2008, 'Agricultural Fatalities in Canada 1990-2005', CAISP, Kingston, Ontario.

Centre for Disease Control, 1987, 'Traumatic occupational fatalties -- United States', *Morbidity and Mortality Weekly Report,* vol. 36, pp. 461-70.

Clark, N., 2008, 'Corporate Farming in Australia', Neil Clark and Associates, Bendigo.

Cohen, J., 1992, 'A power primer', *Psychological Bulletin,* vol. 112, no. 1, pp. 155-59.

Cotton Australia, 2006, 'Cotton Australia Annual Report 2005/06', Cotton Australia, Sydney.

Cotton Australia, 2010, *Australian Cotton History*, viewed 21 January 2010, <http://www.cottonaustralia.com.au/facts/factsandfigures.aspx?id=21>.

Cotton CRC, 2005, *The Australian Cotton CRC*, viewed 21 January 2010, <http://web.cotton.crc.org.au/files/a72da5e6-1e28-48fe-b4c7-996900e73bf8/ar0405mi.pdf>.

Craigmile, P. F., 2007, 'Stat 528: Data Analysis - Obtaining Data', Ohio State Universtity, Columbus.

Currie, G., Kerfoot, K. D., Donaldson, C. and Macarthur, C., 2000, 'Are cost of injury studies useful?', *Injury Prevention,* vol. 6, pp. 175-76.

Davidson, D. J. and Freudenburg, W. R., 1996, 'Gender and Environmental Concerns: A Review and Analysis of Available Research', *Environment and Behaviour,* vol. 28, pp. 302-39.

Day, L. and Stathakis, V., 2004, 'Evaluation of farm injury prevention programs: A report for the Rural Industries Research and Development Corporation', 03/139, Monash University Accident Research Centre (MUARC), Melbourne.

Department of Education, E. a. W. R., 2009, 'Employment outlook for Agriculture, Forestry and Fishing', Department of Education, Employment and Workplace Relations, Canberra.

Driscoll, T., Mitchell, R., Mandryk, J., Healey, S., Hendrie, L. and Hull, B., 2003, 'Coverage of work related fatalities in Australia by compensation and occupational health and safety agencies', *Occupational and Environmental Medicine,* vol. 60, no. 3, pp. 195-200.

Drummond, M., 1992, 'Cost-of-illness studies: a major headache?', *Pharmacoeconomics,* vol. 2, no. 1, pp. 1-4.

Durey, A. and Lower, T., 2004, 'The culture of safety on Australian farms', *Rural Society,* vol. 14, no. 1, pp. 57-69.

European Agency for Safety and Health at Work, 2008, *Agriculture in the EU: Statistical information* viewed 12 December 2009, <http://osha.europa.eu/en/sector/agriculture/index_html/eu_stats>.

Faul, F., Erdfelder, E., Lang, A.-G. and Buchner, A., 2007, 'G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences', *Behavior Research Methods,* vol. 39, no. 175-91.

Fiedler, D., Von Essen, S., Morgan, D., Grisso, R., Mueller, K. and Eberle, C., 1998, 'Causes of Fatalities in Older Farmers vs. Perception of Risk', *Journal of Agromedicine,* vol. 5, no. 13, pp. 13-22.

Foskey, R., 2005, 'Older Farmers and Retirement', 05/006, RIRDC, Canberra.

Fragar, L., 1996, 'Agricultural health and safety in Australia', *Australian Journal of Rural Health,* vol. 4, no. 3, pp. 200-6.

Fragar, L. and Franklin, R., 2000, 'The health and safety of Australia's farming community', ACAHS and RIRDC, Moree.

Fragar, L., Franklin, R. and Coleman, R., 2000, 'The farm injury optimal dataset', Version 1.2, ACAHS and RIRDC, Moree.

Fragar, L. and Houlahan, J., 2002, 'Australian approaches to the prevention of farm injury', *NSW Public Health Bulletin,* vol. 13, no. 5, pp. 103-07.

Fragar, L., Morton, C. and Pollock, K., 2007, 'Health and Safety in Older Farmers in Australia -- The Facts', 07/150, Rural Industries Research and Development Corporation, Canberra.

Fragar, L., Pollock, K. and Morton, C., 2008, 'The changing profile of Australian farm injury deaths', *Australian and New Zealand Journal of Occupational Health and Safety,* vol. 24, no. 5, pp. 425-33.

Fragar, L., Temperley, J., Depczynski, J. and Pollock, K., 2009, 'Achieving Safety Change on Australian Farms: Using new and established pathways to improve adoption', 09/053, Rural Industries Research and Development Corporation (RIRDC), Canberra.

Fragar, L. J., Thomas, P. and Morton, C., 2005, 'Injury on Farms in New South Wales - The Facts', ACAHS and RIRSC, Moree and Canberra.

Franklin, R., Mitchell, R., Driscoll, T. and Fragar, L., 2000, 'Farm-related fatalities in Australia', ACAHS, NOHSC and RIRDC, Moree.

Freeman III, M., 1993, *The measurement of environmental and resource values,* Resources for the Future Press, Washington.

Gielen, A. C. and Sleet, D., 2003, 'Application of Behavior-Change Theories and Methods to Injury Prevention', *Epidemiologic Reviews,* vol. 25, pp. 65-76.

Goeree, R., O'Brien, B. J., Goering, P., Blackhouse, G., Agro, K., Rhodes, A. and Watson, J., 1999, 'The economic burden of schizophrenia in Canada', *Canadian journal of psychiatry,* vol. 44, no. 5, pp. 464-72.

Guthrie, R., Goldacre, L. and Westaway, J., 1997, 'Workers Compensation and Occupational Health and Safety in the Australian Agricultural Industry', *The Agricultural Industry,* vol. 9, pp. 1-17.

Haddon Jr, W., 1973, 'Energy damage and the ten countermeasure strategies', *Journal of Trauma,* vol. 13, no. 4, pp. 321-31.

Hair, J. F., 1995, *Multivariate Data Analysis with Readings (4th ed),* Prentice Hall, Englewood Cliffs, N.J.

Health and Safety Executive, 2001, 'A guide to measuring health and safety performance', HSE, London.

Health and Safety Executive, 2009, *About health and safety in agriculture*, viewed 12 December 2009, <http://www.hse.gov.uk/agriculture/hsagriculture.htm>.

Hoag, J. H., 2002, *Introductory Economics (3rd ed),* World Scientific Publishing Co. , Singapore.

Hodne, C. J., Thu, K., Donham, K. J., Watson, D. and Roy, N., 1999, 'Development of the Farm Safety and Health Beliefs Scale', *Journal of Agricultural Safety and Health,* vol. 5, no. 4, pp. 395-406.

Rural and Regional Services and Development Committee, 2004, 'Robinvalue Public Hearing - Graeme Kelly, Chief Executive Officer, Robinvale District Health Services', *Inquiry into the cause of fatality and injury on Victorian farms*, 23 March 2004, Parliament of Victoria, Melbourne.

Kelsey, T. W., 1991, 'Fatal Farm Accidents in New York: Estimates of Their Costs', *North-eastern Journal of Agricultural and Resource Economics,* vol. 20, pp. 202-07.

Kelsey, T. W., 1992, 'The Economic Cost of Farm Tractor Rollover Deaths in New York', *Journal of Rural Health,* vol. 8, no. 2, pp. 143-46.

Knieser, T. and Leeth, J., 1991, 'Compensating wage differentials for fatal injury risk in Australia, Japan and the United States', *The Journal of Risk and Uncertainty,* vol. 4, no. 1, pp. 71-90.

Knowles, D. J., 2002, 'Risk perception leading to risk taking behaviour amongst farmers in England and Wales', 404/2002, Health and Safety Executive, London.

Koopmanschap, M. A., Rutten, F. F. H., van Ineveld, B. M. and van Roijen, L., 1995, 'The Friction Cost Method for Measuring Indirect Costs of Disease', *Journal of Health Economics* vol. 14, pp. 171-89.

Koopmanschap, M. A. and van Ineveld, B. M., 1992, 'Towards a New Approach for Estimating Indirect Costs of Disease', *Social Science and Medicine,* vol. 34, no. 9, pp. 1005-10.

Leigh, J. P., Markowitz, S., Fahs, M. and Landrigan, P., 2000, *Costs of Occupational Injuries and Illnesses,* University of Michigan Press, Ann Arbor.

Leigh, J. P., McCurdy, S. A. and Schenker, M. B., 2001, 'Costs of occupational injuries in agriculture', *Public Health Report,* vol. 116, no. 3, pp. 235-48.

Levin, K. A., 2006, 'Study design III: Cross-sectional studies', *Evidence-Based Dentistry* vol. 7, no. 1, pp. 24-5.

Locker, A. R., Dorland, J. L., Hartling, L. and Pickett, W., 2003, 'Economic burden of agricultural Machinery injuries in Ontario, 1985 to 1996', *Journal of Rural Health,* vol. 19, no. 3, pp. 285-91.

Low, J. M. and Griffith, G. R., 1996, 'The cost of Australian farm injuries', *Review of Marketing and Agricultural Economics,* vol. 64, no. 3, pp. 290-300.

Macfarlane, E., Chapman, A., Benke, G., Meaklim, J., Sim, M. and McNeil, J., 2008, 'Training and other predictors of personal protective equipment use in Australian grain farmers using pesticides', *Occupational and Environmental Medicine,* vol. 65, no. 2, pp. 141-6.

McBride, W., 2004, 'Guidelines for implementing EUREPGAP® for Australian fresh fruit and vegetable producers', Department of Agriculture, Fisheries and Forestry, Canberra.

Monk, A. S., Morgan, D. D. V., Morris, J. and Radley, R. W., 1984, 'The cost of farm accidents', Occasional paper no. 13, Silsoe.

Murphy, D. J., 2003, *Looking beneath the surface of agricultural safety and health,* American Society of Agricultural Engineers, St Joseph, Michigan.

Murphy, D. J., Kiernan, N. E. and Chapman, L. J., 1996, 'An Occupational Health and Safety Intervention Research Agenda for Production Agriculture: Does Safety Education Work?', *American Journal of Industrial Medicine,* vol. 29, no. 4, pp. 392-96.

Murphy, K. M. and Topel, R. H., 2006, 'The value of health and longevity', *Journal of Political Economy,* vol. 114, no. 5, pp. 871-904.

Muscatello, D. and Mitchell, R., 2001, 'Identifying work-related injury and disease in routinely collected NSW hospitalisation data', *NSW Public Health Bulletin,* vol. 12, no. 7, pp. 195-98.

Muscatello, D. and Travis, S., 2001, 'Using the International Classification of Diseases with HOIST', *NSW Public Health Bulletin,* vol. 12, no. 11, pp. 289-93.

Myers, M. L., Cole, H. P. and Westneat, S. C., 2008, 'Projected Incidence and Cost of Tractor Overturn-Related Injuries in the United States', *Journal of Agricultural Safety and Health,* vol. 14, no. 1, pp. 93-103.

National Agricultural Statistics Service, 2009, '2007 Census of Agriculture -- Demographics', United States Department of Agriculture (USDA), Washington.

National Coroners Information System, 2008, *Case closure rates - by (calendar) year*, viewed 27 December 2009, <http://www.vifp.monash.edu.au/ncis/Case%20Closure%20stats_April%202008.pdf>.

National Coroners Information System, 2009a, *The Coronial Process*, viewed 29 September 2009, <http://ncis.org.au/web_pages/the_coronial_process.htm>.

National Coroners Information System, 2009b, *Historical background* viewed 29 September 2009, <http://ncis.org.au/web_pages/historical_background.htm>.

National Coroners Information System, 2009c, *How is data collected* viewed 29 September 2009, <http://ncis.org.au/web_pages/how_is_it_collected.htm>.

National Coroners Information System, 2009d, *What data is available*, viewed 29 September 2009, <http://ncis.org.au/web_pages/what_data_is_available.htm>.

National Highway Traffic Safety Administration, 1996, 'The economic cost of motor vehicle crashes, 1994', National Highway Traffic Safety Administration, Washington.

National Occupational Health and Safety Commission, 2004, 'The Costs of Work Related Injury and Illness for Australian Employers, Workers and the Community', Commonwealth of Australia, Canberra.

National Occupational Research Agenda Agricultural, Forestry, and Fishing Sector Council, 2008, 'National Agriculture, Forestry, and Fishing Agenda for Occupational Safety and Health Research and Practice in the U.S. Agriculture, Forestry, and Fishing Sector', NORA, Atlanta.

National SAFE KIDS Campaign, 2004, 'Rural Injury Fact Sheet', NSKC, Washington.

National Safety Council, 1937, 'Agricultural safety sessions', *Annual Safety Congress*, Chicago, NSC.

New South Wales Government, 2001, Vol. Occupational Health and Safety Regulation 2001, Clause 5 -- Meaning of "control" of risks (Ed, NSW Government).

NSW Health, 2001a, *Policy Directive - Emergency Department Collection (EDC) - Reporting Requirements*, Available: http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_198.pdf [05 October 2009].

NSW Health, 2001b, *Policy Directive - Inpatient Statistics Collection (ISC) - Public Facilities - Separations dated from 1 July 2001*, Available: http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_210.pdf [05 October 2009].

Pickett, W., Hartling, L., Brison, R. J. and Guernsey, J., 1999, 'Fatal farm injuries in Canada', *Canadian Medical Association Journal,* vol. 160, pp. 1843-48.

Pollock, K., Fragar, L. and Temperley, J., 2008, 'The Australian farm safety study', Rural Industries Research and Development Corporation, Moree.

Pritchard, C. and Sculpher , M., 2000, 'Productivity Costs: Principles and Practice in Economic Valuation', Office of Health Economics, London.

Productivity Commission, 2002, 'Report on Government Services 2002', Productivity Commission, Melbourne.

Productivity Commission, 2004, 'Report on Government Services 2004', Productivity Commission, Melbourne.

Productivity Commission, 2005a, 'Report on Government Services 2005', Productivity Commission, Melbourne.

Productivity Commission, 2005b, 'Trends in Australian Agriculture', Productivity Commission, Canberra.

Productivity Commission, 2006, 'Report on Government Services 2006', Productivity Commission, Melbourne.

Productivity Commission, 2007, 'Report on Government Services 2007', Productivity Commission, Melbourne.

Productivity Commission, 2008, 'Report on Government Services 2008', Productivity Commission, Melbourne.

Public Health Agency of Canada, 1998, 'Economic Burden of Illness in Canada, 1998', Public Health Agency of Canada, Ottawa, Ontario.

Rechner, I. J. and Lipman, J., 2005, 'The costs of caring for patients in a tertiary referral Australian Intensive Care Unit', *Anaesthesia and Intensive Care,* vol. 33, no. 4, pp. 477-82.

Reisenberg, L. E. and Bear, W. F., 1980, 'Instructional impact on accident prevention', In, *Engineering a Safer Food Machine: A Collection of Agricultural Safety Papers*, American Society of Agricultural and Biological Engineers,St Joseph, Michigan.

Reserve Bank of Australia, 2009a, *Bulletin Statistical Tables*, viewed 23 October 2009, <http://www.rba.gov.au/Statistics/Bulletin/index.html#table_f>.

Reserve Bank of Australia, 2009b, *G12 Gross Domestic Product - Income Components*, viewed 10 January 2010, <http://www.rba.gov.au/statistics/by-subject.html>.

Rice, D. P., 1969, 'Measurement and application of illness costs', *Public Health Report,* vol. 84, no. 2, pp. 95-101.

Rice, D. P., 2006, 'Cost of illness studies: what is good about them?', *Injury Prevention,* vol. 6, pp. 177-79.

Safework Australia, 2008, 'Information sheet -- agriculture, forestry and fishing', Safework Australia, Canberra.

Safework Australia, 2009, *National Online Statistics Interactive (NOSI) system extracted from the National Data Set for Compensation-based Statistics (NDS)*, Safework Australia [24 October 2009]

Sandall, J. and Reeve, I., 2000, 'New Ways of Promoting Farm Health & Safety: Through analysing farmers' perceptions of risk', 00/138, RIRDC, Canberra.

Santos, J. R. A., 1999, 'Cronbach's Alpha: A Tool for Assessing the Reliability of Scales ', *Journal of Extension,* vol. 37, no. 2, pp. 1-4.

Schenker, M. B., Orenstein, M. R. and Samuels, S. J., 2002, 'Use of protective equipment among California farmers', *American Journal of Industrial Medicine,* vol. 42, pp. 455-64.

Schwab, C. V., Ralston, A. R., Miller, L. J. and Hanna, H. M., 1995, 'Comparisons between perceptions of farm hazards and injury records in Iowa', *Journal of Agricultural Safety and Health,* vol. 1, no. 4, pp. 241-48.

Sculpher, M., 2001, *The role and estimation of productivity costs in economic evaluation,* Oxford University Press, London.

Segel, J. E., 2006, 'Cost-of-Illness Studies—A Primer', RTI-UNC Center of Excellence in Health Promotion Economics, Research Triangle Park, North Carolina.

Singer, J. D. and Willett, J. B., 2003, *Applied Longitudinal Data Analysis - Modeling Change and Event Occurrence* Oxford University Press, New York.

Smith, D. W., 2004, 'US Agriculture Fatality Statistics', Texas A&M University, College Station.

Stavea, C., Törner, M. and Eklöf, M., 2007, 'An intervention method for occupational safety in farming — evaluation of the effect and process', *Applied Ergonomics,* vol. 38, no. 3, pp. 357-68.

Temperley, J., 2005, 'The Cotton Industry in the Premium Discount Scheme', Australian Centre for Agricultural Health and Safety (ACAHS), Moree.

Tormoehlen, R. L. and Field, W. E., 1995, 'Projecting Economic Losses Associated with Farm-related Permanent Disabilities', *Journal of Agricultural Safety and Health,* vol. 1, no. 1, pp. 27-36.

Victorian WorkCover Authority, 2004, 'Submission', *Inquiry into the cause of fatality and injury on Victorian farms,* vol. 48.

Viscusi, W. K., 2005, 'The Value of Life', No. 517, Harvard Law School Discussion Paper No. 517, Cambridge.

Viscusi, W. K. and Aldy, J. E., 2003, 'The value of a statistical life: A critical review of market estimates throughout the world', *The Journal of Risk and Uncertainty,* vol. 27, no. 1, pp. 5-76.

Watson, W. and Ozanne-Smith, J., 1997, 'The cost of injury to Victoria', 124, MUARC, Melbourne.

Williamson, A. M., Feyer, A.-M., Cairns, D. and Biancotti, D., 1997, 'The development of a measure of safety climate: the role of safety perceptions and attitudes', *Safety Science,* vol. 25, no. 1-3, pp. 15-27.

WorkCover NSW, 2001a, 'Annual Report 2000-2001', Workcover NSW, Sydney.

WorkCover NSW, 2001b, *Premium Discount Scheme*, viewed 1 November 2009, <http://www.workplacesafetymatters.com.au/pdf/PDS%20brochure.pdf>.

WorkCover NSW, 2002, 'Health and Safety at Work -- Shearing Guide', WorkCover NSW, Sydney.

WorkCover NSW, 2003a, 'Annual Report 2002-2003', Workcover NSW, Sydney.

WorkCover NSW, 2003b, 'Safety in the sheep shearing industry', *WorkCover News,* vol. 53, pp. 4-5.

WorkCover NSW, 2008, *Workplace Safety Summit Achievements 2003*, viewed 24 January 2010, <http://www.workcover.nsw.gov.au/OHS/WorkplaceSafetySummit/Pages/SafetySummit2003.aspx>.

WorkCover NSW, 2009, *Tractor Power Take-off Rebate Program*, viewed 24 January 2010, <http://www.workcover.nsw.gov.au/Industry/Rural/Pages/tractor_power_take-off_rebate_program.aspx>.

Zhang, H., Wiegmann, D. A., von Thaden, T. L., Sharma, G. and Mitchell, A. A., 2002, 'Safety Culture: A concept in chaos?', 46th Annual Meeting of the Human Factors and Ergonomics Society, Santa Monica, USA, 30 September - 4 October 2002.

Appendix 1A: Probability of survival, by age, gender

Age	Males	Females	Age	Males	Females	Age	Males	Females
1-2	0.9947	0.9956	41-42	0.9985	0.9992	81-82	0.9374	0.9602
2-3	0.9995	0.9996	42-43	0.9984	0.9991	82-83	0.9306	0.9550
3-4	0.9997	0.9998	43-44	0.9983	0.9990	83-84	0.9228	0.9490
4-5	0.9998	0.9998	44-45	0.9982	0.9989	84-85	0.9138	0.9422
5-6	0.9998	0.9999	45-46	0.9980	0.9988	85-86	0.9036	0.9345
6-7	0.9998	0.9999	46-47	0.9978	0.9987	86-87	0.8924	0.9257
7-8	0.9999	0.9999	47-48	0.9976	0.9986	87-88	0.8802	0.9157
8-9	0.9999	0.9999	48-49	0.9975	0.9985	88-89	0.8672	0.9046
9-10	0.9999	0.9999	49-50	0.9973	0.9983	89-90	0.8537	0.8922
10-11	0.9999	0.9999	50-51	0.9971	0.9982	90-91	0.8399	0.8786
11-12	0.9999	0.9999	51-52	0.9969	0.9981	91-92	0.8258	0.8639
12-13	0.9999	0.9999	52-53	0.9967	0.9979	92-93	0.8117	0.8486
13-14	0.9999	0.9999	53-54	0.9964	0.9978	93-94	0.7981	0.8331
14-15	0.9999	0.9999	54-55	0.9961	0.9976	94-95	0.7845	0.8178
15-16	0.9998	0.9998	55-56	0.9957	0.9973	95-96	0.7710	0.8037
16-17	0.9997	0.9998	56-57	0.9953	0.9971	96-97	0.7575	0.7911
17-18	0.9996	0.9997	57-58	0.9948	0.9968	97-98	0.7441	0.7793
18-19	0.9994	0.9997	58-59	0.9942	0.9964	98-99	0.7307	0.7673
19-20	0.9993	0.9997	59-60	0.9935	0.9961	99-100	0.7173	0.7545
20-21	0.9992	0.9997	60-61	0.9928	0.9956	100-101	0.7040	0.7415
21-22	0.9991	0.9997	61-62	0.9921	0.9952			
22-23	0.9991	0.9997	62-63	0.9913	0.9947			
23-24	0.9991	0.9997	63-64	0.9904	0.9941			
24-25	0.9991	0.9997	64-65	0.9894	0.9936			
25-26	0.9991	0.9997	65-66	0.9883	0.9930			
26-27	0.9991	0.9997	66-67	0.9870	0.9924			
27-28	0.9990	0.9997	67-68	0.9856	0.9917			
28-29	0.9990	0.9996	68-69	0.9840	0.9909			
29-30	0.9990	0.9996	69-70	0.9822	0.9901			
30-31	0.9990	0.9996	70-71	0.9802	0.9891			
31-32	0.9989	0.9996	71-72	0.9780	0.9879			
32-33	0.9989	0.9996	72-73	0.9755	0.9865			
33-34	0.9989	0.9995	73-74	0.9728	0.9849			
34-35	0.9989	0.9995	74-75	0.9698	0.9830			
35-36	0.9989	0.9995	75-76	0.9665	0.9808			
36-37	0.9988	0.9994	76-77	0.9628	0.9783			
37-38	0.9988	0.9994	77-78	0.9587	0.9755			
38-39	0.9987	0.9993	78-79	0.9541	0.9723			
39-40	0.9987	0.9993	79-80	0.9491	0.9687			
40-41	0.9986	0.9992	80-81	0.9436	0.9647			

Appendix 1B: Average annual earnings, by occupation, gender

		Male ($)			
Code	Classification	2001	2002	2003	2004
1	Managers	56,638	58,896	61,538	64,181
2	Professionals	51,482	53,064	55,786	58,507
3	Associate professionals	47,878	50,414	51,331	52,248
4	Tradespersons/related workers	39,938	40,997	42,874	44,750
5	Advanced clerical/service workers	41,201	43,694	45,792	47,890
6	Intermediate clerical, sales/service workers	36,770	37,478	38,825	40,171
7	Intermediate production/transport workers	40,385	42,547	43,776	45,005
8	Elementary clerical, sales/service workers	33,300	33,744	34,860	35,976
9	Labourers/related workers	34,279	35,122	36,802	38,482
13	Farmers/Farm Managers	25,768	28,520	27,957	29,341
21	Science, building/engineering professionals	53,546	55,910	57,329	58,747
22	Business/information professionals	52,332	54,874	56,724	58,574
23	Health professionals	61,171	60,998	66,480	71,962
24	Education professionals	48,554	49,536	51,950	54,365
25	Social, arts/miscellaneous professionals	47,765	48,830	53,110	57,389
31	Science, engineering/related professionals	50,347	53,856	54,533	55,210
32	Business/administration professionals	48,206	50,880	52,795	54,710
33	Managing supervisors (sales/service)	38,671	43,555	43,231	42,907
34	Health/welfare professionals	40,793	41,563	45,146	48,730
39	Other professionals	50,215	50,976	53,426	55,877
41	Mechanical/fabrication engineering tradespersons	43,450	44,218	47,438	50,659
42	Automotive tradespersons	32,520	34,627	36,199	37,771
43	Electrical/electronics tradespersons	45,545	46,387	47,378	48,370
44	Construction tradespersons	39,526	40,757	41,772	42,787
45	Food tradespersons	31,517	31,872	32,642	33,413
46	Skilled agricultural/horticultural workers	29,647	30,658	32,263	33,869
49	Other tradespersons/related workers	42,624	42,451	45,914	49,378
51	Secretaries/personal assistants	41,498	42,893	40,114	37,334
59	Other advanced clerical/service workers	41,167	43,738	46,572	49,406
61	Intermediate clerical workers	36,938	37,613	38,854	40,094
62	Intermediate sales/related workers	38,136	38,933	40,541	42,149
63	Intermediate service workers	33,780	34,714	36,043	37,373
71	Intermediate plant operators	43,044	44,693	46,596	48,499
72	Intermediate machine operators	39,163	40,426	42,082	43,738
73	Road/rail transport drivers	38,352	41,712	42,120	42,528
79	Other intermediate production/transport workers	40,762	42,355	43,519	44,683
81	Elementary clerks	35,873	34,920	36,473	38,026
82	Elementary sales workers	31,709	32,702	33,751	34,800
83	Elementary service workers	35,546	35,549	36,718	37,886

Continued

		Male ($)			
Code	Classification	2001	2002	2003	2004
91	Cleaners	29,057	29,798	30,079	30,360
92	Factory labourers	34,366	35,870	37,260	38,650
99	Other labourers/related workers	35,508	35,669	38,237	40,805
211	Natural/physical science professionals	50,628	50,952	52,253	53,554
212	Building/engineering professionals	54,955	58,339	59,803	61,267
221	Accountants, auditors/corporate treasurers	44,362	48,984	50,887	52,790
222	Sales, marketing/advertising professionals	51,893	54,600	56,074	57,547
223	Computing professionals	58,507	58,027	60,674	63,322
229	Miscellaneous business/information professionals	50,940	54,312	55,555	56,798
231	Medical practitioners	84,816	78,614	90,876	103,138
232	Nursing professionals	46,022	45,782	48,816	51,850
238	Miscellaneous health professionals	51,343	57,998	58,596	59,194
241	School teachers	46,248	47,746	49,056	50,366
242	University/vocational education teachers	56,810	57,442	61,654	65,866
249	Miscellaneous education professionals	43,788	42,528	44,885	47,242
251	Social welfare professionals	32,268	34,349	37,747	41,146
252	Miscellaneous social professionals	55,171	55,248	64,680	74,112
253	Artists/related professionals	45,516	46,666	48,194	49,723
254	Miscellaneous professionals	56,402	58,742	60,257	61,771
311	Medical/science technical officers	42,893	43,934	44,981	46,027
312	Building/engineering professionals	52,368	56,659	57,108	57,557
321	Finance professionals	55,934	58,430	61,147	63,864
329	Miscellaneous business/administration professionals	46,704	49,109	50,801	52,493
331	Shop managers	34,433	35,328	38,016	40,704
332	Hospitality/accommodation managers	34,476	36,125	37,891	39,658
339	Miscellaneous managing supervisors (sales/service)	46,548	56,597	51,998	47,400
341	Enrolled nurses	36,814	42,970	40,714	38,458
342	Welfare professionals	39,190	37,589	40,433	43,277
349	Miscellaneous health/welfare professionals	41,750	43,190	48,574	53,957
391	Police officers	51,720	52,498	54,854	57,211
399	Miscellaneous professionals	46,814	47,218	49,951	52,685
411	Mechanical engineering tradespersons	45,936	46,968	49,699	52,430
412	Fabrication engineering tradespersons	38,501	38,880	43,291	47,702
421	Automotive tradespersons	32,520	34,627	36,199	37,771
431	Electrical/electronics tradespersons	45,545	46,387	47,378	48,370
441	Structural construction tradespersons	40,008	42,264	43,860	45,456
442	Final finishes construction tradespersons	38,726	39,254	40,490	41,726
443	Plumbers	38,376	37,728	38,438	39,149
451	Food tradespersons	31,517	31,872	32,642	33,413
461	Skilled agricultural workers	30,914	32,155	36,878	41,602

Continued

		Male ($)			
Code	Classification	2001	2002	2003	2004
462	Horticultural tradespersons	29,587	30,576	31,913	33,250
491	Printing tradespersons	40,241	40,819	42,742	44,664
492	Wood tradespersons	31,200	34,330	38,124	41,918
493	Hairdressers	26,472	26,597	26,081	25,565
494	Textile, clothing/related tradespersons	29,023	30,653	31,819	32,986
498	Miscellaneous tradespersons/related workers	49,968	48,821	53,786	58,752
511	Secretaries/personal assistants	41,498	42,893	40,114	37,334
591	Advanced numerical clerks	39,211	42,509	43,699	44,890
599	Miscellaneous advanced clerical/service workers	43,373	44,957	48,473	51,989
611	General clerks	35,026	35,875	37,896	39,917
612	Keyboard operators	33,751	35,218	36,970	38,722
613	Receptionists	27,859	29,256	29,923	30,590
614	Intermediate numerical clerks	35,765	36,494	38,678	40,862
615	Material recording/despatching clerks	38,222	38,554	39,293	40,032
619	Miscellaneous intermediate clerical workers	38,366	38,971	39,787	40,603
621	Intermediate sales/related workers	38,136	38,933	40,541	42,149
631	Carers/aides	31,910	33,398	34,411	35,424
632	Hospitality workers	30,950	32,544	32,676	32,808
639	Miscellaneous intermediate service workers	37,433	37,310	40,058	42,806
711	Mobile plant operators	40,891	40,762	42,936	45,110
712	Intermediate stationary plant operators	45,259	48,782	50,306	51,830
721	Intermediate textile, textile machine operators	34,066	37,862	37,339	36,816
729	Miscellaneous intermediate machine operators	40,613	41,136	42,734	44,333
731	Road/rail transport Drivers	38,352	41,712	42,120	42,528
791	Intermediate mining/construction workers	59,990	59,227	65,568	71,909
799	Miscellaneous production/transport workers	34,471	36,216	36,137	36,058
811	Elementary clerks	35,873	34,920	36,473	38,026
821	Sales assistants	31,454	32,261	33,346	34,430
829	Miscellaneous elementary sales workers	32,561	34,205	35,311	36,418
831	Elementary service workers	35,546	35,549	36,718	37,886
911	Cleaners	29,057	29,798	30,079	30,360
921	Process workers	34,462	36,178	37,548	38,918
922	Product packagers	34,106	34,574	35,892	37,210
991	Mining, construction/related labourers	41,018	42,341	44,885	47,429
992	Agricultural/horticultural labourers	27,221	27,485	29,059	30,634
993	Elementary food preparation/related workers	27,410	25,334	27,499	29,664
999	Miscellaneous labourers/related workers	33,458	32,448	34,877	37,306
1311-11	Mixed Crop/Livestock Farmers	24,048	20,708	19,296	23,616
1312-11	Mixed Livestock Farmers	25,392	33,726	30,288	33,600
1312-12	Beef Cattle Farmers	25,968	34,491	31,008	34,368

Continued

Code	Classification	Male ($) 2001	2002	2003	2004
1312-15	Dairy Farmers	29,280	38,890	34,944	38,736
1312-17	Sheep Farmers	24,048	31,941	28,704	31,824
1312-19	Pig Farmers	30,720	40,803	36,672	40,656
1312-21	Poultry Farmers	31,248	41,504	37,296	41,376
1312-23	Horse Breeders	27,888	37,041	33,264	36,912
1312-25	Apiarists	23,952	31,813	28,560	31,680
1312-79	Livestock Farmers nec	22,512	29,901	26,880	29,808
1313-11	Grain, Oilseed/Pasture Grower	25,824	21,508	25,056	23,280
1313-13	Sugar Cane Grower	20,976	17,470	20,352	18,912
1313-15	Tobacco Grower	20,640	17,190	20,016	18,624
1313-17	Fruit/Nut Grower	27,504	22,907	26,688	24,816
1313-19	Vegetable Grower	23,664	19,709	22,944	21,360
1313-21	Flower Grower	22,176	18,470	21,504	20,016
1313-79	Crop Farmers nec	29,280	24,386	28,368	26,400
1314-11	Aquaculture Farmers	28,704	30,897	31,392	32,160
4611-11	Farm Overseer	30,096	28,230	31,200	30,960
4612-11	Shearer	30,192	28,320	31,296	31,104
4613-11	Wool Classer	27,120	25,438	28,128	27,936
9921-11	General Farm Hand	22,080	24,120	24,000	25,872
9921-13	Fruit, Vegetable or Nut Farm Hand	21,312	23,280	23,184	24,960
9921-15	Stud Hand or Stable Hand	20,352	22,233	22,128	23,808
9921-17	Shearing Shed Hand	20,736	22,652	22,560	24,288
9921-79	Farm Hands nec	23,472	25,641	25,536	27,504

		Female ($)			
Code	**Classification**	**2001**	**2002**	**2003**	**2004**
1	Managers	44,995	47,290	51,060	54,830
2	Professionals	44,491	45,941	47,724	49,507
3	Associate professionals	37,942	39,984	40,786	41,587
4	Tradespersons/related workers	29,273	30,490	31,466	32,443
5	Advanced clerical/service workers	34,315	35,194	37,442	39,691
6	Intermediate clerical, sales/service workers	31,162	32,352	33,396	34,440
7	Intermediate production/transport workers	29,297	30,480	31,567	32,654
8	Elementary clerical, sales/service workers	27,631	28,214	29,369	30,523
9	Labourers/related workers	28,061	28,944	30,180	31,416
13	Farmers/Farm Managers	25,768	28,520	27,957	29,341
21	Science, building/engineering professionals	44,640	42,427	45,766	49,104
22	Business/information professionals	44,311	46,392	47,666	48,941
23	Health professionals	46,610	48,715	50,786	52,858
24	Education professionals	44,558	46,186	47,995	49,805
25	Social, arts/miscellaneous professionals	41,971	42,418	44,090	45,763
31	Science, engineering/related professionals	36,432	37,090	37,426	37,762
32	Business/administration professionals	38,700	41,448	42,434	43,421
33	Managing supervisors (sales/service)	35,261	36,792	37,267	37,742
34	Health/welfare professionals	35,136	36,211	37,255	38,299
39	Other professionals	41,230	41,208	42,917	44,626
41	Mechanical/fabrication engineering tradespersons	40,543	44,573	44,364	44,155
42	Automotive tradespersons	30,782	37,877	39,475	41,074
43	Electrical/electronics tradespersons	35,880	41,890	42,130	42,370
44	Construction tradespersons	28,728	31,666	36,653	41,640
45	Food tradespersons	30,814	33,989	32,527	31,066
46	Skilled agricultural/horticultural workers	28,687	27,912	27,799	27,686
49	Other tradespersons/related workers	27,778	27,917	29,818	31,718
51	Secretaries/personal assistants	33,401	34,450	36,686	38,923
59	Other advanced clerical/service workers	36,036	36,274	38,597	40,920
61	Intermediate clerical workers	31,546	32,808	33,984	35,160
62	Intermediate sales/related workers	33,158	33,614	34,726	35,837
63	Intermediate service workers	28,646	29,962	30,444	30,926
71	Intermediate plant operators	33,922	35,875	36,427	36,979
72	Intermediate machine operators	26,789	27,518	28,776	30,034
73	Road/rail transport drivers	30,439	32,822	34,812	36,802
79	Other intermediate production/transport workers	30,499	31,378	32,126	32,875
81	Elementary clerks	30,401	28,642	31,824	35,006
82	Elementary sales workers	27,199	28,229	29,018	29,808
83	Elementary service workers	27,509	27,643	29,578	31,512

Continued

		Female ($)			
Code	Classification	2001	2002	2003	2004
91	Cleaners	26,522	27,581	28,248	28,915
92	Factory labourers	28,690	29,822	31,234	32,645
99	Other labourers/related workers	27,703	27,907	29,460	31,013
211	Natural/physical science professionals	43,718	41,352	44,878	48,403
212	Building/engineering professionals	47,774	45,350	47,887	50,424
221	Accountants, auditors/corporate treasurers	41,410	44,213	44,165	44,117
222	Sales, marketing/advertising professionals	43,927	47,256	48,696	50,136
223	Computing professionals	54,638	55,142	56,954	58,766
229	Miscellaneous business/information professionals	42,929	44,045	46,637	49,229
231	Medical practitioners	68,513	70,848	74,834	78,821
232	Nursing professionals	44,287	46,037	48,043	50,050
238	Miscellaneous health professionals	46,939	49,354	50,954	52,555
241	School teachers	43,901	45,648	47,599	49,550
242	University/vocational education teachers	50,666	52,243	53,942	55,642
249	Miscellaneous education professionals	43,272	43,162	45,523	47,885
251	Social welfare professionals	39,739	39,312	41,244	43,176
252	Miscellaneous social professionals	48,643	48,192	50,854	53,515
253	Artists/related professionals	39,240	42,235	41,885	41,534
254	Miscellaneous professionals	44,904	43,349	44,194	45,038
311	Medical/science technical officers	34,598	34,982	35,578	36,173
312	Building/engineering professionals	40,826	42,682	41,995	41,309
321	Finance professionals	42,840	44,290	45,943	47,597
329	Miscellaneous business/administration professionals	38,191	40,939	41,786	42,634
331	Shop managers	33,079	32,352	33,830	35,309
332	Hospitality/accommodation managers	32,436	32,525	34,814	37,104
339	Miscellaneous managing supervisors (sales/service)	40,337	45,643	43,718	41,794
341	Enrolled nurses	34,145	34,862	35,261	35,659
342	Welfare professionals	36,384	36,562	37,661	38,760
349	Miscellaneous health/welfare professionals	35,162	38,486	41,064	43,642
391	Police officers	44,671	45,221	47,489	49,757
399	Miscellaneous professionals	36,283	36,125	37,591	39,058
411	Mechanical engineering tradespersons	41,558	43,670	43,474	43,277
412	Fabrication engineering tradespersons	38,827	46,742	47,738	48,734
421	Automotive tradespersons	30,782	37,877	39,475	41,074
431	Electrical/electronics tradespersons	35,880	41,890	42,130	42,370
441	Structural construction tradespersons	17,054	34,109	50,354	66,600
442	Final finishes construction tradespersons	0	0	0	0
443	Plumbers	0	0	0	0
451	Food tradespersons	30,814	33,989	32,527	31,066
461	Skilled agricultural workers	0	45,586	42,456	39,326

Continued

Code	Classification	Female ($) 2001	2002	2003	2004
462	Horticultural tradespersons	28,565	27,619	25,442	23,266
491	Printing tradespersons	29,347	31,008	34,471	37,934
492	Wood tradespersons	0	0	0	0
493	Hairdressers	25,826	25,118	25,901	26,683
494	Textile, clothing/related tradespersons	28,104	28,982	32,186	35,390
498	Miscellaneous tradespersons/related workers	35,722	35,928	38,614	41,299
511	Secretaries/personal assistants	33,401	34,450	36,686	38,923
591	Advanced numerical clerks	34,610	35,669	37,169	38,669
599	Miscellaneous advanced clerical/service workers	37,531	37,258	40,625	43,992
611	General clerks	31,445	32,520	33,595	34,670
612	Keyboard operators	30,468	31,162	31,942	32,722
613	Receptionists	27,984	29,870	30,650	31,430
614	Intermediate numerical clerks	31,958	33,288	34,745	36,202
615	Material recording/despatching clerks	33,082	34,018	35,722	37,426
619	Miscellaneous intermediate clerical workers	34,080	35,078	36,358	37,637
621	Intermediate sales/related workers	33,158	33,614	34,726	35,837
631	Carers/aides	27,869	28,973	29,261	29,549
632	Hospitality workers	28,762	30,461	30,737	31,013
639	Miscellaneous intermediate service workers	29,902	31,166	31,874	32,582
711	Mobile plant operators	48,689	42,091	39,938	37,786
712	Intermediate stationary plant operators	31,493	34,382	35,422	36,461
721	Intermediate textile, clothing machine operators	25,435	26,160	27,276	28,392
729	Miscellaneous intermediate machine operators	29,640	30,859	31,630	32,400
731	Road/rail transport Drivers	30,439	32,822	34,812	36,802
791	Intermediate mining/construction workers	63,019	66,614	73,817	81,019
799	Miscellaneous production/transport workers	29,525	29,918	30,571	31,224
811	Elementary clerks	30,401	28,642	31,824	35,006
821	Sales assistants	26,762	27,974	28,560	29,146
829	Miscellaneous elementary sales workers	29,004	29,083	30,682	32,280
831	Elementary service workers	27,509	27,643	29,578	31,512
911	Cleaners	26,522	27,581	28,248	28,915
921	Process workers	28,807	29,890	31,812	33,734
922	Product packagers	28,505	29,726	30,470	31,214
991	Mining, construction/related labourers	37,975	43,901	48,442	52,982
992	Agricultural/horticultural labourers	25,877	24,869	26,710	28,550
993	Elementary food preparation/related workers	27,257	26,870	28,476	30,082
999	Miscellaneous labourers/related workers	26,508	26,683	29,131	31,579
1311-11	Mixed Crop/Livestock Farmers	24,048	20,708	19,296	23,616
1312-11	Mixed Livestock Farmers	25,392	33,726	30,288	33,600
1312-12	Beef Cattle Farmers	25,968	34,491	31,008	34,368

Continued

		Female ($)			
Code	Classification	2001	2002	2003	2004
1312-15	Dairy Farmers	29,280	38,890	34,944	38,736
1312-17	Sheep Farmers	24,048	31,941	28,704	31,824
1312-19	Pig Farmers	30,720	40,803	36,672	40,656
1312-21	Poultry Farmers	31,248	41,504	37,296	41,376
1312-23	Horse Breeders	27,888	37,041	33,264	36,912
1312-25	Apiarists	23,952	31,813	28,560	31,680
1312-79	Livestock Farmers nec	22,512	29,901	26,880	29,808
1313-11	Grain, Oilseed/Pasture Grower	25,824	21,508	25,056	23,280
1313-13	Sugar Cane Grower	20,976	17,470	20,352	18,912
1313-15	Tobacco Grower	20,640	17,190	20,016	18,624
1313-17	Fruit/Nut Grower	27,504	22,907	26,688	24,816
1313-19	Vegetable Grower	23,664	19,709	22,944	21,360
1313-21	Flower Grower	22,176	18,470	21,504	20,016
1313-79	Crop Farmers nec	29,280	24,386	28,368	26,400
1314-11	Aquaculture Farmers	28,704	30,897	31,392	32,160
4611-11	Farm Overseer	30,096	28,230	31,200	30,960
4612-11	Shearer	30,192	28,320	31,296	31,104
4613-11	Wool Classer	27,120	25,438	28,128	27,936
9921-11	General Farm Hand	22,080	24,120	24,000	25,872
9921-13	Fruit, Vegetable or Nut Farm Hand	21,312	23,280	23,184	24,960
9921-15	Stud Hand or Stable Hand	20,352	22,233	22,128	23,808
9921-17	Shearing Shed Hand	20,736	22,652	22,560	24,288
9921-79	Farm Hands nec	23,472	25,641	25,536	27,504

Appendix 1C: Employee benefits as per cent of earnings

2002–03		**Benefits**		
Industry	**Earnings ($m)**	**Super ($m)**	**FBT ($m)**	**Per cent of Earnings**
Mining	6,181	459	129	8.7
Manufacturing	44,201	3,679	532	8.7
Electricity, gas and water supply	3,672	324	41	9.0
Construction	17,113	1,479	87	8.4
Wholesale trade	18,511	1,669	394	10.0
Retail trade	26,725	2,189	138	8.0
Accommodation, cafes and restaurants	10,021	822	39	7.9
Transport and storage	13,787	1,175	87	8.4
Communication services	6,703	194	83	4.0
Finance and insurance	19,177	1,327	340	8.0
Property and business services	45,544	4,305	382	9.3
Government administration and defence	18,222	1,963	120	10.3
Education	27,235	2,842	102	9.8
Health and community services	32,498	2,942	77	8.5
Cultural and recreational services	6,214	521	54	8.5
Personal and other services	10,804	1,041	70	9.3
All industries	306,609	26,930	2,675	8.8

Appendix 1D: Age adjustment, by gender

Age	Males				Females			
	2001	**2002**	**2003**	**2004**	**2001**	**2002**	**2003**	**2004**
15	0.259	0.259	0.235	0.235	0.165	0.165	0.156	0.156
16	0.311	0.311	0.285	0.285	0.241	0.241	0.230	0.230
17	0.363	0.363	0.335	0.335	0.316	0.316	0.303	0.303
18	0.415	0.415	0.386	0.386	0.391	0.391	0.377	0.377
19	0.466	0.466	0.436	0.436	0.466	0.466	0.451	0.451
20	0.572	0.572	0.558	0.558	0.572	0.572	0.558	0.558
21	0.667	0.667	0.656	0.656	0.667	0.667	0.656	0.656
22	0.751	0.751	0.741	0.741	0.751	0.751	0.741	0.741
23	0.823	0.823	0.815	0.815	0.823	0.823	0.815	0.815
24	0.886	0.886	0.879	0.879	0.886	0.886	0.879	0.879
25	0.940	0.940	0.934	0.934	0.940	0.940	0.934	0.934
26	0.985	0.985	0.980	0.980	0.985	0.985	0.980	0.980
27	1.024	1.024	1.019	1.019	1.024	1.024	1.019	1.019
28	1.056	1.056	1.051	1.051	1.056	1.056	1.051	1.051
29	1.082	1.082	1.078	1.078	1.082	1.082	1.078	1.078
30	1.104	1.104	1.099	1.099	1.104	1.104	1.099	1.099
31	1.121	1.121	1.116	1.116	1.121	1.121	1.116	1.116
32	1.134	1.134	1.129	1.129	1.134	1.134	1.129	1.129
33	1.145	1.145	1.139	1.139	1.145	1.145	1.139	1.139
34	1.152	1.152	1.147	1.147	1.152	1.152	1.147	1.147
35	1.158	1.158	1.152	1.152	1.158	1.158	1.152	1.152
36	1.162	1.162	1.156	1.156	1.162	1.162	1.156	1.156
37	1.165	1.165	1.159	1.159	1.165	1.165	1.159	1.159
38	1.167	1.167	1.160	1.160	1.167	1.167	1.160	1.160
39	1.169	1.169	1.161	1.161	1.169	1.169	1.161	1.161
40	1.170	1.170	1.162	1.162	1.170	1.170	1.162	1.162
41	1.171	1.171	1.163	1.163	1.171	1.171	1.163	1.163
42	1.172	1.172	1.164	1.164	1.172	1.172	1.164	1.164
43	1.174	1.174	1.165	1.165	1.174	1.174	1.165	1.165
44	1.175	1.175	1.167	1.167	1.175	1.175	1.167	1.167
45	1.177	1.177	1.169	1.169	1.177	1.177	1.169	1.169
46	1.179	1.179	1.171	1.171	1.179	1.179	1.171	1.171
47	1.182	1.182	1.174	1.174	1.182	1.182	1.174	1.174
48	1.184	1.184	1.177	1.177	1.184	1.184	1.177	1.177
49	1.187	1.187	1.180	1.180	1.187	1.187	1.180	1.180
50	1.189	1.189	1.182	1.182	1.189	1.189	1.182	1.182
51	1.191	1.191	1.185	1.185	1.191	1.191	1.185	1.185
52	1.192	1.192	1.187	1.187	1.192	1.192	1.187	1.187
53	1.192	1.192	1.187	1.187	1.192	1.192	1.187	1.187
54	1.190	1.190	1.187	1.187	1.190	1.190	1.187	1.187
55	1.187	1.187	1.184	1.184	1.187	1.187	1.184	1.184
56	1.181	1.181	1.179	1.179	1.181	1.181	1.179	1.179
57	1.172	1.172	1.172	1.172	1.172	1.172	1.172	1.172
58	1.160	1.160	1.161	1.161	1.160	1.160	1.161	1.161
59	1.144	1.144	1.146	1.146	1.144	1.144	1.146	1.146
60	1.123	1.123	1.126	1.126	1.123	1.123	1.126	1.126

Continued

Age	Males				Females			
	2001	2002	2003	2004	2001	2002	2003	2004
61	1.096	1.096	1.102	1.102	1.096	1.096	1.102	1.102
62	1.064	1.064	1.070	1.070	1.064	1.064	1.070	1.070
63	1.024	1.024	1.032	1.032	1.024	1.024	1.032	1.032
64	0.977	0.977	0.987	0.987	0.977	0.977	0.987	0.987
65	0.921	0.921	0.932	0.932	0.921	0.921	0.932	0.932
66	0.855	0.855	0.868	0.868	0.855	0.855	0.868	0.868
67	0.779	0.779	0.793	0.793	0.779	0.779	0.793	0.793
68	0.691	0.691	0.707	0.707	0.691	0.691	0.707	0.707
69	0.591	0.591	0.608	0.608	0.591	0.591	0.608	0.608
70	0.477	0.477	0.495	0.495	0.477	0.477	0.495	0.495

Appendix 1E: Life-Cycle wage growth rate, by age, gender

	Male		Female			Male		Female	
Age	2001-02	2003-04	2001-02	2003-04	Age	2001-02	2003-04	2001-02	2003-04
16	1.2005	1.2152	1.4558	1.4726	44	1.0014	1.0013	1.0014	1.0013
17	1.1670	1.1771	1.3131	1.3209	45	1.0016	1.0017	1.0016	1.0017
18	1.1431	1.1504	1.2384	1.2430	46	1.0019	1.0020	1.0019	1.0020
19	1.1252	1.1308	1.1925	1.1955	47	1.0020	1.0023	1.0020	1.0023
20	1.2254	1.2795	1.2255	1.2384	48	1.0021	1.0024	1.0021	1.0024
21	1.1671	1.1747	1.1671	1.1747	49	1.0021	1.0025	1.0021	1.0025
22	1.1253	1.1300	1.1253	1.1300	50	1.0019	1.0024	1.0019	1.0024
23	1.0968	1.0999	1.0968	1.0999	51	1.0015	1.0020	1.0015	1.0020
24	1.0762	1.0783	1.0762	1.0783	52	1.0009	1.0015	1.0009	1.0015
25	1.0607	1.0621	1.0607	1.0621	53	0.9999	1.0006	0.9999	1.0006
26	1.0486	1.0496	1.0486	1.0496	54	0.9987	0.9995	0.9987	0.9995
27	1.0390	1.0397	1.0390	1.0397	55	0.9971	0.9979	0.9971	0.9979
28	1.0313	1.0317	1.0313	1.0317	56	0.9951	0.9960	0.9951	0.9960
29	1.0249	1.0252	1.0249	1.0252	57	0.9926	0.9936	0.9926	0.9936
30	1.0198	1.0198	1.0198	1.0198	58	0.9896	0.9907	0.9896	0.9907
31	1.0155	1.0155	1.0155	1.0155	59	0.9860	0.9871	0.9860	0.9871
32	1.0120	1.0119	1.0120	1.0119	60	0.9817	0.9829	0.9817	0.9829
33	1.0091	1.0089	1.0091	1.0089	61	0.9765	0.9778	0.9765	0.9778
34	1.0068	1.0066	1.0068	1.0066	62	0.9703	0.9718	0.9703	0.9718
35	1.0050	1.0047	1.0050	1.0047	63	0.9629	0.9645	0.9629	0.9645
36	1.0036	1.0033	1.0036	1.0033	64	0.9538	0.9557	0.9538	0.9557
37	1.0025	1.0022	1.0025	1.0022	65	0.9427	0.9448	0.9427	0.9448
38	1.0018	1.0015	1.0018	1.0015	66	0.9288	0.9313	0.9288	0.9313
39	1.0013	1.0010	1.0013	1.0010	67	0.9110	0.9140	0.9110	0.9140
40	1.0010	1.0008	1.0010	1.0008	68	0.8874	0.8912	0.8874	0.8912
41	1.0009	1.0007	1.0009	1.0007	69	0.8548	0.8599	0.8548	0.8599
42	1.0010	1.0008	1.0010	1.0008	70	0.8068	0.8143	0.8068	0.8143
43	1.0011	1.0011	1.0011	1.0011					

Appendix 1F: Gross Domestic Product (GDP) Deflator

	Target Year							
Death Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
2001	1.0000	0.9634	0.9335	0.8976	0.8732	0.8477	0.8207	0.7919
2002	1.0380	1.0000	0.9690	0.9317	0.9063	0.8799	0.8518	0.8220
2003	1.0712	1.0320	1.0000	0.9615	0.9353	0.9081	0.8791	0.8483
2004	1.1141	1.0733	1.0400	1.0000	0.9728	0.9444	0.9143	0.8823
2005	1.1453	1.1033	1.0691	1.0280	1.0000	0.9709	0.9399	0.9070
2006	1.1796	1.1364	1.1012	1.0588	1.0300	1.0000	0.9681	0.9342
2007	1.2185	1.1739	1.1375	1.0938	1.0640	1.0330	1.0000	0.9650
2008	1.2627	1.2165	1.1788	1.1334	1.1026	1.0704	1.0362	1.0000

Appendix 1G: Employment cost index, wages and benefits

	Employment Cost Index	
	Wages	**Benefits**
2001	1.03436	1.03436
2002	1.03322	1.03212
2003	1.03430	1.03541
2004	1.03627	1.03627

Appendix 1H: Value of household production, by age, gender

Age	Male ($)				Female ($)			
	2001	2002	2003	2004	2001	2002	2003	2004
15	10,498	10,486	10,779	11,069	12,581	12,741	13,510	14,266
16	12,872	12,857	13,216	13,572	15,194	15,386	16,315	17,228
17	15,245	15,228	15,653	16,074	17,806	18,031	19,120	20,190
18	17,619	17,599	18,091	18,577	20,418	20,676	21,925	23,151
19	19,993	19,970	20,528	21,080	23,030	23,322	24,730	26,113
20	22,366	22,341	22,965	23,583	25,642	25,967	27,535	29,075
21	20,173	20,150	20,713	21,270	25,274	25,595	27,140	28,658
22	18,611	18,590	19,109	19,624	25,537	25,860	27,422	28,956
23	17,573	17,553	18,043	18,528	26,261	26,594	28,200	29,778
24	16,960	16,941	17,414	17,883	27,305	27,651	29,321	30,961
25	16,689	16,670	17,136	17,597	28,546	28,908	30,653	32,368
26	16,683	16,664	17,130	17,591	29,882	30,260	32,088	33,883
27	16,878	16,858	17,329	17,795	31,228	31,624	33,534	35,409
28	17,215	17,195	17,675	18,151	32,518	32,930	34,918	36,871
29	17,646	17,626	18,118	18,606	33,697	34,124	36,185	38,209
30	18,131	18,110	18,616	19,117	34,728	35,168	37,292	39,378
31	18,634	18,613	19,133	19,647	35,582	36,033	38,208	40,346
32	19,129	19,107	19,641	20,169	36,241	36,701	38,917	41,094
33	19,593	19,571	20,117	20,659	36,699	37,165	39,409	41,613
34	20,010	19,988	20,546	21,099	36,956	37,424	39,684	41,904
35	20,369	20,346	20,914	21,477	37,017	37,486	39,750	41,973
36	20,661	20,637	21,214	21,784	36,895	37,363	39,619	41,835
37	20,883	20,859	21,442	22,019	36,608	37,072	39,310	41,509
38	21,034	21,011	21,597	22,178	36,175	36,633	38,845	41,018
39	21,118	21,094	21,683	22,266	35,619	36,070	38,249	40,388
40	21,138	21,114	21,704	22,288	34,966	35,409	37,547	39,647
41	21,102	21,078	21,667	22,250	34,240	34,674	36,768	38,825
42	21,018	20,994	21,581	22,161	33,469	33,893	35,940	37,950
43	20,896	20,873	21,456	22,033	32,677	33,091	35,089	37,052
44	20,747	20,724	21,302	21,875	31,889	32,293	34,243	36,159
45	20,582	20,558	21,132	21,701	31,127	31,522	33,425	35,295
46	20,412	20,389	20,958	21,522	30,413	30,799	32,659	34,486
47	20,249	20,226	20,791	21,350	29,765	30,143	31,963	33,751
48	20,104	20,081	20,642	21,197	29,199	29,569	31,354	33,108
49	19,988	19,965	20,522	21,075	28,726	29,090	30,847	32,572
50	19,910	19,887	20,443	20,993	28,356	28,715	30,450	32,153
51	19,880	19,857	20,412	20,961	28,095	28,451	30,169	31,857
52	19,905	19,882	20,437	20,987	27,945	28,299	30,008	31,686

Continued

	Male ($)				Female ($)			
Age	**2001**	**2002**	**2003**	**2004**	**2001**	**2002**	**2003**	**2004**
53	19,991	19,969	20,526	21,079	27,904	28,258	29,965	31,641
54	20,144	20,121	20,683	21,240	27,969	28,323	30,034	31,714
55	20,367	20,343	20,912	21,474	28,130	28,487	30,207	31,897
56	20,660	20,636	21,213	21,783	28,377	28,737	30,472	32,176
57	21,023	20,999	21,586	22,167	28,695	29,059	30,814	32,537
58	21,455	21,430	22,029	22,622	29,068	29,436	31,214	32,960
59	21,950	21,925	22,537	23,144	29,476	29,849	31,652	33,422
60	22,502	22,477	23,104	23,726	29,898	30,277	32,106	33,902
61	23,103	23,077	23,721	24,360	30,314	30,698	32,552	34,373
62	23,743	23,716	24,378	25,034	30,699	31,088	32,965	34,809
63	24,407	24,380	25,061	25,735	31,031	31,424	33,322	35,186
64	25,084	25,055	25,755	26,448	31,288	31,685	33,598	35,477
65	25,754	25,725	26,444	27,155	31,449	31,848	33,771	35,660
66	26,402	26,372	27,108	27,838	31,496	31,895	33,821	35,713
67	27,006	26,975	27,728	28,475	31,413	31,811	33,732	35,619
68	27,545	27,514	28,282	29,043	31,189	31,584	33,492	35,365
69	27,996	27,964	28,745	29,518	30,819	31,209	33,094	34,945
70	28,334	28,302	29,093	29,875	30,302	30,686	32,539	34,359
71	28,535	28,503	29,299	30,087	29,646	30,021	31,834	33,615
72	28,572	28,539	29,336	30,125	28,868	29,233	30,999	32,733
73	28,417	28,384	29,177	29,962	27,993	28,348	30,060	31,742
74	28,043	28,011	28,793	29,568	27,061	27,404	29,059	30,684
75	27,422	27,391	28,156	28,913	26,121	26,452	28,049	29,618
76	26,527	26,497	27,237	27,970	25,180	25,500	27,039	28,552
77	0	0	0	0	24,240	24,547	26,030	27,486
78	0	0	0	0	23,300	23,595	25,020	26,420
79	0	0	0	0	22,360	22,643	24,010	25,353
80	0	0	0	0	21,419	21,691	23,001	24,287
81	0	0	0	0	20,479	20,739	21,991	23,221

Appendix 1I: Workers' compensation death payments, by age

Age	Payment ($)	Age	Payment ($)
18	104,875	47	263,225
19	104,875	48	263,225
20	28,825	49	263,225
21	28,825	50	223,200
22	28,825	51	223,200
23	28,825	52	223,200
24	28,825	53	223,200
25	121,325	54	223,200
26	121,325	55	210,300
27	121,325	56	210,300
28	121,325	57	210,300
29	121,325	58	210,300
30	268,225	59	210,300
31	268,225	60	246,400
32	268,225	61	246,400
33	268,225	62	246,400
34	268,225	63	246,400
35	261,975	64	246,400
36	261,975	65	328,275
37	261,975	66	328,275
38	261,975	67	328,275
39	261,975	68	328,275
40	252,825	69	328,275
41	252,825	70	328,275
42	252,825	71	328,275
43	252,825	72	328,275
44	252,825	73	328,275
45	263,225	74	328,275
46	263,225	75	328,275

Appendix 1J: Other direct costs

	Ambulance	Emergency Dept	ICU/day	Coronial	Funeral	Police	Workers Comp
2001	432	831	2,579	1,277	3,200	6,867	2,791
2002	426	783	2,670	1,374	3,264	7,075	2,876
2003	433	996	2,769	1,594	3,329	7,242	2,944
2004	454	1,000	2,867	1,634	3,396	7,430	3,020

Appendix 2A: Information Package

AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY

CONSENT FORM

Farm Safety Studies

- I agree to participate in the above research project and give my consent freely.
- I understand that the project will be conducted as described in the Participant Information Statement, a copy of which I have read and retained.
- I understand that I can withdraw from the project at any time and do not have to give any reason for withdrawing.
- I consent to:

  ❑ Complete two questionnaire booklets; in DATE and DATE.

- I understand that my personal information will remain confidential to the researchers.
- I have had the opportunity to have questions answered to my satisfaction.

Name: ____

Property Name: ____

Address: ____

____

Telephone: ________________________

Signature: ________________________ Date: ______________

Australian Centre for Agricultural Health and Safety
University of Sydney
PO Box 256
Moree NSW 2400

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Email: nfidc@health.usyd.edu.au

AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY

PARTICIPANT INFORMATION STATEMENT

Farm Safety Studies

You are invited to participate in the Farm Safety Studies project, a study funded by the Farm Health and Safety Joint Research Venture, which is being conducted by the Australian Centre for Agricultural Health and Safety (ACAHS) in Moree. ACAHS is a research centre of the University of Sydney.

What is the study about?
The study aims to identify health and safety problems in agriculture, to determine the cost-effectiveness of on-farm OHS interventions and to investigate the effectiveness of industry and government policy and programs. The data collected in the study will develop:

- ☑ A profile of perceptions, attitudes, behaviours of farmers to health and safety
- ☑ A profile of the prevalence of key OHS risk factors of importance to industry
- ☑ A benchmarking system to assist farmers in monitoring their own OHS performance within the industry.

Who is carrying out the study?
The study is being conducted by:

- ☑ Associate Professor Lyn Fragar, Australian Centre for Agricultural Health and Safety, University of Sydney, Moree.
- ☑ Professor Brian Kelly, Centre for Rural and Remote Mental Health, University of Newcastle, Orange.
- ☑ Associate Professor Jeff Fuller, Northern Rivers University Department of Rural Health, University of Sydney, Lismore.
- ☑ Kirrily Pollock, Australian Centre for Agricultural Health and Safety, University of Sydney, Moree.

What does the study involve?
The study will involve the completion of two questionnaires, the first in DATE and then another following in DATE.

How much time will the study take?
The time taken to complete each questionnaire will be a <u>maximum</u> of 20 to 30 minutes.

How have I been selected?
Ten Statistical Local Areas (SLAs) have been randomly selected throughout NSW, with all farmers in those SLAs invited by mail to participate in the study.

NATIONAL FARM INJURY DATA CENTRE
AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY
PO BOX 256 MOREE NSW 2400
nfidc@health.usyd.edu.au
PH: 02 6752 8215 FAX: 02 6752 6639

Can I withdraw from the study?
Being in this study is completely voluntary - you are not under any obligation to consent and you may withdraw at any time without penalty or prejudice.

Will anyone else know the results?
All data provided by you will be identified with a unique code. No identifying data such as your name and address will appear in the questionnaire. You will be provided with an envelope to return your questionnaire, which will be addressed to a dedicated member of the research team in Moree. The questionnaires and returned consent forms will be stored securely in a locked metal filing cabinet at Moree until data collection is complete. They will then be stored securely at the Australian Centre for Agricultural Health and Safety, only accessible to the researchers listed above. Survey information that is entered onto computer for analysis, will be password protected. All records will be retained for 7 years after completion of the project and then destroyed confidentially as per University of Sydney guidelines. A report of the study will be submitted for publication, but individual participants will not be identifiable in such a report.

Will the study benefit me?
The study provides the opportunity to have your say on how working in agriculture impacts on the health and safety of you, your family and your workers and to contribute to the direction of future farm health and safety initiatives. It will also enable you to benchmark your own farm OHS performance relative to industry averages.

Can I tell other people about the study?
Yes! If you know any other grains, beef, sheep and wool or cotton farmers in your local area who would be interested in joining the study, please don't hesitate to contact us on (02) 6752 8215.

What if I require further information?
If at any stage you would like to know more about the study, please feel free to contact the Australian Centre for Agricultural Health and Safety on (02) 6752 8215.

What do you need to do to participate?
Please read this Information Statement and be sure you understand its contents before you consent to participate. We ask you to complete the enclosed Consent Form and return it with the completed questionnaire in the reply paid envelope provided.

What if I have a complaint or concerns?

Any person with concerns or complaints about the conduct of this research study can contact the Manager, Ethics Administration, University of Sydney on

Phone: (02) 9351 4811
Email: gbriody@mail.usyd.edu.au

This project has been approved by the University's Human Research Ethics Committee, Approval No. 02-2006/1/8854.

This information sheet is for you to keep

AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY

IMPORTANT NOTE

~ SAFETY BENCHMARKING ~

Participating in the first round of the Farm Safety Studies Project will enable us to send back information on the safety performance of <u>your</u> business, relative to those in your region, industry and across all study participants – which you will be able to monitor over time.

You will be eligible to receive the Ag Health Benchmarking Newsletter, containing up to date information on industry safety performance, risk management recommendations and new data arising from the Ag Health Benchmarking Groups.

The survey will NOT be time consuming. It offers you the chance to have your say on health and safety in Australian agriculture and also the opportunity to gain better understanding of your business safety performance.

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AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY

CONSENT FORM

Farm Safety Studies

- I agree to participate in the above research project and give my consent freely.
- I understand that the project will be conducted as described in the Participant Information Statement, a copy of which I have read and retained.
- I understand that I can withdraw from the project at any time and do not have to give any reason for withdrawing.
- I consent to:

  ❑ Complete two questionnaire booklets; in DATE and DATE.

- I understand that my personal information will remain confidential to the researchers.
- I have had the opportunity to have questions answered to my satisfaction.

Name: ______________________________

Property Name: ______________________________

Address: ______________________________

____

Telephone: ____________________

Signature: ____________________ Date: ______________

Australian Centre for Agricultural Health and Safety
University of Sydney
PO Box 256
Moree NSW 2400

Phone: 02 6752 8210
Fax: 02 6752 6639

Email: nfidc@health.usyd.edu.au

Appendix 2B: Questionnaire

ID No:

AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY

FARM SAFETY STUDIES

PHASE 1

INSTRUCTIONS

Please complete all questions.

Section 1:
You can select your desired answer by placing a cross in the relevant box(es). Please also fill in the text answers.

Section 2-4:
Please select desired response by placing a cross through the relevant circle.

Section 5:
Please note down any changes you have made to farm safety practices.

Section 6:
There are four Injury Sheets included in this booklet. Please complete a sheet for each incident that required either medical attention or a full day off work/school. If you require additional sheets, please don't hesitate to contact us on (02) 6752 8215.

Please return the completed questionnaire to the Australian Centre for Agricultural Health and Safety in the reply paid envelope provided.

Thank you for your time.

The University of Sydney

NATIONAL FARM INJURY DATA CENTRE
AUSTRALIAN CENTRE FOR AGRICULTURAL HEALTH AND SAFETY
PO BOX 256 MOREE NSW 2400
kimlyp@health.usyd.edu.au
PH: 02 6752 8215
FAX: 02 6752 6639

SECTION 1 – DEMOGRAPHICS

1. Sex: ☐ Male ☐ Female

2. Position on Farm: ……………………………………………………

3. Age Group: ☐ 18-19 ☐ 20-24 ☐ 25-29 ☐ 30-34 ☐ 35-39 ☐ 40-44 ☐ 45-49 ☐ 50-54 ☐ 55-60 ☐ 60-64 ☐ 65 yrs plus

4. Farm Enterprises (*select all applicable*)

   ☐ Grains: …………… Ha ☐ Cattle: …………… Hd

   ☐ Cotton: …………… Ha ☐ Sheep: …………… Hd

   ☐ Cane: …………… Ha ☐ Dairy: …………… Hd

   ☐ Horticulture – *Please specify:* ……………………………………………………

   ☐ Other – *Please specify:* ……………………………………………………………

5. No. of full time employees: ……………………………………………………………………………

6. No. of full time employees that are family: ……………………………………………………………

7. No. of part-time employees (over a 12 month period): …………………………………………………

8. No. of part-time employees that are family members: ………………………………………………

9. Best estimate of total number of days worked annually by part-time employees: ………………..

10. No. of contractors (*Please list type and number. Eg. 3 Shearers, 1 Spray Contractor*):
………
………
………

11. No. households on property: ………………………………………………………………………

12. Do children under 15: ☐ Reside on the farm (*Please specify number*): ………………………

    ☐ Regularly visit the farm.

SECTION 2 – SAFETY CLIMATE

	Yes	To some extent	No	Not sure
1. It costs too much to be committed to farm safety	○	○	○	○
2. It takes too much time out from work to be committed to farm safety	○	○	○	○
3. Farm safety is too difficult and complicated for us to tackle	○	○	○	○
4. Farm safety improves farm productivity	○	○	○	○
5. Farm safety helps employees become more responsible in their work	○	○	○	○
6. We provide adequate safety training for workers on our farm	○	○	○	○
7. The effectiveness of farm safety lies mainly with our workers	○	○	○	○
8. Managing safety on our farm is as important as profit	○	○	○	○
9. Everybody works safely on our farm	○	○	○	○
10. The owners, managers and/or partners all play a part in farm safety	○	○	○	○
11. I have operated machinery that was not fitted with the right safety features	○	○	○	○
12. I have not worked safely because I didn't know the risks involved at the time	○	○	○	○
13. I have not worked safely because safety was not part of my farm training or upbringing.	○	○	○	○
14. I have not worked safely because I needed to get the job done quickly	○	○	○	○
15. I have not worked safely because replacing the guard was a hassle	○	○	○	○
16. If I worried about safety all the time I would not get my job done	○	○	○	○
17. I cannot avoid taking risks in my job	○	○	○	○
18. Accidents will happen no matter what I do	○	○	○	○
19. Not all accidents are preventable, some people are just unlucky	○	○	○	○
20. People who work to safety procedures will always be safe	○	○	○	○

SECTION 3 – SAFETY MANAGEMENT

	Yes	To some extent	No	Not sure
1. This farm allocates resources to safety	○	○	○	○
1.1 On this farm, the routine monthly percent allocation of time to safety is…	*Estimate of management/worker time:* ______ %			
2. All individuals who work on the farm know their responsibilities for safety	○	○	○	○
3. Safety responsibilities of the business partners and managers are clearly defined and understood	○	○	○	○
4. Safety responsibilities of employees are included in duty statements	○	○	○	○
5. Responsibility for supervision of safe work is specified	○	○	○	○
6. All employees **AND** contractors receive safety induction before starting work	○	○	○	○
7. All employees receive safety induction to all hazardous jobs before starting that job on the farm	○	○	○	○
8. All those who work on the farm are actively involved in the farm's safety program	○	○	○	○
9. Safety is on the agenda of regular meetings held between employer and employees	○	○	○	○
10. Training has been undertaken for all current workers in safety risk management	○	○	○	○
11. All those who work on the farm actively report *unsafe situations* and *unsafe acts* to the employer or manager of the workplace	○	○	○	○
12. Action is taken following all reports of *unsafe situations* and *unsafe acts* reported	○	○	○	○
13. Regular hazard inspections are undertaken for all parts of the farm workplace	○	○	○	○
14. Hazard inspections are scheduled for ensuring the safety of workers before key seasonal activity begins	○	○	○	○
15. Safety risk assessment is a key part of the investigation of all new equipment for the farm	○	○	○	○
16. A farm safety business plan is in operation with clear timelines and budget	○	○	○	○
17. Short term and long term plans are included in the action plan	○	○	○	○
18. Safety risks on the farm are managed mostly by rules for doing the job safely.	○	○	○	○
19. Engineering solutions can mostly be found to manage safety risk	○	○	○	○

	Yes	To some extent	No	Not sure
20. There are safety rules for keeping guards in place and in good condition	○	○	○	○
21. The personal protective equipment (PPE) that is necessary for safe work is available for all relevant jobs on the farm	○	○	○	○
22. Helmets are always worn when any worker rides the ATV, farm motorcycle or horse	○	○	○	○
23. Ear muffs or plugs are always worn in the workshops when noisy work is being done	○	○	○	○
24. All family members, workers and contractors are aware of the emergency arrangements on the farm, including phone numbers	○	○	○	○
25. Arrangements for regular communication between farmers and workers during the day are in place	○	○	○	○
26. Safety information is available for all hazardous jobs on the farm	○	○	○	○
27. All workers can access the Operators Manual for all plant and equipment in use on the farm	○	○	○	○
28. Relevant safety training has been provided for all workers	○	○	○	○
29. Training has been undertaken by all workers engaged in pesticides application	○	○	○	○
30. Training has been undertaken by all current workers in safe ATV, motorcycle and tractor operation	○	○	○	○
31. Day-to-day records of reports of unsafe situations and unsafe acts are kept for planning action	○	○	○	○
32. Up-to-date records are available of pesticides held and used on the farm	○	○	○	○
33. Up-to-date records of worker and contractor safety induction are available	○	○	○	○
34. Up-to-date records of machine and equipment maintenance are available	○	○	○	○
35. Records of injury and near-miss accidents are kept and used to plan safer systems of work	○	○	○	○

SECTION 4 – MAJOR SAFETY HAZARDS

	Yes	To some extent	No	Not sure	N/A
1. All tractors on the farm are fitted with a ROPS that meets Australian standards	○	○	○	○	○
1.1 How many tractors are in operation on the farm?	*Number:* ______				
1.2 How many are fitted with a ROPS that meets Australian standards?	*Number:* ______				
2. All tractors on the farm are fitted with a tractor PTO masterguard	○	○	○	○	○
2.1 How many are fitted with an undamaged tractor PTO masterguard?	*Number:* ______				
3. All PTO shafts on tractor powered equipment are protected by an undamaged PTO shaft guard	○	○	○	○	○
3.1 How many PTO powered items of equipment are in use on the farm?	*Number:* ______				
3.2 How many are fitted with undamaged PTO shaft guards?	*Number:* ______				
4. Bench grinders in the farm workshop are all fitted with undamaged guards	○	○	○	○	○
5. Intakes of all grain augers are effectively guarded so that hands or feet cannot be caught in the flight	○	○	○	○	○
6. A Residual Current Device is fitted into the electrical system of the farm workshop	○	○	○	○	○
7. Chemicals are stored in a separate locked area of the farm workplace, with access only by designated people	○	○	○	○	○
8. There is a securely fenced and gated play area around the home to protect children from injury in the farm workplace	○	○	○	○	○
9. All silos have systems that effectively prevent injury from falling from a height	○	○	○	○	○
10. Roads that are used by farm and contractor vehicles are in safe condition have set speed limits	○	○	○	○	○
11. It is an established and accepted rule that all adults and children must be properly restrained in any vehicle on the farm.	○	○	○	○	○
12. It is an established and accepted rule that no adult or child is to ride an ATV, motorcycle or horse without wearing a correctly fitted helmet	○	○	○	○	○
13. People handling pesticides on the farm always wear the PPE advised on the label	○	○	○	○	○
14. Ear muffs or plugs are always worn by workers and others when noisy work is undertaken in the workshop	○	○	○	○	○
15. Eye goggles are always used by people using grinders in the workshop	○	○	○	○	○

SECTION 5 –CHANGES IN FARM SAFETY PRACTICE

1. What changes have you made on your farm in the past 12 months to improve farm safety?

2. What prompted you to make these changes?

3. What do you see as the current safety risks or issues on your farm?

SECTION 6 – INJURY REPORTING

Please fill out an Injury Sheet for *each* incident that occurred on your farm in the last 12 months which resulted in an injury that:

a) Required medical attention (hospital, doctor's surgery, physiotherapy etc)

OR

b) Required at least one full day off work or school.

There are four Injury Sheets included in this booklet.

INJURY SHEET (1)

Age: ………….. Gender: …………… Position on Farm: ……………………………………..

Hospitalisation Required: ○ Yes ………… days / weeks / months ○ No

Time Off Work/School: ○ Yes ………… days / weeks / months ○ No

1. Nature of Injury:
   - ○ Soft Tissue – *Please circle: cut, puncture, bite, abrasion, penetrating wound, burn, bruise, bleeding, inflammation, foreign body, damage to major blood vessel, crushing injury*
   - ○ Bone/Tendon – *Please circle: fracture, dislocation, sprain/strain, amputation*
   - ○ Systemic/Other – *Please circle: poisoning, respiratory difficulty, electric shock, concussion, dental*
   - ○ Other – *Please specify:* ……………………………………………………………………………….
2. Bodily Location of injury:
   - ○ Head – *Please circle: eye, nose, mouth, ear, face, skull, neck*
   - ○ Upper extremity – *Please circle: collarbone, shoulder, arm, elbow, wrist, hand, fingers*
   - ○ Lower extremity – *Please circle: hip, upper leg, knee, lower leg, ankle, foot, toes*
   - ○ Trunk – *Please circle: ribs, spine, pelvis, chest, abdomen, back, genitalia, heart*
   - ○ Respiratory tract – *Please circle: larynx, trachea, lung*
   - ○ Digestive tract – *Please circle: oesophagus, stomach, bowel, colon, rectum, liver, spleen*
   - ○ Nervous system – *Please circle: brain, brain stem, spinal cord, peripheral nerve*
   - ○ Other – *Please specify:* ……………………………………………………………………………
3. Cause/Agent involved in injury:
   - ○ Farm Vehicle – *Please specify:* ……………………………………………………………………….
   - ○ Mobile Plant – *Please specify:* ……………………………………………………………………….
   - ○ Fixed Plant – *Please specify:* …………………………………………………………………………
   - ○ Workshop Equipment – *Please specify:* ………………………………………………………………
   - ○ Materials – *Please specify:* ……………………………………………………………………………
   - ○ Farm Structure – *Please specify:* ……………………………………………………………………….
   - ○ Animal – *Please specify:* ………………………………………………………………………………
   - ○ Farm Chemicals – *Please specify:* ……………………………………………………………………
   - ○ Other – *Please specify:* ……………………………………………………………………………….
4. Where did the accident take place? *Eg. Paddock, stockyard, windmill, dam, machinery shed, house yard.*
   ………
   ………
5. What was the injured person doing? *Eg. I was mustering cattle on the ag bike.*
   ………
   ………
   ………
6. What went wrong? *Eg. I didn't see the branch in the long grass and hit it at speed.*
   ………
   ………
   ………
   ………
7. What actually caused the injury? *Eg. A stick punctured my lower leg, resulting in 15 stitches.*
   ………
   ………
   ………
   ………

INJURY SHEET (2)

Age: ……………. Gender: …………… Position on Farm: ……………………………………..

Hospitalisation Required: ○ Yes …………. days / weeks / months ○ No

Time Off Work/School: ○ Yes …………. days / weeks / months ○ No

1. Nature of Injury:
   - ○ Soft Tissue – *Please circle: cut, puncture, bite, abrasion, penetrating wound, burn, bruise, bleeding, inflammation, foreign body, damage to major blood vessel, crushing injury*
   - ○ Bone/Tendon – *Please circle: fracture, dislocation, sprain/strain, amputation*
   - ○ Systemic/Other – *Please circle: poisoning, respiratory difficulty, electric shock, concussion, dental*
   - ○ Other – *Please specify:* ……………………………………………………………………………………….

2. Bodily Location of injury:
   - ○ Head – *Please circle: eye, nose, mouth, ear, face, skull, neck*
   - ○ Upper extremity – *Please circle: collarbone, shoulder, arm, elbow, wrist, hand, fingers*
   - ○ Lower extremity – *Please circle: hip, upper leg, knee, lower leg, ankle, foot, toes*
   - ○ Trunk – *Please circle: ribs, spine, pelvis, chest, abdomen, back, genitalia, heart*
   - ○ Respiratory tract – *Please circle: larynx, trachea, lung*
   - ○ Digestive tract – *Please circle: oesophagus, stomach, bowel, colon, rectum, liver, spleen*
   - ○ Nervous system – *Please circle: brain, brain stem, spinal cord, peripheral nerve*
   - ○ Other – *Please specify:* ……………………………………………………………………………………

3. Cause/Agent involved in injury:
   - ○ Farm Vehicle – *Please specify:* ………………………………………………………………………………
   - ○ Mobile Plant – *Please specify:* ………………………………………………………………………………
   - ○ Fixed Plant – *Please specify:* …………………………………………………………………………………
   - ○ Workshop Equipment – *Please specify:* …………………………………………………………………
   - ○ Materials – *Please specify:* ……………………………………………………………………………………
   - ○ Farm Structure – *Please specify:* ……………………………………………………………………………
   - ○ Animal – *Please specify:* ………………………………………………………………………………………
   - ○ Farm Chemicals – *Please specify:* …………………………………………………………………………
   - ○ Other – *Please specify:* …………………………………………………………………………………………

4. Where did the accident take place? *Eg. Paddock, stockyard, windmill, dam, machinery shed, house yard.*
……
……

5. What was the injured person doing? *Eg. I was mustering cattle on the ag bike.*
……
……
……

6. What went wrong? *Eg. I didn't see the branch in the long grass and hit it at speed.*
……
……
……
……

7. What actually caused the injury? *Eg. A stick punctured my lower leg, resulting in 15 stitches.*
……
……
……
……

INJURY SHEET (3)

Age: …………….   Gender: ……………   Position on Farm: ……………………………………..

Hospitalisation Required: ○ Yes …………. days / weeks / months   ○ No

Time Off Work/School: ○ Yes …………. days / weeks / months   ○ No

1. Nature of Injury:
    - ○ Soft Tissue – *Please circle: cut, puncture, bite, abrasion, penetrating wound, burn, bruise, bleeding, inflammation, foreign body, damage to major blood vessel, crushing injury*
    - ○ Bone/Tendon – *Please circle: fracture, dislocation, sprain/strain, amputation*
    - ○ Systemic/Other – *Please circle: poisoning, respiratory difficulty, electric shock, concussion, dental*
    - ○ Other – *Please specify:* ……………………………………………………………………………………
2. Bodily Location of injury:
    - ○ Head – *Please circle: eye, nose, mouth, ear, face, skull, neck*
    - ○ Upper extremity – *Please circle: collarbone, shoulder, arm, elbow, wrist, hand, fingers*
    - ○ Lower extremity – *Please circle: hip, upper leg, knee, lower leg, ankle, foot, toes*
    - ○ Trunk – *Please circle: ribs, spine, pelvis, chest, abdomen, back, genitalia, heart*
    - ○ Respiratory tract – *Please circle: larynx, trachea, lung*
    - ○ Digestive tract – *Please circle: oesophagus, stomach, bowel, colon, rectum, liver, spleen*
    - ○ Nervous system – *Please circle: brain, brain stem, spinal cord, peripheral nerve*
    - ○ Other – *Please specify:* ……………………………………………………………………………………
3. Cause/Agent involved in injury:
    - ○ Farm Vehicle – *Please specify:* ………………………………………………………………………………
    - ○ Mobile Plant – *Please specify:* ………………………………………………………………………………
    - ○ Fixed Plant – *Please specify:* …………………………………………………………………………………
    - ○ Workshop Equipment – *Please specify:* ……………………………………………………………………
    - ○ Materials – *Please specify:* ……………………………………………………………………………………
    - ○ Farm Structure – *Please specify:* ……………………………………………………………………………
    - ○ Animal – *Please specify:* ………………………………………………………………………………………
    - ○ Farm Chemicals – *Please specify:* …………………………………………………………………………
    - ○ Other – *Please specify:* ………………………………………………………………………………………
4. Where did the accident take place? *Eg. Paddock, stockyard, windmill, dam, machinery shed, house yard.*
………
………
5. What was the injured person doing? *Eg. I was mustering cattle on the ag bike.*
………
………
………
6. What went wrong? *Eg. I didn't see the branch in the long grass and hit it at speed.*
………
………
………
………
7. What actually caused the injury? *Eg. A stick punctured my lower leg, resulting in 15 stitches.*
………
………
………
………

INJURY SHEET (4)

Age: …………… Gender: …………… Position on Farm: ……………………………………..

Hospitalisation Required: ○ Yes ………… days / weeks / months ○ No

Time Off Work/School: ○ Yes ………… days / weeks / months ○ No

1. Nature of Injury:
   - ○ Soft Tissue – *Please circle: cut, puncture, bite, abrasion, penetrating wound, burn, bruise, bleeding, inflammation, foreign body, damage to major blood vessel, crushing injury*
   - ○ Bone/Tendon – *Please circle: fracture, dislocation, sprain/strain, amputation*
   - ○ Systemic/Other – *Please circle: poisoning, respiratory difficulty, electric shock, concussion, dental*
   - ○ Other – *Please specify:* ……………………………………………………………………………………
2. Bodily Location of injury:
   - ○ Head – *Please circle: eye, nose, mouth, ear, face, skull, neck*
   - ○ Upper extremity – *Please circle: collarbone, shoulder, arm, elbow, wrist, hand, fingers*
   - ○ Lower extremity – *Please circle: hip, upper leg, knee, lower leg, ankle, foot, toes*
   - ○ Trunk – *Please circle: ribs, spine, pelvis, chest, abdomen, back, genitalia, heart*
   - ○ Respiratory tract – *Please circle: larynx, trachea, lung*
   - ○ Digestive tract – *Please circle: oesophagus, stomach, bowel, colon, rectum, liver, spleen*
   - ○ Nervous system – *Please circle: brain, brain stem, spinal cord, peripheral nerve*
   - ○ Other – *Please specify:* ……………………………………………………………………………………
3. Cause/Agent involved in injury:
   - ○ Farm Vehicle – *Please specify:* ………………………………………………………………………………
   - ○ Mobile Plant – *Please specify:* ………………………………………………………………………………
   - ○ Fixed Plant – *Please specify:* …………………………………………………………………………………
   - ○ Workshop Equipment – *Please specify:* ……………………………………………………………………
   - ○ Materials – *Please specify:* ……………………………………………………………………………………
   - ○ Farm Structure – *Please specify:* ……………………………………………………………………………
   - ○ Animal – *Please specify:* ………………………………………………………………………………………
   - ○ Farm Chemicals – *Please specify:* ……………………………………………………………………………
   - ○ Other – *Please specify:* ………………………………………………………………………………………
4. Where did the accident take place? *Eg. Paddock, stockyard, windmill, dam, machinery shed, house yard.*
   ……
   ……
5. What was the injured person doing? *Eg. I was mustering cattle on the ag bike.*
   ……
   ……
   ……
6. What went wrong? *Eg. I didn't see the branch in the long grass and hit it at speed.*
   ……
   ……
   ……
   ……
7. What actually caused the injury? *Eg. A stick punctured my lower leg, resulting in 15 stitches.*
   ……
   ……
   ……
   ……

Appendix 2C: Scoring of questionnaire

SAFETY CLIMATE (α=0.73)	Yes	To some extent	No	Not sure	N/A
1. It costs too much to be committed to farm safety.	0.0	2.5	5.0	0.0	–
2. It takes too much time out from work to be committed to farm safety.	0.0	2.5	5.0	0.0	–
3. Farm safety is too difficult and complicated for us to tackle.	0.0	2.5	5.0	0.0	–
4. Farm safety improved productivity.	5.0	2.5	0.0	0.0	–
5. Farm safety helps employees become more responsible in their work.	5.0	2.5	0.0	0.0	–
6. We provide adequate safety training for workers on our farm	5.0	2.5	0.0	0.0	–
7. The effectiveness of farm safety lies mainly with our workers	0.0	2.5	5.0	0.0	–
8. Managing safety on our farm is as important as profit	5.0	2.5	0.0	0.0	–
9. Everybody works safely on our farm	5.0	2.5	0.0	0.0	–
10. The owners, managers and/or partners all play a part in farm safety	5.0	2.5	0.0	0.0	–
11. I have operated machinery that was not fitted with the right safety features	0.0	2.5	5.0	0.0	–
12. I have not worked safely because I didn’t know the risks involved at the time	0.0	2.5	5.0	0.0	–
13. I have not worked safely because safety was not part of my farm training or upbringing.	0.0	2.5	5.0	0.0	–
14. I have not worked safely because I needed to get the job done quickly	0.0	2.5	5.0	0.0	–
15. I have not worked safely because replacing the guard was a hassle	0.0	2.5	5.0	0.0	–
16. If I worried about safety all the time I would not get my job done	0.0	2.5	5.0	0.0	–
17. I cannot avoid taking risks in my job	0.0	2.5	5.0	0.0	–
18. Accidents will happen no matter what I do	0.0	2.5	5.0	0.0	–
19. Not all accidents are preventable, some people are just unlucky	0.0	2.5	5.0	0.0	–
20. People who work to safety procedures will always be safe	0.0	2.5	5.0	0.0	–

SAFTETY MANAGEMENT (α=0.92)		Yes	To some extent	No	Not sure	N/A
1.	This farm allocates resources to safety.	2.0	1.0	0.0	0.0	–
2.	All individuals who work on the farm know their responsibilities for safety.	2.0	1.0	0.0	0.0	–
3.	Safety responsibilities of the business partners and managers are clearly defined and understood.	2.0	1.0	0.0	0.0	–
4.	Safety responsibilities of employees are included in duty statements.	2.0	1.0	0.0	0.0	–
5.	Responsibility for supervision of safe work is specified.	2.0	1.0	0.0	0.0	–
6.	All employees AND contractors receive safety induction before starting work.	2.0	1.0	0.0	0.0	–
7.	All employees receive safety induction to all hazardous jobs before starting that job on the farm.	2.0	1.0	0.0	0.0	–
8.	All those who work on the farm are actively involved in the farm's safety program.	2.0	1.0	0.0	0.0	–
9.	Safety is on the agenda of regular meetings held between employer and employees.	2.0	1.0	0.0	0.0	–
10.	Training has been undertaken for all current workers in safety risk management.	2.0	1.0	0.0	0.0	–
11.	All those who work on the farm actively report unsafe situations and unsafe acts to the employer or manager of the workplace.	4.0	2.0	0.0	0.0	–
12.	Action is taken following all reports of unsafe situations and unsafe acts reported.	4.0	2.0	0.0	0.0	–
13.	Regular hazard inspections are undertaken for all parts of the farm workplace.	4.0	2.0	0.0	0.0	–
14.	Hazard inspections are scheduled for ensuring the safety of workers before key seasonal activity begins.	4.0	2.0	0.0	0.0	–
15.	Safety risk assessment is a key part of the investigation of all new equipment for the farm.	4.0	2.0	0.0	0.0	–
16.	A farm safety business plan is in operation with clear timelines and budget.	2.0	1.0	0.0	0.0	–
17.	Short term and long term plans are included in the action plan.	2.0	1.0	0.0	0.0	–
18.	Safety risks on the farm are managed mostly by rules for doing the job safely.	2.0	1.0	0.0	0.0	–
19.	Engineering solutions can mostly be found to manage safety risk.	2.0	1.0	0.0	0.0	–
20.	There are safety rules for keeping guards in place and in good condition.	2.0	1.0	0.0	0.0	–

SAFTETY MANAGEMENT (continued)	Yes	To some extent	No	Not sure	N/A
21. The personal protective equipment (PPE) that is necessary for safe work is available for all relevant jobs on the farm.	2.0	1.0	0.0	0.0	–
22. Helmets are always worn when any worker rides the ATV, farm motorcycle or horse.	2.0	1.0	0.0	0.0	–
23. Ear muffs or plugs are always worn in the workshops when noisy work is being done.	2.0	1.0	0.0	0.0	–
24. All family members, workers and contractors are aware of the emergency arrangements on the farm, including phone numbers.	2.0	1.0	0.0	0.0	–
25. Arrangements for regular communication between farmers and workers during the day are in place.	2.0	1.0	0.0	0.0	–
26. Safety information is available for all hazardous jobs on the farm.	4.0	2.0	0.0	0.0	–
27. All workers can access the Operators Manual for all plant and equipment in use on the farm.	4.0	2.0	0.0	0.0	–
28. Relevant safety training has been provided for all workers.	4.0	2.0	0.0	0.0	–
29. Training has been undertaken by all workers engaged in pesticides application.	4.0	2.0	0.0	0.0	–
30. Training has been undertaken by all current workers in safe ATV, motorcycle and tractor operation.	4.0	2.0	0.0	0.0	–
31. Day-to-day records of reports of unsafe situations and unsafe acts are kept for planning action.	4.0	2.0	0.0	0.0	–
32. Up-to-date records are available of pesticides held and used on the farm.	4.0	2.0	0.0	0.0	–
33. Up-to-date records of worker and contractor safety induction are available.	4.0	2.0	0.0	0.0	–
34. Up-to-date records of machine and equipment maintenance are available.	4.0	2.0	0.0	0.0	–
35. Records of injury and near-miss accidents are kept and used to plan safer systems of work.	4.0	2.0	0.0	0.0	–
MAJOR SAFETY HAZARDS (α=0.84)					
1. All tractors on the farm are fitted with a ROPS that meets Australian standards	10.0	5.0	0.0	0.0	10.0
2. All tractors on the farm are fitted with a tractor PTO masterguard	10.0	5.0	0.0	0.0	10.0
3. All PTO shafts on tractor powered equipment are protected by an undamaged PTO shaft guard	10.0	5.0	0.0	0.0	10.0

MAJOR SAFETY HAZARDS (continued)	Yes	To some extent	No	Not sure	N/A
4. Bench grinders in the farm workshop are all fitted with undamaged guards	10.0	5.0	0.0	0.0	10.0
5. Intakes of all grain augers are effectively guarded so that hands or feet cannot be caught in the flight	10.0	5.0	0.0	0.0	10.0
6. A Residual Current Device is fitted into the electrical system of the farm workshop	5.0	2.5	0.0	0.0	5.0
7. Chemicals are stored in a separate locked area of the farm workplace, with access only by designated people	5.0	2.5	0.0	0.0	5.0
8. There is a securely fenced and gated play area around the home to protect children from injury in the farm workplace	5.0	2.5	0.0	0.0	5.0
9. All silos have systems that effectively prevent injury from falling from a height	5.0	2.5	0.0	0.0	5.0
10. Roads that are used by farm and contractor vehicles are in safe condition have set speed limits	5.0	2.5	0.0	0.0	5.0
11. It is an established and accepted rule that all adults and children must be properly restrained in any vehicle on the farm.	5.0	2.5	0.0	0.0	5.0
12. It is an established and accepted rule that no adult or child is to ride an ATV, motorcycle or horse without wearing a correctly fitted helmet	5.0	2.5	0.0	0.0	5.0
13. People handling pesticides on the farm always wear the PPE advised on the label	5.0	2.5	0.0	0.0	5.0
14. Ear muffs or plugs are always worn by workers and others when noisy work is undertaken in the workshop	5.0	2.5	0.0	0.0	5.0
15. Eye goggles are always used by people using grinders in the workshop	5.0	2.5	0.0	0.0	5.0