

Effective Occupational Health Interventions in Agriculture

Summary Report

Kirsten Lovelock and Colin Cryer

On behalf of the Occupational Health in Agriculture Research Team

Report No.5

**Final Report No.5
Occupational Health in Agriculture Study.
Injury Prevention Research Unit
Department of Preventive and Social Medicine
Dunedin School of Medicine
University of Otago**

February 2009

ISBN: 0-908958-67-6

OR072

Suggested citation

Lovelock K, Cryer C. Effective Occupational Health Interventions in Agriculture – Summary report no.5. Injury Prevention Research Unit, University of Otago, Dunedin, New Zealand. Occasional Report OR 072. February 2009.

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ACKNOWLEDGEMENTS

This study was funded and supported by the Occupational Health and Safety Joint Research Portfolio, a joint initiative in Occupational Health and Safety research, funded by the Accident Compensation Corporation (ACC), Department of Labour (DoL) and the Health Research Council of New Zealand (HRC). The views and/or conclusions expressed in this report are those of the research project team and may not reflect those of the funders.

Without the cooperation of a wide range of stakeholders this study would not have been possible. The project team would like to acknowledge and thank the following groups for their support and participation: public sector employees, members and representatives of non-governmental organizations, industry representatives, those engaged in industry education; and last and by no means least the farmers, farm workers and their family members.

ABBREVIATIONS

ACC	Accident Compensation Corporation
ATV	All Terrain Vehicle
CATI	Computer-Assisted Telephone Interviews
CI	Confidence Interval
DoL	Department of Labour
FFNZ	Federated Farmers of New Zealand
FS	FarmSafe™
IPRU	Injury Prevention Research Unit
nec	Not elsewhere classified
NIHL	Noise Induced Hearing Loss
HRC	Health Research Council
LBP	Low Back Pain
MSC	Musculoskeletal condition
MSD	Musculoskeletal disorder
ORs	Odds Ratios
PPE	Personal Protective Equipment
RCD	Residual current device
WCdays	Number of days for which earnings-related compensation was paid

1.0 INTRODUCTION

This report presents an overview of the findings of the national study of effective occupational health interventions in agriculture conducted between January 2007 and January 2009. Detailed accounts of these findings can be found in the following reports: *Effective Occupational Health Interventions in Agriculture*:

- *Risk Factors for Occupational Injury and Disease in Agriculture in North America, Europe and Australasia: A review of the literature (Report No.1).*
- *An international literature review of primary interventions designed to reduce injury and disease in agriculture (Report No.2);*
- *A report of a survey of risk factors and exposures on farms (Report No.3);*
- *Stakeholders, sector dynamics, intra-sector collaborations, and emergent issues for injury and disease prevention in the agricultural sector (Report No.4).*

Occupational injury and disease in the agricultural sector in New Zealand has been acknowledged as a significant public health issue. The burden of occupational disease and injury in agriculture is of concern to those working in the agricultural sector as well as to researchers, policy makers, community interest groups and government alike. Whilst it is known that agricultural workers and their families are vulnerable to high rates of injury as well as occupationally related diseases, effective prevention and the reduction of these disproportionate levels of ill-health have to date remained elusive (Cryer 1989; Marshall et al 1996; Feyer et al 1999, Horsburgh 2001; Feyer et al 2001). Agriculture remains central to New Zealand's economy, generating over 60% of export earnings and employing approximately 9% of the total New Zealand workforce, the burden of occupational injury and disease is significant, costing millions of dollars each year in treatment and compensation costs and immeasurable social, psychological and economic costs to those families and rural communities who experience serious injury and or fatality while farming.

Previous research has identified that the primary mechanisms involved in fatal and non-fatal serious injury experienced by those working in the agricultural sector are : injury by machinery, ATV's , tractors (in respect to fatal injury, particularly as a consequence of roll-overs), injury by animals, other vehicle injuries, and bystander injuries – (particularly of children); injury resulting from lifting and straining, and slips, trips and falls (Cryer 1989; Horsburgh 2001; Houghton & Barnett 1996; Houghton and Wilson 1994; Houghton & Wilson 1992; Fathallah 2008; Feyer et al 2001; Lilley 2004). Additionally, exposure to noise and resultant hearing loss has emerged as a significant burden affecting predominantly middle aged and older men (McBride 2003, Thorne et al 2008). Occupational overuse syndrome and or musculoskeletal conditions, often requiring ongoing and lengthy treatment are also significant ill-health outcomes for those working in agriculture (Milosavljevic 2005; Fathallah 2008). With respect to occupational disease, research has focussed on a range of occupational exposures and the relation to various ill-health outcomes. Predominantly this has included considering exposure to pesticides, insecticides and herbicides and cancer outcomes (Beane et al 2005; Engel et al 2005; Bonner et al 2005). Specific cancers and their association with agricultural production include: non-Hodgkin's lymphoma, prostate cancer, breast and ovarian cancer, leukemia, multiple myeloma and brain cancers, skin cancer, and cancer of the lip (t'Mannetje 2007; Fitschi et al 2005; Duel et al 2000). Researchers have also focused on respiratory disorders associated with exposure to dust, organic materials, chemicals and animals (Chaudemanche et al 2003; Musken et al 2000). In all of the

aforementioned research areas, researchers have stressed the need for ongoing research on occupational injury and disease in agriculture.

1.1 The Aim of this Research Project:

The Effective Occupational Health Interventions in Agriculture: key characteristics of their development and implementation in New Zealand project sought to update the knowledge base on injury and disease in this sector and to provide a platform from which stakeholders could work toward developing evidence based policy and practice aimed at reducing injury and disease in this sector.

1.2 Summary in brief:

- The research has identified and reviewed risk factors and exposures for injury and disease in agriculture through a review of research literature in North America, Western Europe and Australasia.
- The research has updated previous reviews and documented accounts of the efficacy of primary interventions for the prevention of injury and disease in agriculture internationally and established the need for a multifaceted approach in addressing occupational injury and disease in this sector.
- The national computer assisted telephone survey has documented:
 - the current health and injury record of participants
 - their exposure to chemical, biological and physical agents
 - work practices
 - farm occupational health and safety knowledge and practice
 - interventions in place, and
 - farmers, workers and farm residents perceptions of barriers and critical factors relating to implementation of interventions
- The research has documented stakeholder perceptions and understandings of:
 - The sector
 - Risks and hazards faced by agricultural workers
 - The effectiveness of current interventions
 - Current intra-sector initiatives
 - Barriers and critical factors relating to the implementation of interventions

1.3 Objectives:

The study had four main objectives:

- (1) To identify the key agricultural risks and hazards;
- (2) To identify effective interventions that address these risks and hazards;
- (3) To identify the barriers to implementation and adoption of the key interventions;
- (4) To identify the critical factors which need to be considered when designing and implementing interventions.

A number of methods were employed to meet the aims and objectives of the study, including two international literature reviews, a national survey of farmers, farm workers and family members, and face to face in-depth interviews with key stakeholders in the agricultural sector, including

farmers, farm workers and their families. This multifaceted methodological approach is outlined in the following table.

	Objectives	Approach
1	To identify key risks and hazards to people working in agriculture and their families.	<ol style="list-style-type: none"> 1. Literature review 2. Survey of farmers, farm workers and their families to describe exposure to risks and hazards (including both the social and physical environment) 3. In depth interviewing of selected farmers, farm workers and their families. 4. Interviews of stakeholders
2	To identify evidence-based effective interventions to address these risks and hazards.	<ol style="list-style-type: none"> 1. Literature review 2. Interviews of stakeholder
3	To identify the barriers to implementation and adoption of these interventions.	<ol style="list-style-type: none"> 1. Survey of farmers, farm workers and their families. 2. In depth interviewing of selected farmers, farm workers and their families to identify barriers to implementation of known effective interventions. 3. Interviews of stakeholders
4	To identify the critical factors that should be considered when designing and implementing those interventions.	<ol style="list-style-type: none"> 1. In- depth interviewing of selected farmers, farm workers and their families. 2. Interviews of stakeholders 3. Synthesis of the information generated by the methods used to address objectives (1) to (3).

There were several distinct study phases spanning the two year period of research.

1. An update of recent literature reviews: addressing both risks and exposures in agriculture and effective primary interventions to prevent injury and disease in the agricultural sector.
2. A national computer assisted telephone interview survey (CATI) of the population to describe: exposure to hazards, interventions already in place and potential problems (barriers and critical factors) relating to implementation of further interventions.
3. Face-to-face interviewing of selected farmers, farm workers and their families to provide a more in-depth look at the same issues.
4. Interviews of other sector stakeholders to ascertain their perceptions of occupational health issues in agriculture and barriers to effective intervention

Each of these study phases has resulted in a report and will result in further published outputs. This summary makes a number of recommendations which are based on an assessment of the research findings of each distinct phase. Key amongst these is the recommendation for the most effective route for future interventions in this sector and the identification of critical factors that need to be considered when designing and implementing those interventions.

2.0 SUMMARY OF STUDY RESULTS

2.1 An international literature review of occupational risks and exposures to injury and disease in agriculture.

We carried out a review of the international literature on injury and disease amongst agricultural workers and their families was conducted; with a particular focus on research in North America, Western Europe and Australasia. This review is soon to be available in report form: *Effective Occupational Health Interventions in Agriculture. Risks factors for Occupational Injury and Disease in Agriculture in North America, Europe and Australasia: A Review of the Literature (Report No.1)*¹

The aim of this review was to systematically identify and review epidemiological studies that have investigated risk factors contributing to agricultural injuries and occupational disease in North America, Europe and Australasia.

The search was limited to publications from 2000 to 2008 and by the following study designs: cohort, case-control, cross-sectional, prevalence surveys, case-series, and analyses of routine data. Studies were included in this review if they specifically considered agricultural related injuries, diseases or deaths as an outcome, measured any potential risk factor for occupational injury and disease and if they were written in English. In addition, studies were required to address not only prevalence, but also risk, exposure and outcome. Reference lists of included studies were searched for additional relevant studies. The search and inclusion was limited to English language only. Major injury journals published between 2000 and 2008 were also searched. These included: Injury Prevention, Accident Analysis and Prevention, Injury, Journal of Safety Research, Injury Control and Safety Promotion. Specific rural journals searched included, Journal of Agricultural Health and Safety, Journal of Rural Health, Australian Journal of Rural Health. Specialist journals searched included: Applied Ergonomics, American Journal of Industrial Medicine, Ergonomics, Journal of Biomechanics, Journal of Occupational and Environmental Medicine, Journal of Safety Science, Occupational and Environmental Medicine, Scandinavian Journal of Work and Environment.

The database searches located over 400 papers. Restricting this search to English language and specified epidemiological study designs reduced the number of studies to 210 for consideration. Abstracts from each of these were considered for eligibility and the full texts of selected articles were then appraised. Key reviews from 2000 until 2007 were also appraised.

¹ Effective Occupational Health Interventions in Agriculture. Risk factors for occupational injury and disease in agriculture in North America, Europe and Australasia; A Review of the Literature (Report No.1).

Kirsten Lovelock, Rebecca Lilley, David McBride, Stephan Milosavljevic, Heather Yates and Colin Cryer on behalf of the Occupational Health In Agriculture research team.

A total of 200 papers met the inclusion criteria and were included in this review, 83 papers addressing injury risk factors and exposure were included and 117 papers addressing risk factors and exposures associated with occupational disease in agriculture were included for review.

The main findings were:

- The most common mechanisms for serious non-fatal injury and fatal injury include agricultural machinery (including vehicles –tractors, ATVs), livestock and falls for all age groups, in all three regions under review.
- The exposures and risks of disease in the agricultural sector currently being researched and where researchers agree there is a need for further research include:
 - exposure to dust and organic materials and the relation to respiratory disorders;
 - exposure to pesticides, herbicides and insecticides and associations with various cancers including: non-Hodgkin’s lymphoma; prostate cancer, breast and ovarian cancer, leukaemia, multiple myeloma and brain cancers;
 - environmentally associated cancers (for example, skin cancer and cancer of the lip) and their association with production practice.
- Occupational fatalities in agriculture remain high, despite decreases in occupational fatality rates for other industry groups, in all three regions over the last decade. The research demonstrates that there are various groups that are particularly at risk, these include:
 - men in all age groups;
 - older workers/farmers;
 - migrant and seasonal workers;
 - youths (particularly those aged between 11-15 years and male)
 - Children (particularly male children)
 - Farm-owners and managers, with respect to intentional fatal self harm injury) again predominantly men.

2.2 An international literature review of primary interventions designed to reduce occupational injury and disease in agriculture.

A systematic review of the efficacy of primary interventions designed to reduce injury and disease outcomes in agriculture was conducted. This review is available in report form: *Effective Occupational Health Interventions in Agriculture. An international literature review of primary interventions designed to reduce injury and disease in agriculture (Report No.2)*²

The aim of this phase of the project was to systematically review research publications that address agricultural injury and disease prevention interventions targeted at farmers, farm workers and their family members, published from 2000 to 2008. This report evaluated the body of evidence to emerge since the reviews of the efficacy of agricultural injury prevention

² *Effective Occupational Health Interventions in Agriculture. An international literature review of primary interventions designed to reduce injury and disease in agriculture. (Report No.2).*

Rebecca Lilley, Colin Cryer, David McBride, Kirsten Lovelock, Kate Morgaine, Stephan Milosavljevic and Peter Davidson. Injury Prevention Research Unit, Department of Preventive and Social Medicine, University of Otago.

interventions targeted at children by Hartling et al (2004) and agricultural injury prevention interventions targeted at adults by De Roo and Rautiainen (2000). The search criteria from these 2 previous reviews were replicated with some refinements. In total 10 electronic databases were searched for studies meeting the inclusion criteria. The main electronic search was supplemented by a hand search of specialist occupational health and safety, biomechanical, ergonomic and injury journals. Further search strategies were also used to find any updated publications for studies included in the two previous reviews.

The criteria for inclusion were:

- 1) the paper evaluated the efficacy of interventions to prevent injury or disease in farmers, farm workers and their families, reporting at least one objectively quantified outcome (e.g. injury rate, or an intermediary outcomes such as safety knowledge, or change in behaviour);
- 2) the interventions were targeted at adults or children only, or both adult and child populations on the farm;
- 3) the study design was either a before/after study (pre/post study), case-control, or cohort study, controlled trial or randomised controlled trial (RCT); and
- 4) studies were published after the relevant time periods covered in the existing reviews.

Abstracts of studies that appeared at face value to meet the criteria of this review were obtained and reviewed by two independent reviewers for inclusion. Full copies of papers meeting the abstract review criteria were obtained and reviewed in their entirety. The methodological quality of the eligible studies was assessed using a partially validated quality assessment tool (Downes and Black 1998).

The two previous reviews on the effectiveness of interventions to reduce injuries in agriculture concluded there was insufficient evidence to recommend one particular interventional approach to reducing agricultural injuries in the farm community (De Roo and Rautiainen 2000; Hartling et al 2004). Our review reaffirms this assertion and concludes that given the multitude of occupational health issues in the agricultural sector a multi-faceted approach to injury and disease prevention is necessary.

The methodological quality of the studies identified was variable with 7 studies assessed as being of high quality, 22 of moderate, and just one of poor methodological quality. The interventions evaluated can be classified into the following categories:

- 15 educational
- 2 engineering
- 5 ergonomic
- 2 were safety performance evaluations of personal protective equipment
- 2 were financial or work scheduling interventions, and
- 6 evaluated multi-faceted interventions, which involved a number of separate intervention approaches

The main findings:

- The evidence regarding what works to prevent injury or ill-health outcomes on farms is weak and is reliant on research conducted in North America, Europe and Australasia;
- Many interventions have shown little or no effect on injury or ill-health outcomes on farms;
- There is evidence of effectiveness for some highly specific interventions, e.g. Roll-over protective structures on tractors, and ergonomic interventions to prevent back injury/strain/pain;
- The evidence from this and previous reviews indicates that multi-faceted interventions are a promising interventional approach to improve farm safety behaviours, attitudes and knowledge.

The review identified a number of issues and concerns:

- It is evident that poor targeting of prevention programs for major agricultural injury or health concerns, or with respect to high risk populations was a feature of intervention initiatives.
- There is a need to reach beyond educational interventions and consider other engineering/design, organizational and legislative/enforcement solutions.
- There is a need to identify and understand the barriers to implementing interventions to improve the likelihood of success.
- Intervention design and implementation is often under-theorized and or relies on a weak understanding of behavioural change (both at the individual level and for social groups).

The review identified a number of methodological issues:

- Limited examination of injury or disease outcomes by intervention evaluations with most studies assessing changes in safety knowledge, attitudes and behaviours and only a few addressing the incidence of injuries or disease.
- There was improved use of more rigorous study designs, since the previous systematic reviews, but overall the quality of evidence remains limited.
- The potential applicability of the study findings to the NZ agricultural context needs to be addressed since most interventions were designed and undertaken in Northern Europe and North America.

2.3 The National Telephone Survey

A report that provides the full results from the national survey will be available: *Effective Occupational Health Interventions in Agriculture. A report of a survey of risk factors and exposures on farms (Report No.3)*³.

³ *Effective Occupational Health Interventions in Agriculture. A report of a survey of risk factors and exposures on farms (Report No.3).* Colin Cryer, Kirsten Lovelock, Rebecca Lilley, Peter Davidson, Gabrielle Davie, Ari Samarandayaka, David McBride, Stephan Milosavljevic, Kate Morgaine, Injury Prevention Research Unit, Department of Preventive and Social Medicine, University of Otago.

The survey sought information from participants on:

- Their current health and injury record
- Perceived key agricultural risks and hazards
- Their exposure to chemical, physical and biological agents
- Workplace organisation and practices
- Farm occupational health and safety knowledge and practice
- Interventions in place, and
- Barriers and critical factors relating to implementation of interventions

The target population for the survey included people directly employed in agricultural production, ancillary workers who support agricultural production (for example, farm workers) and partners and other family members of employers or employees, who were potentially exposed to the same work-related risks and hazards on farms.

The national survey was administered by telephone and was computer assisted (CATI). The variation of exposure over the farming year was addressed by staggering the period of the survey over 12 months. Interviewing was conducted during the day and in evenings and the survey ran between August 2007 and August 2008.

The survey sample drew from the AgriQuality™ database (AgriBase™) of farms; this sample is referred to as the AgriBase™ sample. Stratified sampling was used and the key strata were: (a) sheep, (b) beef, (c) dairy, (d) horticultural and other crop growing, and (e) other livestock. In addition the survey was also conducted for a sample of recent ACC claimants where the earnings related compensation (ERC) was for over 21 days. This sample is referred to as the ACC sample.

Summary of Results

Sample characteristics:

- The responders from the AgriBase™ sample were the main decision maker on the property. Two hundred and fifty-three (n=253) decision makers were interviewed giving a response rate of 38% (253/657). On the whole these respondents were: mature (79% were aged 45 years plus) and experienced (73% with > 20 years farming) with a self rated high working capacity. Seventy-six percent (76%) of the respondents were male. In contrast the ACC sample responders had diverse status (decision maker, farm workers, family members) were slightly younger (61% were 45 years plus) with less experience (51% with > 20 years farming). Eighty-one percent of the ACC sample respondents were male. The majority of respondents were New Zealand European (90% for the AgriBase™ sample and 80% for the ACC sample) and a small proportion of respondents were Maori (2% and 8% respectively).
- The respondents from both samples mainly comprised sheep, beef and dairy producers. There were relatively few participants who identified horticultural activities as their primary form of income.

- There were a mix of farm sizes and terrains in both samples (1/3rd plains, 1/3rd rolling, 1/3rd hill, high or mixed terrain)
- Most farms had one or more of resident adults, and 25% and 19% had four or more resident adults.
- Farm Characteristics. Fifty-one percent (51%) had dams/ponds, and seventy-three percent (73%) had rivers/streams on their property. Forty-three percent (43%) had overhead power-lines, thirteen percent (13%) had stables and twenty-eight percent (28%) had silos.

Outcomes, Risk Factors and Exposures:

- Illness and conditions in the previous 12 months. A cough lasting more than 3 days was the most common condition amongst the AgriBase™ sample. Hay fever and asthma requiring medication were also common with prevalence(s) of thirteen percent (13%) and nineteen percent (19%) for hay-fever and ten percent (10%) for asthma requiring medication in both the AgriBase™ and ACC samples. This was followed by noise induced hearing loss (NIHL) with prevalence(s) of nineteen percent (19%) amongst the AgriBase™ sample and thirteen percent (13%) amongst the ACC sample. Other common conditions included diabetes, bronchitis, vascular disease (heart attacks and stroke) were similar to the general population.
- Musculoskeletal conditions were common. Sixty four percent (64%) of the AgriBase™ sample and sixty-seven percent (67%) of the ACC sample reported lower back pain and fifty seven percent (57%) and fifty eight percent (58%) reported shoulder and neck pain in the AgriBase™ and ACC samples respectively. Only a small proportion of AgriBase™ respondents had musculoskeletal conditions that resulted in a compensation claim being made.
- Injury. With respect to injury, thirteen percent (13%) of farmers from the AgriBase™ sample had had an injury, in the three months prior to interview, which had restricted their activity for a half a day or more and/or which required medical treatment from a health professional. Generally these injuries were reasonably serious and respondents reported work capacity was poor following injury. For two-thirds of those injured it was over a week before they could resume normal farming duties; yet only a third of these respondents made a claim to the Accident Compensation Corporation.
 - Amongst the AgriBase™ sample the most frequent injuries were: sprains and strains, predominantly to the back; cuts to the head, wrist/hand or multiple body sites; crush injuries to the chest, ankle/foot, wrist/hand, shoulder/upper arm or multiple sites and burns to the lower leg or to multiple sites.
 - Amongst the AgriBase™ sample Injuries in summer had the highest estimated crude rate (40 per 100) with spring the next highest rate (13 per 100). The majority of injuries occurred outdoors, on flat terrain and nine-tenths occurred when it was fine and dry.
 - Of the seriously injured persons from the ACC sample, the majority were sprains and strains, fractures, dislocations, crush injuries, loss of consciousness, and in one case an amputation. The majority took place outdoors, on flat terrain and in fine and dry conditions.

- For both samples, injury events involved primarily: animals, vehicles and machinery.
- Physiochemical hazards.
 - Vehicle vibration was the most prevalent physical exposure, for example whole body vibration, with shock vibration being more common in the use of all terrain vehicles (ATV's).
 - Noise. Fourteen percent (14%) reported noise exposure where “noise was so loud you had to shout”.
 - Dust. Exposure to dust of biological origin (animals, plants) was the most frequently reported dust exposure.
 - Frequent (often and sometimes) handling hazardous substances had a prevalence of just over 50% of respondents. Herbicides were the most commonly used chemicals amongst respondents.
 - Chemicals. When working with chemicals respondents generally protected the trunk and extremities from exposure, but less commonly the face and eyes, with the use of masks, respirators and face protection low.
 - Health effects from chemicals were reported by 2.5% of the AgriBase™ sample and 5.3% of the ACC sample.
 -
- Ergonomic Hazards.
 - Working on the farm in a sitting position, associated with use of quad bikes, tractors and other farm vehicles puts farmers at risk of whole body vibration;
 - Bending without support (25%/32%) and lifting or manoeuvring heavy loads (23.0%/37%) in twisted work postures (14%/18%) that are often described as painful and tiring positions (13%/19%) are consistent with the typical stock work that many farmers undertake with sheep, cattle, and other farm animals.
 - The high levels of repetitive hand/arm movements (44%/62%) reported by these farmers/workers is also consistent with stock work such as drenching/shearing/crutching.
- Job Stressors. The highest reported prevalence(s) associated with stress amongst the AgriBase sample were the unpredictable factors of machinery breakdown and having a farm-related accident. Unsurprisingly, farm-related accidents were reported as the predominant source of stress by responders from the ACC sample. Other dominant stressors were time pressures due to increased seasonal workload, and unpredictable factors, for example, machinery breakdown.
- Work Organisation.
 - Working hours. Working hours were longer in spring and summer; long working hours is a known risk factor for injury amongst those working in agriculture (Day et al 2008, Hwang et al 2001).
 - Employees. On-call or casual employment arrangements were common for those farms employing labour. ACC sample farms were more likely to have employees working on subcontract. Subcontracting is a practice associated with poorer occupational health and safety conditions in other industry groups (Mayhew et al 2003).
 - Multiple job holding. Multiple job holding was more common amongst the AgriBase™ sample and most commonly the second job was casual or of short

duration. There was a lower prevalence of multiple job holding for those in the ACC sample.

- Children. For children there were distinctive age and gender patterns with respect to farm activity and work.
 - Children in this study under five years are riding on farm vehicles as passengers (including ATVs), are exposed to animals and are accompanying adults while they work on the farm.
 - Young children (5-9 years) are operating ATVs and motorbikes, riding on vehicles as passengers (including ATVs), playing near machinery, have access to farm structures, performing animal work, using firearms, and accompanying adults working on the property.
 - Older children (10-15 years) share the sample exposures as those in the 5-9 year age range.
- Vehicles/machinery/animals. Respondents report high levels of exposure to: two wheeled motorcycles, four wheeled ATVs, shearing equipment, tractors, implements pulled by tractors, chainsaws, firearms, workshop equipment, and stock. There appears to be greater use of ATVs and less use of two wheeled motorbikes, when compared to previous research conducted in 1993/94.
- Tractors. Few farmers used seatbelts when driving vehicles on the farm. Leaving keys in the ignition of a tractor that was unattended was common to a high proportion of respondents in both samples. There appears to have been a significant improvement in farm safety features: ROPS, safety belts, passenger seats, guarded PTOs and safety starters over the last fourteen years.
- Farm Bikes. When using farm bikes (2-wheeled) only 19% of the AgriBase™ sample and 11% of the ACC sample reported they wore a helmet.
- ATVS. ATVs tended to be used every day. Few indicated that they used a helmet when riding an ATV, approximately 50% indicated they always wore work boots when using the ATV, and only 2 people ever wore a seat belt. Sixty-three percent (63%) of the AgriBase™ sample reported sometimes or always carrying passengers, eighteen percent (18%) reported they sometimes or always get on or off a moving ATV, the majority (75%) reported sometimes or always leaving their keys in the ATV when unattended.
- Work Safety Climate. Workers did perceive their workplace as a contributor to their capacity to work safely. Workers were less likely to justify their unsafe practice by blaming a lack of training or lack of correct or poor equipment in the workplace. Most considered that they had adequate safety equipment, training and support on the farm. Workers who had experienced a severe injury perceived they had less control over their workplace.
- Training. With respect to training, the majority of respondents from both samples had not received any training in the last six months, with the exception of formal training for chemical use. Just over 40% of both samples had attended the FarmSafe™ Awareness Course since its inception in 2002.
- Safety Checks. Very few respondents from both samples had had a formal safety check on the farm in the previous six months. For those who had had a safety check on the farm, it was more likely to have occurred amongst those who had experienced a serious injury.

- *Barriers to safety.* Having to rush and being tired and/or fatigued were the most prevalent barriers to safety reported by the AgriBase™ sample. In addition, twenty five percent (25%) of responders reported a lack of equipment would present a barrier at least some of the time. Similar responses were evident amongst the ACC sample, but they also cited pressure from neighbours, co-workers, or management as affecting their ability to work safely. Economic and time pressures subsume safety concerns on a significant proportion of farms.

2.4 Stakeholder perceptions and understandings of issues facing the sector

Face-to-face in-depth interviews were conducted with stakeholders in the agricultural sector in order to explore their perceptions and understandings of:

- the sector
- risks and hazards faced by agricultural workers
- the effectiveness of current interventions
- barriers and critical factors relating to implementation of interventions in agriculture
- current intra-sector initiatives

An analysis of these interviews is available in report form in: *Stakeholders, sector dynamics, intra-sector collaborations, and emergent issues of injury and disease prevention in the agricultural sector (Report No.4)*⁴

The agricultural sector is defined as: governmental, non-governmental, industry and educational organizations that have an explicit interest and involvement in agricultural production; farmers (owners, farm managers, and or decision makers on properties); farm workers and family members working and living on farms throughout New Zealand.

Face-to-face in-depth interviews were conducted with 20 stakeholders and a further three stakeholders by telephone from key organisations within the agricultural sector from October 2007 to March 2008. The purpose of these interviews was to survey their perceptions, understandings and knowledge of key issues currently facing the agricultural sector. Specifically, the participants were asked to reflect on exposure to risks and hazards for agricultural workers, the efficacy of current interventions, and their perceptions of barriers and critical factors relating to the implementation of these and other interventions. The key organizations included: Accident Compensation Corporation, Agricultural Health and Safety Council, Agricultural ITO, the Amalgamated Workers Union, Dairy Insight, Department of Labour, FarmSafe™, Federated Farmers, Meat and Wool, Ministry of Agriculture and Forestry and Rural Women.

In addition, interviews were conducted on 25 farms, in the regions of Southland, Otago, Canterbury, the Wairarapa and Waikato from April to July 2008. Participants included farmers,

⁴ Effective Occupational Health Interventions in Agriculture. Stakeholders, sector dynamics, intra-sector collaborations, and emergent issues for injury and disease prevention in the agricultural sector. (Report No.4). Kirsten Lovelock, on behalf of the Occupational Health in Agriculture Research Team, Injury Prevention Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago.

farm workers and family members (30 participants). The participants had participated in the national survey and volunteered to participate in a follow up interview. The selection from those who volunteered was done on the basis of region, production type and representiveness of production type for the region. The interviews were conducted from April to June 2008. The purpose of these interviews was to explore more fully issues that the farmers, farm workers and family members wanted to discuss in relation to occupational health, but also to explore their perceptions of barriers to effective interventions that would prevent and or reduce occupational injury and disease in agriculture.

Key findings from interviews with government, non-government and industry organisations:

- There are many people and organisations addressing injury and disease prevention. However, there is no long term prevention strategy for injury and disease that specifically addresses the agricultural sector. Having a strategy would facilitate a more refined focus on the problems faced by this sector and would also facilitate more effective co-ordination and collaboration amongst stakeholders.
- The dominant idea amongst stakeholders that the farming community is “different” is a culturally patterned response. That is, a response which has been shaped by the socio economic status (over time), how the sector has been and is represented by the media and lobby groups (including political parties), and the association of the centrality of farming to the colonial settlement of New Zealand, national identity and economic sustainability. The idea that the farming community is different is taken by many to be a *given* and thus is largely uncritically accepted. The dominant stereotype of the farmer as being rugged, independent and self-sufficient (and masculine) is also largely uncritically accepted by many stakeholders. These and associated stereotypes about the nature of rural life and notions of rural isolation are problematic and potentially can undermine effective health interventions in this sector.
- It is important to be explicit about these stereo-types because as with all stereotypes they are at times used as a proxy or substitute for empirically established, or documented social actualities; and belie the considerable diversity that exists within the “farming community” in New Zealand. They can and do distort or exaggerate commonalities within the farming community; exaggerate the differences that exist between rural and urban New Zealanders and potentially inhibit a critical understanding of the nature of the “farming community” and how fatal and non-fatal injury and disease rates might be effectively reduced in this community. It is particularly important that preventive promotional materials do not reproduce such stereotypes if the objective is to target all at risk on rural properties.
- The use of the “farmer” stereotype and/or the “rural” stereotype by stakeholders is not a socially neutral practice; it is about power and it is about staking a claim, over ownership of, and a closer proximity to a social territory. For example, demonstrating that you identify with these stereotypes, or are a member of the community that these stereotypes claim to represent invariably involves invoking a contrast to those who cannot and do not identify with these stereotypes. This has implications with respect to inter-organisational relationships within this sector, especially when public servants are held to be distant from this stereotype and where a lack of identification is considered a disqualification from participating in decisions that affect this sector. The perpetuation of these

stereotypes by some stakeholders is divisive and is a barrier to collaborative engagement in this sector.

- While all of the stakeholders are involved in initiatives addressing occupational ill-health in the sector, there is a tendency for initiatives to be *ad-hoc* and for there to be a lack of co-ordination and coherence, and in some instances, where there are some questions around the efficacy of various interventions, an unwillingness to accept that there are problems.
- There is common recognition of the need for an agreed upon strategy, that is informed by research. In the absence of this there will continue to be coordination issues, a lack of coherence, lack of agreement surrounding the efficacy of specific interventions, duplication of effort and a concentration of effort at the macro level (with little or no involvement at meso and micro levels).
- Intra-sector collaboration exists; however, effective sector intervention is at times undermined by: internal and inter-organisation politics; lack of resourcing in some areas; problems with how resources are allocated; understaffing at an operational level; and institutional restructuring (loss of staff, uncertainty for staff, loss of institutional knowledge, gaps in delivery, shifts in priorities).
- Some organisations in the sector have limited ability to engage at the level of locality and regions. There is a lack of skilled personnel available for recruitment to organizations where their role involves engaging in the localities. There are a limited number of personnel available to enforce health and safety requirements and those currently employed in the inspectorate have responsibility not only for agriculture, but also for a number of other sectors.
- To date the approach to addressing occupational injury and disease in this sector has been a ‘top down’ approach (with the exception of FarmSafe™ which engaged people to run courses from rural communities).
- There is a recognized need amongst those in the sector that all stakeholders need to work together. At times the relationship between the state and the agricultural sector has been strained.
- Little is known about the capacity of the rural sector to address injury and disease prevention. There is some evidence that capacity was undermined during economic restructuring of the rural sector in the 1980s and 1990s. And some evidence from NGOs that capacity is uneven across regions.
- Farm consolidation and changes in labour force composition are significant issues for the sector and have implications for both injury and disease. Farms are larger (especially diary units), involve the management of greater numbers of stock, involve a larger number of employees and or fewer employees (depending on land use); under a range of contract circumstances; and involve a greater number of vehicles and machines over larger territories. How risk is managed on these properties and the nature of employment experiences for workers on these properties remains largely unknown. Addressing human capability issues for stakeholders in response to these changes is a significant issue.
- Women are often posited as the agents of change, but caution is necessary here as rural research demonstrates that rural women are still under-represented on committees and boards in rural areas – and have limited decision making power in this respect.
- Some in the sector noted an absence of leadership in rural New Zealand and that this would impede efforts to encourage participation in prevention at the community level.

Key findings from interviews with farmers, farm workers and family members:

- There was an evident stoicism toward ill-health and/or injury; this was the case for both the men and the women. However, amongst the men there was a dominant tendency to understate injury or harm and to dismiss any preoccupation with health as somehow “unhealthy” or a sign of a “flawed” or “weak” character. This did not mean that they were unconcerned, but rather there was cultural tendency to downplay health or health issues in their lives.
- In connection to this evident stoicism was a vocational identification to the work they do; most could not imagine not farming, it was not just a job. The implications here are that they would often keep on working with an injury (such as a back condition), as doing the work was more important, not just economically, but also in terms of their identity, and an underlying belief that it would heal itself if they just kept on going.
- There were also evident differences in the definition of what constituted serious injury. That is, different from that held by researchers and or government agencies. In the main, amongst these participants, a serious injury was one that killed you or seriously disabled you so you were unable to work again – for example, if a head injury, then it was serious if you, in the words of one man “ended up a cabbage” (Wairarapa DS300050). Anything less than this was minor or at least considered fairly insignificant. An injury that resulted in a lengthy time off work was moving into the serious category, but still minor, if they recovered from it. Whether or not you would be compensated for the injury did not seem to feature in how seriousness was defined.
- The lack of fit between the governmental, research, and farming community definition of risk is in part about resistance, and exercising power (on all parts). Nonetheless, the definition of serious injury amongst this group is a lay epidemiology and it makes sense not only to them but also to the context within which they work. To up play every ailment or injury and to take time off to recover is not an economically viable thing to do when you are often reliant on a very small labour pool (if on a family farm) and it is simply not possible on economically marginal properties.
- Stakeholders indicated that “having close calls”, “near misses”, or “scares” brought about changes in behaviour, or what they called a “respect” for the risks of using certain machines or working with animals, of working at heights. Experiencing a near fatality they argued changed behaviour. Knowing of someone close who had died in a farm related incident they also argued also had some impact on behaviour and having a member of the family die from a work related farm injury “changed their lives”.
- Working alone was a significant factor for all the men, not having somebody else to look out for things that might happen and the inability to rely on somebody if something happens are key features of working on these farms. However, in some instances, serious injury did occur when they were working as part of a team – or “gang” and where something was done that the team member did not anticipate. However, the movements and time keeping of those who work alone is usually being monitored by somebody on the property, often family members fulfil this function for the men working on these farms. Cell-phones and or radios enable contact from a distance and many reported using them in emergencies. Knowing where they are, how long they will be, what they are doing and

responding when they deviate from all of the aforementioned are common practices of those living and working on these farms.

- Working with machines is central to a farming way of life. All of the men had machinery related injuries at one time or another, all thought that it was necessary to “respect machines” and the risks which they presented to their operators. All thought that technological advances meant that machines today were far more reliable and safe than those in the past (with cabs, less noisy, four wheel drive, ROPS) and most of the men demonstrated considerable faith in their machines, if not always their ability to master them. Machinery related injury was embarrassing for many of these men, this embarrassment points to the importance of mastering machines and it’s relation to masculine identity. It also means that acquiring knowledge about these machines can be a shaming experience, as too is not controlling the machine and being injured as a consequence.
- Focusing on the “positive” aspects of farming was important for all of the participants and this also means not focusing on injury and disease. Prevention of injury and disease means focusing on it and as this is not considered a positive experience many do not want to do it. This is also in part connected to an evident fatalism amongst the participants- “When your times up, it’s up”; there is no point in worrying about it because it will happen anyway. This finding is consistent with other research that demonstrates that rural men are generally not proactive in terms of preventive health care, screening or otherwise and this has been implicated in rates of cardiovascular disease (Beaglehole 1990, Frazer 2006) and with respect to the mental health issues (Booth et 2000). Rural women are also less likely to undergo screening, in part due to access issues but also because it is not seen as a priority.
- Many said they were too tired at the end of a working day to read about injury and disease or to go onto the internet to learn about it either. When they opened the paper they wanted to know about local and international news, not health matters. This presents some real challenges for the sector in terms of disseminating information.
- Shifts and changes in labour arrangements, in particular contracting out work has ensured that the farms in this study are no longer as “autonomous” as they once were, indeed many people come and go from the property at any given time. The workforce is not then concentrated in terms of residence either, and as many observed this has meant that many of the risks they once faced are no longer their risks- but those of contractors. And while contractors might be at risk they are better prepared for it – in terms of safety gear and up-to-date equipment. This of course is the case for those whose properties are economically viable and where they can afford to contract out. Those in more marginal circumstances cannot afford to contract work out, work long hours, invariably work alone (cannot afford labour) and are arguably more at risk of serious injury. The cultural pattern of not thinking about risk of injury or disease, would in these circumstances offer a degree of psychological protection, but they are nonetheless much more vulnerable to injury and disease. Economic circumstances undeniably shape the level of protection one can afford not only in terms of technological interventions but also in terms of adequate labour and assistance.
- None of the participants were on amalgamated properties and/or managing on the behalf of companies or corporations. We know very little about the labour arrangements on these “super” farms, other than the observations made by these participants that they often

employ migrant labour and that many of these migrants have no experience of industrialised agriculture.

- Labour issues on these farms reported by participants included a shortage of skilled labour; a awareness (and experience) that people new to farming faced an increased risk of injury; and that employing some young people local to the area, who lack motivation and or the necessary skills, also meant an increased risk of injury.
- Most do not want to read about injury and disease statistics in their sector. This is consistent with the argument that what motivates people to change their behaviour is not some abstract risk (even if real to some) For example telling a farmer, farm worker or family member that the current fatality rate for male agricultural workers is approximately 21.2/100 000 is too abstract (Horsburgh 2001); more appropriately if behavioural change is the objective these workers need to know the *real* risk of injury and disease, that is, the risk injury and disease might pose to their plans and dreams (White 1997, Trostle 2005).
- There appears to be a gendered difference in how risk is perceived – this emerged not only in the interviews, and particularly when spouses were present, but is also evident in the statistics. There is no other New Zealand research that addresses the gendered nature of injury or disease with respect to agriculture. However, research in the United States suggests it is not just gendered but often shaped by ethnicity and socio-economic status as well. This study found that “white” males consistently perceive the risks of potentially hazardous activities as lower than both “white” females and “non-whites”, of both sexes (Slovic, 1997: 73 in Trostle 2005). What this suggests is that social and economic status is a determinant of perceptions of risk.
- There is a need to know more about the changing nature of labour and labour arrangements on farms.
- There was some evidence in this study that being a farm worker can mean that you are vulnerable to increased risk if your employer is unwilling to provide protective equipment.
- In one instance, an employer was constantly having to reinforce wearing safety gear and thought that state enforcement would assist her role as a responsible employer.
- The perceptions of farmers, farm workers and family members of government workers were considerably more empathetic than the experiences of many government employees may indicate from their interactions with members of the farming community. However, amongst most there was a resistance to the idea of enforcement or “regulation”. For most this was attributed to pragmatic reasons; and for a minority, because it was seen as unnecessary state interference.

3.0 DISCUSSION

This research project set out to address the following objectives: i) To identify the key agricultural risks and hazards; ii) to identify effective interventions that address these risks and hazards; iii) to identify the barriers to implementation and adoption of the key interventions; iv) to identify the critical factors which need to be considered when designing and implementing interventions. It employed a range of approaches, including reviews of international and local literature, a national computer assisted telephone survey and face-to-face in-depth interviews with stakeholders in the agricultural sector.

This discussion describes the findings of this research relating to each of these objectives. Firstly, however, we describe the recent injury experiences and current disease prevalence(s) of the responders to the national survey of farmers. These themselves, may impact on future disease and injury rates.

Injury and Disease Prevalence / Incidence

Thirteen percent of farmers from the stratified random sample of farms had had an injury in the 3 months prior to interview which had restricted their activity for half a day or more and / or which required medical treatment from a health professional. In fact, the injury outcomes for participants in this research were serious, with two thirds of workers reporting loss of work time for a week or longer.

Significantly, only a third of those experiencing injury and loss of work time in this study made a compensation claim to the Accident Compensation Corporation. This suggests that potentially the economic burden of injury in agriculture could be significantly greater than it is currently assumed to be and that our current understanding of injury rates in this sector are likely to be underestimates of the actual extent of injury amongst these workers.

Whilst there is no conclusive evidence from this study which explains the current under-reporting and/or compensation claim rates amongst these participants; the face to face interviews with a sub-sample of farmers, farm workers and their family members suggest that underreporting and low compensation claim rates may well be a consequence of the evident negation and denial of ill-health amongst participants and of a lay epidemiology which defines serious injury as that that completely incapacitates a person (permanently). There is no evidence to suggest that this underreporting is due to the nature of the relationship between participants and the Accident Compensation Corporation. Indeed there is evidence to suggest that participants were generally pleased with their interactions with the organisation when reporting and or dealing with a compensatory claim and that any tensions arose over administrating and or dealing with payments of levies rather than seeking compensation or assistance when injured.

The majority of reported injuries in this study took place outdoors and in the least hazardous conditions, on flat terrain and during fine and dry weather conditions.

A cough lasting more than three days was the most common condition. Hay fever and asthma were also common. The burden of occupational disease from noise and noise induced hearing loss was confirmed as too was the burden from musculoskeletal conditions. Respiratory conditions emerged as one of the most common ill-health conditions amongst both samples, in keeping with the known burden of airborne exposures.

Objective 1: To identify the key agricultural risks and hazards.

The research has demonstrated that the key agricultural occupational health risks and hazards on New Zealand farms parallel those in North America, Europe and Australia. The literature review of risk factors for occupational injury and disease, our national survey, and our follow-up face to face interviews confirm that the most common mechanisms for injury were agricultural machinery (including vehicles – tractors, ATVs, etc.) and livestock. Like other work, this research identified males as a high at-risk groups group at all ages. Farmers and farm workers working on economically marginal properties appear differentially exposed to hazards. Children are an important vulnerable group in this sector, being exposed to animals and machinery (ie. using or riding on ATVs and motorbikes) from a relatively early age.

Exposure to physical and ergonomic hazards, were common. Physiochemical exposures included vehicle vibration, for example whole body vibration, with shock vibration being more common in the use of all terrain vehicles (ATVs). Exposure to noise, dust and chemicals were common and herbicides were the most commonly used chemical amongst respondents. The ergonomic hazards included bending without support and lifting, manoeuvring heavy loads, and work practices that involve repetitive hand and arm movements.

Stress is an important psychosocial factor associated with occupational disease. The highest reported prevalence(s) for stress amongst the AgriBase™ sample were associated with unpredictable factors of machinery breakdown and having a farm-related accident. Unsurprisingly, farm-related accidents were reported as the predominant source of stress by responders from the ACC sample. Other dominant stressors were time pressures due to increased seasonal workload, and unpredictable factors – machinery breakdown. Farmers and their workers worked long hours and most days of the week. Fatigue is a known risk factor for injury. Multiple job holding was also common.

Amongst children, common exposures were riding on or operating ATVs, tractors, and farm bikes, other farm machinery and animals. A significant proportion of children in this sample were reported to be exposed to firearms at an early age.

Objective 2: To identify effective interventions which address these risks and hazards.

The research has updated previous reviews and documented accounts of the efficacy of primary interventions for the prevention of injury and disease in agriculture internationally. The main findings were that (a) the evidence regarding what works to prevent injury or ill-health outcomes on farms is weak and is reliant on research conducted in North America, Europe and Australia; (b) many interventions have shown little or no effect on injury or ill-health outcomes on farms; (c) there is evidence of effectiveness for some highly specific interventions, e.g. roll-over protective structures on tractors, and ergonomic interventions to prevent back injury/strain/pain; and (d) the evidence from this and previous reviews indicates that multi-faceted interventions are a promising interventional approach to improve farm safety behaviours, attitudes and knowledge.

This findings from this project suggest a need to target interventions at those most at-risk, as well as a need to move beyond solely educational interventions and toward considering more fully design/engineering, organisational and legislative/enforcement options for use alongside educational interventions. The face to face interviews with stakeholders also revealed that some interventions (i.e. those involving engineering design) were impeded by the inability of some stakeholder groups to endorse or enforce mechanical changes / adaptations to machines and vehicles. Some stressed that most machines and vehicles were designed and manufactured abroad, and so design change was very much more difficult to influence. With regard to the provision and dissemination of occupational health information to farmers, farm workers and their families, many participants stressed they were experiencing information overload and some completely ignored this dissemination strategy.

With respect to children, a promising intervention in North America is the North American Guidelines for Children's Agricultural Tasks (NAGCAT). The implementation of these guidelines was found to be effective at reducing child farm-related injuries covered under the guidelines with moderate quality evidence provided by a single RCT trial. These would obviously need to be adapted to the New Zealand farm environment, and tested in a New Zealand context, before implementation.

Objective 3: To identify the barriers to implementation and adoption of the key interventions.

Most of the participants irrespective of injury history considered they had adequate safety equipment, training and support on their farm. When compared to research conducted fourteen years ago, many now have equipment, machinery and vehicles with protective features, for example, ROPS, safety belts, passenger seats and safety starters. Yet rates of injury on farms remain high. Even where safety features are present, there are problems around unsafe behaviours. Few farmers, farm workers and their family members reported that they used seat belts on tractors, many left keys in the ignition of tractors and ATVs (opening up the possibility of children using these vehicles), and many did not wear helmets when riding farm bikes or ATVs. The face to face interviews revealed that many did not wear belts, use ear plugs, or wear helmets, because they found these protective measures inconvenient, uncomfortable or they were simply in a rush most of the time and didn't think they had time to stop and apply or wear the protective gear.

The research has revealed a number of significant barriers to the implementation and or employment of interventions which address occupational injury and disease in the agricultural sector. The absence of a clear strategy for addressing occupational health in agriculture means that whilst there are a large number of initiatives that stakeholders are engaged in (both collaboratively and independently) there is a lack of co-ordination, some duplication, and evidence that interventions are decided upon in an ad-hoc fashion. This in itself is a significant barrier to *effective* intervention in this sector. In addition intra and inter-organisational politics can impede and or serve as a barrier to effective intervention.

A number of other barriers were identified by all stakeholders. These included *economic barriers* to the procurement of adequate safety equipment, staffing on properties, and or the procurement of contemporary vehicles with inbuilt safety features (for example, tractors with cabs, tractors with ROPS, ATVs with belts).

The survey identified that the most prevalent barriers to safety were: “having to rush” and “being tired and or fatigued while working”. Pressure from neighbours, co-workers and or management also affected some participant’s ability to work safely.

The findings from the face-to-face in-depth interviews suggest that the uncritical adoption of stereotypes amongst stakeholders can also serve as a barrier to effective intervention. The problem arises:

- when it is assumed that those working in agriculture conform to the dominant stereotype – are rugged, independent, self reliant, autonomous and male;
- when those engaged with and responsible for addressing occupational health in agriculture operate with stereotypical understandings of who they are working with or for;
- where farmers and farm workers also employ stereotypical understandings of the state sector, and its employees (the nature of public servants), their responsibilities and mandates; and moreover,
- where stereotypical understandings exaggerate “difference” and ensure that commonalities with other sectors, other workers and other self employed are ignored and or not fully utilised or explored when designing, interacting or intervening with and within the agricultural sector.

Objective 4: To identify the critical factors which need to be considered when designing and implementing interventions.

This project revealed a number of critical factors that need to be considered for effective health interventions in agriculture and these include:

- That a strategy for occupational health and safety in agriculture is devised and agreed upon by all key stakeholders.

- That any proposed intervention is evidence based - or where efficacy has not been established, interventions should be implemented in the context of research and evaluation.
- That the intervention targets the key exposures/hazards for those working in agriculture.
- Assumptions made about the population are empirically based rather than reliant on an uncritical acceptance of established stereotypes.
- The economic viability of any proposal for all farming production groups; and when or if viability is compromised economically, that the intervention addresses this.
- Gender and gender relations on farms and the gendered nature of injury; and disease rates specific to males and females.
- The ability of non-deciders to influence deciders on properties. For example, children influencing parents, or workers influencing managers.
- The ability to enforce, monitor and evaluate interventions has been considered and addressed.
- What “engineering design” interventions are possible in New Zealand, given that most equipment is designed and manufactured abroad and where few vehicles have been designed, specifically with New Zealand terrain and production uses in mind.

4.0 RECOMMENDATIONS/IMPLICATIONS

1. *There is common recognition of the need for an agreed upon strategy that is evidence based. In the absence of this there will continue to be coordination issues, a lack of coherence, issues surrounding the efficacy of specific interventions, duplication of effort and a concentration of effort at the macro level (with little or no involvement at meso and micro levels).*
2. *A programme for the development of appropriate interventions to reduce the burden of agricultural injury and disease needs to be formulated. It is recommended that a programme involving the development of appropriate interventions to reduce the burden of agricultural injury and disease be formulated. Any proposed intervention should be evaluated in New Zealand for efficacy in one or more trials. If found to be efficacious under controlled conditions, the proposed intervention should be tested and evaluated for its effectiveness under ‘field’ conditions. If the intervention effect is positive, only then would the intervention be implemented on a national basis.*
3. *Addressing the key injury and poor health causes. Interventions need to be designed to address the key exposure/hazards faced by the farming community. Targeted interventions have a greater likelihood of success.*
4. *Interventions need to reach beyond educational interventions and be multifaceted. Interventional approaches other than educational approaches need to be considered to address the multitude of mechanical, physical, biological, chemical, musculoskeletal and psychosocial hazards faced by farmers within the farming*

environment. Interventions that have the hierarchy of control as a keystone are most likely to succeed. We recommend the use of a multi-faceted interventional approach where interventions should be truly multi-faceted, including combinations of relevant, policy, work place organisation, educational, engineering/design and regulatory interventional components, where applicable.

5. *Consideration of the barriers to implementation of interventions.* Intervention design needs to consider the barriers to implementation. For example, interventions need to address and include those farmers resistant to safety improvement in farming; those with poor health and where safety conditions are far from optimal. Steps such as identifying high risk, more resistant farmers at initiation of the intervention and providing targeted interventions for these groups may improve the outcome of the intervention. Other barriers that need to be considered include: economic, different definitions of what constitutes serious injury and behavioural responses to ill health, perceptions of difference within the sector and ensuring that any future initiatives involve full engagement from the rural community. Dissemination of occupational health information to farmers, farm workers and their families needs to include more than written communications.
6. *Sustained support.* Interventional programs work better if sustained over time in a supportive environment (i.e. support networks, follow-up contact, booster interventions, farmer empowerment). The potential for promotional activities to build upon existing programs with sustained support should be considered (i.e. take place during times of heightened farm health and safety activity and have the support of key stakeholder groups). Interventions are more successful if programs can be delivered in a receptive environment and having rural community involvement in the design of interventions is important.
7. *Novel farm health and safety interventional approaches and leadership.* Many approaches target the farmer or farm manager and attempt to influence through the farmer as the key decision maker in the farming operation. There is a whole chain of people involved in agriculture who may be used to influence agricultural health and safety (i.e. financial and insurance groups, commodity groups, commodity purchasers, contractors and farm workers and their families). Alternative targets for intervention also need to be considered.
8. *Pilot testing interventions in the New Zealand agricultural context.* Any future interventions targeting the agricultural industry in New Zealand need to be piloted and evaluated for effectiveness in reducing agricultural injury and disease in the New Zealand agricultural context (for NZ farmers and on NZ farms), before being implemented nationally.

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