RURAL TRAINING PROGAMS: EFFECTIVENESS AND PROFITABILITY

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This Thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the Thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the Thesis.

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ABSTRACT

A diversity of groups including the National Farmers Federation, politicians and business leaders, stress the need for farmers to upgrade their skills in order to compete effectively on international markets. There are public demands for improved environmental management of farming land which require farmers to make changes in addition to those changes required for global competitiveness. These calls for change come at the same time as Australia reforms its training system.

The National Farmers Federation believes that farmers will be motivated to participate in education and training if it can be shown that training leads to changes which improve farm profitability. Hitherto there has been a lack of empirical data on the effectiveness of training in agriculture and a consequent uncertainty about what sort of training and which delivery modes are most effective in facilitating profitable changes to farm management or agricultural practice.

A multi-method methodology was used in this study. A large sample of Australian farm businesses from the Australian Bureau of Statistics' Agricultural Financial Survey 1993-94 provided cross-section, quantitative data on farm managers' education levels, recent and planned participation in training and changes to practice, in addition to financial data. The quantitative data were analysed within constraints imposed by the Australian Bureau of Statistics in relation to confidentiality and the amount of technical support allowed for analysis.

This quantitative data set is illuminated by a semi-structured interview survey of 65 Tasmanian farmers, 45 of whom had completed one of three agricultural courses. The methodology proved most appropriate with the quantitative and qualitative data providing a richer understanding of farmers, change, training and profitability.

The findings relate to (i) the relationship between education/training and profitability, (ii) the relationship between training and change, and (iii) future training.

Considering farm businesses of similar asset value, large farm businesses managed by those with formal, agricultural qualifications are more profitable than other farm businesses, and more profitable farm businesses of all sizes tend to participate in more training.

Farm businesses where there are changes to practice which are intended to improve profitability are more profitable than those where there are no changes. Also, farm managers who participate in training are more likely to make changes to their practice.

Whilst a large proportion of farm business managers intend to participate in some training in the next three years, most intend to participate in training about agricultural practices. In contrast, areas identified by 'experts' where practising farmers require training are management practices, marketing, and communication skills. Farm managers with a low level of education are less likely to train and less likely to intend to train in the future. The study makes some suggestions about program attributes which would contribute to effective training delivery in the future.

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CHAPTER 1

INTRODUCTION

Farm businesses operate in a climate of on-going change. This chapter sets out the contexts of the changes which impact on farm businesses, starting from a global perspective, moving on to a national perspective, and then an agricultural industry perspective.

Education and training is identified as a means for facilitating change at national, industry and individual business levels. The words 'education and training' are used in this thesis to refer to general education and industry-specific training. Governments, industry and individual farm businesses all have an input into the ease with which individuals can access available education and training. This chapter briefly examines general government education and training policy, and then the views of national industry and business leaders on education and training.

A large part of the chapter is devoted to issues of the farm workforce's participation in education and training. This part of the chapter compares participation rates, first, with Australia's international competitors, second, with other industry sectors and third, there is a discussion of the differences between urban and rural participation in education and training. Next, factors which influence farmers' motivation to train are considered.

A brief discussion of the areas where farmers should be making changes to their practice precedes the final section, which comprises the research questions of this thesis.

1. Global and domestic change

The fortunes of Australia's agricultural sector have a substantial impact on the Australian economy; the rural sector contributed 29% of Australia's merchandise exports in 1994-95 (Martin, 1996). Most of Australia's agricultural production is sold in the global marketplace, where our farmers are 'price-takers' who do not supply a sufficient proportion of the world production to influence the prices they receive. Farm businesses are directly exposed to global competitive pressures and subject to international economic cycles. The terms of trade received by our farmers have declined substantially in recent years (Australian Bureau of Agricultural and Resource Economics, 1996).

Until now, Australia has been able to achieve high productivity in agriculture compared to other countries. This is because Australia has had a comparative advantage in agriculture, largely due to our large quantity of relatively cheap land (Blandy & Brummitt, 1990). There is no guarantee that this advantage will continue to be sufficient for farm business to compete successfully, as changes continue in trading arrangements. For example, there have been recent changes to the protection policies of our competitors, such as the United States and the European Community, and to regional trading agreements, for example, the establishment of trading blocks in Asia and North America.

Products need to be of consistently high quality to compete with products from around the world, and to satisfy the increasingly discerning consumers in the growing Asian food market. Strict regulations on chemical residues in food imposed by overseas markets such as Japan, coupled with domestic concerns about the impact on the food chain of the use of chemicals in agriculture, require farmers to rethink and change many of their traditional on-farm practices. Not only must there be changes on the farm, there must also be changes in farmers' relationships with others in the 'marketing chain'. A cattle producer, for example, must communicate with those from whom stock are purchased about previous chemical treatment of the stock; communicate with cattle buyers about fat requirements; and communicate with the abattoir about the condition of carcasses after slaughter. It is no longer sufficient to load the cattle onto the truck then wait for the cheque to arrive (Falk & Kilpatrick, 1996).

The changes occurring in global markets are parallelled by domestic changes, many of which have had an unfavourable impact on farm businesses. Deregulation of domestic markets, disbanding of marketing authorities such as the Apple and Pear Marketing Board, a policy of reduction in government support in times of poor seasonal conditions, and removal of tariffs and other import restrictions have exposed those selling on domestic markets to more competition (Mahoney, 1996; Murray-Prior, 1996; Miller, 1994).

Further pressures for farmers to change their farming practices come from a growing awareness of environmental degradation in both urban and rural Australia.

Since farm businesses are operating in global and domestic contexts which are characterised by on-going change, it is essential for the agricultural sector that Australia's farmers are adept at dealing with change. Because of the importance of agriculture's contribution to the Australian economy through exports, having farmers who are skilled in dealing with change is a national imperative.

2. Change and education and training

The link between education and training and economic outcomes is change; that is adaptability, flexibility and responsiveness to changes in technology, markets, the environment and input costs. The importance of education and training for enhancing economic performance and dealing with change is recognised internationally, for example, in this World Bank discussion paper by Haddad (1990):

> Education has been recognized as the cornerstone of economic and social development. Now it is even more important as technological change and new methods of production transform the world economy. (Haddad, 1990).

OECD and government reports have identified low levels of participation in post-school education and in training as an impediment to economic growth and international competitiveness, for example, Economic Planning Advisory Commission (1995b), Carmichael (1992) and Finn (1991). The following quote from an OECD report suggests that changes are required in Australia's education and training system in order to match changes in other countries:

> Australia's system of education and training [has] not been capable of keeping up with increases in educational attainment overseas and [has been biased against vocational skills... (Organisation for Economic Cooperation and Development, 1992)

Australian reports, such as Clare and Johnston (1993), Mayer (1992) and Finn (1991), also espouse the view that education and training assist in dealing with change. The following quote from an Economic Planning and Advisory Commission report by Clare and Johnston (1993) links education to the ability to respond to change:

> An educated workforce should be more flexible and adaptable to changes in technologies and workplace methods, and thus more productive. Training and re-training in particular are essential to maintain workforce flexibility and adaptability and to provide competence and foster creativity. (Clare & Johnston 1993, 9)

Several Australian reports have identified a need for continuing education and training for those already in the workforce in addition to entry level training. One such report is Finn (1991), which suggests that initial post-compulsory education and training should be followed by an on-going commitment to learning for work.

> Traditional notions of separation between education and work, especially the notion of a one-off period of education followed by employment, will be replaced by an integrated concept of work intertwined with lifelong learning commencing with post-compulsory education and training. (Finn, 1991, 6-7)

2.1. Government support for education and training

Most of Australia's competitors and trading partners in the international economy have national skills development policies (for example, Japan, United States, Korea, Malaysia, Singapore) as do those countries such as the United Kingdom, New Zealand, Germany, France and Sweden which have traditionally been benchmarks for Australian education and training policies (Fitzgerald, 1994). Government support for training at an enterprise level exists in many countries. For example, Ploszajska (1994) describes a system of extensive support for enterprise level training in Britain. Skills development policies may also address changing demands for skills as some industries decline whilst others expand. For example, in the United States, the Clinton Administration's Re-Employment Act provides training for workers who lose their jobs as a result of economic restructuring (Fitzgerald, 1994). Australia's National Training Reform Agenda recognises the central place of training in achieving international competitiveness (Australian National Training Authority, 1994).

The reform of vocational training in Australia in recent years follows from the reports of Finn (1991), Mayer (1992) and Carmichael (1992). The reform agenda reflects a belief in the link between training, change and economic competitiveness. One of the aims of the National Training Reform Agenda, outlined in the Australian National Training Authority's *Toward a Skilled Australia: A National Strategy for Vocational Education and Training*, is to:

> ... raise the skills profile of the labour force to better equip the nation to adjust to change and to increase our general level of international economic competitiveness. (ANTA, 1994, 6)

The National Strategies Conference, convened by the Economic Planning Advisory Commission, identified Australia's national goals as "a country that is both creative and productive and inclusive and ecologically sustainable" (Keating, 1995). Two of the four key future priorities for achievement of these goals are particularly relevant to education and training in agriculture, namely:

- further development of Australia' capacities as an ***Innovative Nation*** in each of the economic, social and environmental spheres;
- reinvigoration of the commitment to a ***Sustainable Australia*** through ecologically sensitive activities and policy development. (Keating, 1995)

The Liberal-National Party government elected in March 1996 also recognises the need to improve Australia's skills base, with policies which focus on youth training through its Modern Apprenticeship and Traineeship System. The government also has specifically acknowledged the need to enhance the education and skills base of farmers, farm workers and support industries (Anderson, 1996).

2.2. Industry and business support for education and training

Business support for education and training has increased in recent years (Maglen, McKenzie, Burke & McGaw, 1994; Business Council of Australia, 1993). Business leaders stress the role of education and training in

Australia's future (Allan Moss in Economic Planning Advisory Commission, 1995a; Ralph, 1994; Ritchie, 1994).

> ...the two most important measures of national success are economic growth and social harmony - and education and training skills are central to both. ... Today, that link is nearly as critical in primary industry as it is in manufacturing and services. (Allan Moss in Economic Planning Advisory Commission, 1995a, 215)

At the same conference, corporate leader and then Chairman of Wool International, Richard Wharburton, listed the skills required for economic growth and asked how best our education and training system can produce people with these skills. Skills that he suggested were required included:

> - lifelong learning; ...
> - excellent communication skills;
> - flexible adaptive technical skills with a base of strong general skills ....
> - accepting change and continually developing skills as required. (Economic Planning Advisory Commission, 1995a, 228)

He advocated that:

> The educational sectors must seek to include;
> - a more thorough and broader preparation for the workforce;
> - a greater commitment to workforce retraining, especially for those people with no post school qualifications; and
> - introducing and accepting concepts of 'best practice' and quality across the board. (Economic Planning Advisory Commission, 1995a, 4, 229)

Like the government reports discussed in the previous section, business and industry leaders perceive the need to have a workforce which is more flexible and better able to respond to change. Education and training are regarded by business and industry leaders as the means for achieving this change in the workforce. Their view of education and training as the means for improving the flexibility and adaptability of the workforce is in accord with the broad thrust of government policy for upskilling the Australian workforce.

2.3. Managers, change and education and training

Managers hold a crucial position in determining how their organisations and businesses respond to changes in their environment. Managers are responsible for allocating the human, financial and physical resources of their organisation so as to maximise the organisation's performance. They are also responsible for anticipating changes which could bring threats or opportunities to their organisation, and ensuring that the organisation responds, or changes, appropriately. The following quote from management author Gareth Morgan (1988) illustrates the importance of awareness of changes which are occurring, and of making changes accordingly.

> Increasing turbulence and change will require organisations and their managers to adopt a much more proactive and entrepreneurial relationship with the environment, to anticipate and manage emergent problems, and to create new initiatives and directions for development. (p 4)

The Karpin report (Karpin, 1995a) into management education in Australia stresses the urgent need to improve the skills of managers of businesses of all sizes. In the following quote Karpin concentrates on the need to upgrade the management skills of the managers of small and medium-sized businesses.

> Good managers are the key to a more competitive economy and better performing enterprises. ... We must upgrade the capacity of vocational education and training, and of business support, to improve the skills of managers in small and medium-sized enterprises. (pp 10-11)

3. The agricultural sector, change and education and training

There are both macro and micro imperatives for Australian farmers to become more able and willing to respond to change. As suggested in the first section of this chapter, at a macro level, farmers need to be adaptable, flexible, and willing to accommodate change if Australia is to compete effectively in global agricultural markets (National Farmers' Federation, 1993). In order for the macro situation to change, there must first be change at a micro level. That is, individual farm business must be willing and able to adopt new technologies and practices. There is evidence that there has been insufficient willingness to change on the part of farm businesses, as the following quote suggests:

> Rural industry research councils .... have been increasingly concerned about what they perceive as the widening gap between research output and farm practice (i.e., adoption). Primary Industries and Energy Minister, John Kerin, in listing his top seven issues for making agriculture sustainable in the 1990s placed at the top: "What are the barriers to farmers adopting known, economically viable, environmentally sound technologies and practices?" (Ison, 1990, 102)

While Kerin claims that there has been insufficient uptake of research among farmers, there is evidence that some farmers are prepared to make changes to their technical agricultural practices by taking advantage of new technology. These changes have led to improvements in productivity, as suggested by the following quote from a National Farmers' Federation report by Ferguson and Simpson (1995):

> The significant erosion in farmers' terms of trade world-wide has encouraged farmers to sustain substantial increases in productivity .... This has been possible through the uptake of significant advances in technology by Australian farmers. (p 5)

A Department of Primary Industries and Energy (1988) report into rural post-secondary education suggests that the education and training which has occurred in rural Australia has made a substantial contribution to the improvements in productivity. This report confirms that there is a link between education and training and farm business outcomes:

> ... it would appear that education and training have played a key role in facilitating the outstanding productivity growth experienced by agriculture in recent years. (Department of Primary Industries and Energy, 1988, 8)

Changes to technical agricultural practice are not the only class of changes which can be made in farm businesses. Other areas of farm management practice include financial management, marketing, and the increasingly prominent area of environmental management. The National Farmers' Federation identified increased participation in management training and establishment of a training culture as priorities in its strategy document entitled *New Horizons: A Strategy for Australia's Agrifood Industries* (National Farmers' Federation, 1993). In this document, the National Farmers' Federation emphasised the need for training and flexibility in order for the agricultural sector to remain internationally competitive.

> ... the skills required of farmers in the past in order to succeed in agriculture will in future need to be supplemented with additional skills in order to cope with the changes that have emerged over recent decades. Good technical skills in crop and livestock husbandry will need to be supported with skills in financial management... and with skills in risk management. This is not to say that good technical skills are of any less importance than in the past, but in the future, additional skills will be pivotal to the survival of farm businesses... (National Farmers' Federation, 1993, 75-76)

Thus, the National Farmers' Federation shares the belief of government, industry and business leaders in the links between training, willingness and ability to make changes, and economic competitiveness. The National Rural Finance Summit held in July 1996 confirmed a strongly held belief amongst the leading section of the agricultural industry that education and training is essential for managing and promoting the changes that must occur if farm businesses are to be viable and sustainable in the twenty-first century (Asimus, 1996). One of the outcomes of the summit was the establishment of a National Rural

Finance Summit Activating Committee. The Activating Committee is to develop workable proposals coming from the recommendations of the Summit and identify further action. The first newsletter published by the Activating Committee stated that education and training were a recurring theme at the Summit and that education and training are a mechanism for assisting farmers to deal with change.

> Education and training were identified as key mechanisms by which enhanced productivity, initiative, financial self reliance and smooth adjustment could be better achieved. ... Farmers need to be able to identify challenges arising out of change and how best to deal with those challenges. ... attitudinal change is a complex and long term task which needs to be addressed through education... (National Rural Finance Summit Activating Committee, 1996, 1-2)

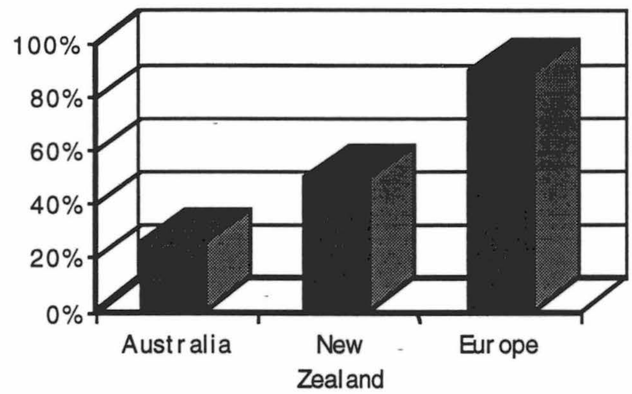
3.1. How does agricultural education and training compare with other countries and other sectors?

An earlier quote from the OECD report (1992) suggested that the Australian education and training system had not kept up with the systems of countries which are our international competitors. There is evidence that the Australian farm workforce is less well qualified than the workforces of our overseas competitors, and is less likely to train than other sections of the Australian workforce.

3.1.1 Our competitors in agricultural markets

Bell and Pandey (1987) pointed out that Australian farmers have lower education qualifications than overseas farmers and than Australians in other vocations. Cameron and Chamala (1993) found that only 25% of the Australian farm workforce had school leaving, trade or higher qualifications in 1992, compared to 50% in New Zealand and up to 90% in Europe. These are countries which are some of our major competitors in global agricultural markets. Chudleigh (1991) estimated that only 11.7% of new entrants to Australian agriculture per year had tertiary agricultural education, and only 4.7% had farm management training.

Percentage of farm workforce with school leaving or higher qualifications, 1993



Source: Cameron & Chamala (1993)

The data presented above suggests a need for increased participation in post-compulsory education and training in order for the farm workforce to be more responsive and adaptable, and consequently better able to compete on international markets.

3.1.2 Other Australian industry sectors

Australian Bureau of Statistics (1994) reports that 23.6% of employees in the agriculture, forestry, fishing and hunting industry group had post-school qualifications compared to 47.8% of all Australian employees.

Training activity in Australia is measured by the Australian Bureau of Statistics' *Employer Training Expenditure, Australia* (1994) which measured training expenditure and activity over a 6 month period in 1993. Training, which includes on-the-job training, averaged 4.1 hours per employee over six months for small employers (one to 19 employees), and 5.3 hours for employers of 20 to 99 people. Only 18% of small employers reported training expenditure, compared to 80% of those employing between 20 and 99 people.

On an industry basis, 79.7% of employees in the agriculture, forestry, fishing and hunting industry group received some training in the six month period (the lowest of any industry group), compared to 85.8% of all employees, including, 80.1% in manufacturing, 84.8% in construction and 91.2% in mining. The same trend is evident for external training, where 7.2% of employees took a training course in the agriculture, forestry, fishing and hunting industry group, compared to 11.8% overall.

3.2. Rural participation in post-compulsory education and training

Rural participation in post-compulsory education and training is lower than urban participation. Well over 90% of farm businesses are family owned (Australian Bureau of Agricultural and Resource Economics, 1996), and many are passed on from one generation to the next. Hence, most of the farm workforce not only lives in rural Australia, but also grew up in rural Australia. The comparatively low level of educational qualifications of the farm workforce quoted above is likely to be related to the lower participation of rural Australians in post-compulsory education.

Relatively low participation in education and training is both an equity issue and an economic issue (National Board of Employment, Education and Training, 1991; Department of Primary Industries and Energy, 1988; Clarke, 1987). The economic aspects of lower participation in education and training are those which have been discussed above; they are related to reduced flexibility, adaptability and willingness to change, and to reduced awareness of changes in the farm business's environment which offer opportunities or pose threats to the farm business. The macro level

outcome of lower participation in education and training is being less competitive in international markets, which in turn means a lower rate of economic growth in Australia.

The equity issue is complex. Its dimensions range from inadequate access to the full school curriculum in secondary school, which limits opportunities for future study, to the travel time and associated costs of accessing post-compulsory education and training which are incurred by those living at a distance from where the education training is delivered.

Government reports identify several barriers to rural participation in education and training related to provision of suitable courses, financial considerations and lack of information about possible education and training opportunities. The National Board of Employment, Education and Training (1991) argued that lack of access to appropriate, relevant, quality education and training opportunities is the major reason for low rural participation in education and training. It identified locational and consequent financial barriers to access. The Commonwealth Tertiary Education Commission and Department of Primary Industries and Energy (1987) identified low rural incomes and the high cost of education and related expenses, lack of information about suitable courses and inadequate provision of education and training in rural areas as barriers to participation. Clarke (1987) identified lack of suitable port-secondary education opportunities in rural areas, lack of information about educational opportunities and the relatively high cost of participation in post-secondary education for rural Australians as barriers to participation in post-secondary education.

Many farm managers have a relatively low level of formal school education, largely because of lack of opportunity. The average age of the chief farm operator or manager in Australia is 53 years. Therefore, most of the current chief farm operators did their formal education in the 1940s and 1950s when very few people in rural Australia were able to go beyond year 9 at school (Ferguson & Simpson, 1995). Prior educational experience as a barrier and/or fostering factor to participation in further education and training is explored further in Chapter 2.

These equity issues are closely related to economic outcomes, through the economic performance of the farm businesses which are managed by those with reduced opportunities for participation in post-compulsory education and training.

The picture of lower rates of participation in post-compulsory education and training compared to urban Australia is balanced by a substantial increase in the qualifications of those living in rural Australia in recent times, albeit from a low base level of qualifications (Epps, 1993). Farm women tend to be better educated than their husbands, but their qualifications are mostly in non-agricultural areas (Woodford & Collins, 1993).

3.3. Motivating farmers to train

There are sections of the agricultural industry which are sceptical about the value of education and training: they say that farmers have always managed without much education. Historically, there has been an assumption that if you provide people with land they will know by instinct how to be effective farmers. In the past, less academic sons have traditionally worked on and inherited the farm. They are less disposed towards formal courses which are viewed as too theoretical for 'practical' farming. These attitudes were found, for example, by Lees and Reeve's (1991) in a review of competencies required for farming, and by Moore (1990) in a New Zealand study. They are reiterated by the National Farmers' Federation (1993):

> Most farmers continue to put local knowledge, the willingness to work hard (for extended hours) and the ability to work reliably without close supervision ahead of trade or university qualifications in farming when listing the important characteristics of a farm manager. (Moore, 1990, 5)
>
> The most difficult barrier to improving managerial skill levels in agriculture is to develop a recognition among farmers of the need for additional skills... (National Farmers' Federation, 1993, 76)

Farm businesses are overwhelmingly small businesses; 99.6% of Australian farm businesses are family owned (Australian Bureau of Agricultural and Resource Economics, 1996). Because they own and operate the farm businesses, the attitudes of the family members who manage farm businesses are the key determinants of the level of education and training in the industry. Industry leaders are very interested in 'proving' that education and training has an impact on the bottom line. They want to motivate all farmers to participate in education and training. Industry leaders also want to persuade those with control over funding of the benefits of investing in agricultural education and training. The funding provided by agricultural industry bodies for the research study of which this thesis is an outcome, is an illustration of the importance which industry leaders place on obtaining accurate information about the impact of education and training on their industry.

Background information to the Karpin Report (Karpin, 1995a) illustrates the importance of considering the managers of small agricultural businesses when talking about Australian management skills. Eighty percent of businesses have four or fewer employees and the majority of these small businesses are in agriculture and personal services (Andrewartha, 1995). Two thirds of the Australian farm workforce are classified as farmers or farm managers and only one third as employees or other workers such as shearers (Australian Bureau of Statistics data in Ferguson & Simpson, 1995). The high proportion of the agricultural workforce who are in managerial roles points to the importance of management skills and strategic planning ability for the future of Australian agriculture.

4. What sorts of changes should farmers make?

Many possibilities for change exist on Australian farms. The range of choices includes, which enterprises to engage in and technical choices about how to manage those enterprises; financial choices such as, where to borrow, how much to borrow, whether to invest returns on- or off-farm; how and where to market the farm production; and choices about how to manage the land, for example, consideration of long and short term costs and gains of conservation practices.

There appears to be some consensus that many farmers do make changes to their agricultural practices, but no such consensus emerges in relation to farmers' willingness to make changes in other areas of the farm management, such as financial management, marketing and land management. Changes in the non-technical agricultural areas are essential. The National Farmers' Federation strategy document quoted earlier suggested that changes required for the survival of farm businesses are related not only to the technical aspects of agriculture, but also to management.

Financial and marketing skills which enable farmers to make appropriate changes to their practice have been identified as important for farm business survival (National Farmers Federation, 1993). Inadequate business and/or financial management skills have been identified as the main reason for small business failure (Carr, 1992) and farm business failure (Mahoney, 1996; Edwards, 1993) in Australia. Farmers themselves identify responding to risk by making appropriate financial management and marketing decisions as important for farm viability, for example, Van Tassell and Keller (1991).

Agriculture is under pressure in rural Australia from other industries such as mining and tourism, and from the increased environmental awareness of the general public (Epps, 1993). Land degradation is a major problem in agriculture in Australia (Mahoney, 1996; Evans, 1996). Farmers are under pressure to change their land management practices to ensure sustainability of land and water resources. Their use of chemicals in pesticides and fertilisers and subsequent impacts on the food chain is under increasing scrutiny (Fulton, 1994). These pressures on farmers to manage the land and water resources responsibly and sustainably, are evidenced by initiatives such as a recent project which established benchmarks for farm sustainability (Rendell McGuckian, 1996).

At a more general level, farmers need skills in recognising opportunities and threats to their business, and responding appropriately. Some of these skills are related to being aware of the available research output (Ison, 1990) others are related to being aware of and interpreting market signals.

Another major area for change is the development of a training culture in agriculture. A training culture is the prerequisite to increasing participation in education and training in agriculture, and in rural Australia more generally. Benefits in terms of increased willingness and ability to change and a resultant improved economic performance will flow from establishment of a training culture in agriculture.

If education and training do impact on farm managers' propensity to make changes to their farm management practice, and those changes do impact on farm business profitability as the discussion to this point implies is the case, then it is essential to identify those factors which foster and hinder farmer participation in training.

5. Research questions

Five research questions emerge from the issues considered in this chapter and are addressed by this thesis. The first question relates to the economic impact of education and training on farm businesses. It is:

1. What impact has training had on farm profitability?

Two research questions emerge from consideration of the role of change in farm management. They are:

2. What 'triggers' farm managers to make major changes to their farming practices?
3. What are the support mechanisms or who are the people who mentor farmers as change is undertaken?

Two final research questions emerges from a consideration of fostering and hindering factors to participation in education and training, and the areas of change which are necessary for future farm prosperity. They are:

4. What are the reasons which foster farmer, and their workforce, participation in training?
5. What are the future training needs in agriculture?

Each is discussed in turn below.

5.1. What impact has training had on farm profitability?

The scope of 'training' investigated is broad, ranging from formal qualifications from agricultural colleges and other institutions to seminars and field days. It includes technical agricultural training (ranging from Agricultural Science degrees to field days), management training (university degrees to bookkeeping courses) and training in sustainable agriculture. The impact of 'advice' from agricultural extension officers and development authorities, fellow farmers and others is also relevant. In practice it is difficult to distinguish between 'training' and 'advice'; for example, is watching a video on using chemicals 'training' or 'advice'? To help clarify these and other issues, both training and advice are considered in this thesis.

5.2. What 'triggers' farm managers to make major changes to their farming practices?

The discussion above says that the provision of training is widely regarded as increasing adaptability and so facilitating adjustment to changing conditions and opportunities. There are 'triggers' to change including training itself, advice from government authorities, agricultural companies, consultants, accountants, bank managers and informal exchanges with fellow farmers and employees.

Are some 'triggers' (including different types of training) more successful in precipitating change than others? Do some 'triggers' result in more profitable changes than others? Does the amount of education and/or training of those involved in the farm influence the likelihood of change? Are there other factors that influence the likelihood of change?

5.3. What are the support mechanisms or who are the people who mentor farmers as change is undertaken?

Farmers must be supported when making major changes as well as being persuaded to change. Support is essential in the success of a major change or innovation. The nature, type and duration of this support are key factors that are investigated.

5.4. What are the reasons which foster farmer, and their workforce, participation in training?

Government and industry bodies have expressed concern about low training participation rates in agriculture. The National Farmers' Federation document, *New Horizons; a Strategy for Australia's Agrifood Industries* (1993) which arose out of discussions across Australia with farmers, farm organisations and government, identified as a priority for a more competitive and profitable agrifood sector "acquisition of broader managerial skills including finance, risk management and marketing."

This leads to the questions: Which delivery mode is most acceptable (and effective)? How important is the location of a training program? Are there personal or farm characteristics (for example, education, age, value of farm business assets) which influence participation rates?

5.5. What are the future training needs in agriculture?

The first four questions provide a data base to consider this final question; that is, how to implement a training strategy to improve farm profitability. Both effective delivery modes and content are relevant to planning.

6. Structure of the thesis

The structure of the remainder of this thesis is as follows. The next chapter consists of a literature review of works from a variety of disciplines including education, economics and sociology. Chapter 3 describes the methodology used to address the research questions. Chapter 4 presents the results of the research conducted, as described in the methodology chapter, and the final chapter, Chapter 5, is a discussion of the results in the light of the literature reviewed in Chapter 2. Chapter 5 also contains conclusions from the thesis and recommendations for further research.

CHAPTER 2

LITERATURE REVIEW

This chapter is structured around the five research questions. More general literature relevant to each question is discussed first, followed by literature relating to agriculture. The exception is the second focus question, concerning triggers for changes to practice (section 2.), where much of the research effort has been in agriculture. In this section agricultural and general literature are considered together. To assist the reader, summary tables of relevant research studies appear at the start of a number of the sections.

1. Research Question 1: What impact does education and training have on economic indicators?

1.1. Macroeconomic and industry level

Education and training are widely acknowledged as contributors to national economic well-being and growth, as discussed in Chapter 1. Countries with higher levels of income generally have higher levels of education; human capital, which includes both formal education and informal on-the-job training, is a major factor in explaining differences in productivity and income between countries (Hicks, 1987). Two writers who stress the importance of education for a nation's economic success are Porter (1990), writing in his influential book, *The Comparative Advantage of Nations*, and Lundvall (1992), a Scandanavian writer and researcher on the role of learning in organisations and networks of organisations within nations:

> Education and training constitute perhaps the single greatest long term leverage point available to all levels of government in upgrading industry. (Porter, 1990, 628)
> First, it is assumed that the most fundamental resource in the modern economy is knowledge and, accordingly, that the most important process is learning. (Lundvall, 1992, 1)

Advances in knowledge (including diffusion of knowledge) is the most important of the factors which contribute to productivity growth, followed by changes in the quality of labour (of which education and training is the major component) according to a British study by Kendrick and Grossman (quoted in Blandy & Brummitt, 1990, 7). Specific, or on-the-job, training is an important factor in increasing productivity. A study by the American Society for Training and Development found that over half the productivity increases which occurred in the United States between 1929 and 1989 were due to learning on the job, and that people given formal workplace training have a thirty percent higher productivity rate (Business Council for Effective Literacy, 1993).

Whilst there is a widespread consensus that investment in education and training promotes economic growth, international comparisons of the impact of education and training on macroeconomic indicators do not provide clear cut evidence of the relationship between education and economic growth (Sloan, 1994; Maglen, 1990; Leslie & Brinkman, 1988; Gottchalk, 1978; Blaug, 1972). Maglen (1990) goes so far as to suggest that there is no quantifiable evidence that education affects national output from either cross-country studies or time-series studies within a country. The increased participation in post-compulsory education and training in Australia in recent years has not coincided with a significant rise in labour productivity, or output per hour worked (Maglen, McKenzie, Burke & McGaw, 1994). There are, however, some difficulties in accurately measuring labour productivity, particularly in the tertiary, service sector of the economy which has been expanding relative to the primary and secondary sectors. Also, it is difficult to disentangle the contributions of capital and labour to total productivity (Maglen, McKenzie, Burke & McGaw, 1994) .

The income of education graduates and non-graduates or apprentices and the 'non-qualified' can be used to compare relative contributions to national output (gross domestic product) and to compare individual income. Such 'rates of return' studies include Dockery and Norris (1996), Maglen (1995), Chia (1991), Leslie and Brinkman (1988) and Miller, (1984).

The rate of return model assumes earnings are an accurate measure of productivity. It ignores the possibility that education itself does not increase productivity, but is used as a screening device by employers to select employees with 'high productivity' characteristics. Additionally, the external benefits of education are not captured. External benefits include the impact of the management skills of well educated managers on their staff's productivity, and an increased willingness to invest in new technology. Because they consider life time earnings, rate of return studies reflect historical income trends rather than the impact of education on current income and output (Blaug, 1992).

The most recent rate of return study (Dockery & Norris, 1996), using data from the 1991 Australian census, found some rates of return to apprenticeships were negative, especially for females, while the highest rate of return was for electrical mechanics. Maglen (1995), using Australian data for 1989/90, found a rate of return to individuals on a university degree of between 12% and 20%, depending on gender and the school leaving age used for comparison. Rates of return to a degree are higher for males, and higher when compared to a school leaving age of 18 rather than 15 years. Overseas studies, such as those summarised by Haddad et. al. (1990) and Woodhall (1987), also find positive rates of return to university degrees of a similar or slightly lower order. For example, Leslie and Brinkman (1988) calculate a mean rate of return of 12.4% for male first degree graduates in the United States. McMahon, Jung and Boediono (1992) find rates of return to vocational or technical education in Indonesia of between 8% and 29% depending on gender and province. Education also increases productivity, as measured by income, for less skilled workers, for example, a study of manufacturing workers in the United States finds that better educated workers earn more (Daily Report Card, 1996).

1.1.1 Does education cause economic growth or does economic growth induce higher levels of education?

The rate of return model is the way in which the traditional neo-classical economic theory of labour markets, known as human capital theory, explains the decision of individuals and society to invest in education and training. Individuals and society undertake education or training, according to human capital theory, if the rate of return is positive, that is, if an investment of time and money in education and training will return a greater financial reward than investing that same time and money elsewhere in the economy, for example by doing unskilled work. Human capital theory also maintains that education causes increases in productivity and economic growth in firms and nations (Norris, 1993). This is society's return on its investment in education and training.

Several writers argue that the relationship is actually more complex, and the direction of causation is not only from education to economic growth.

> Human capital plays a dual role in the process of economic growth. As a stock of knowledge, it is a source of technological change. At the same time, the formation of skills in the work force is, in part, induced by changes in technology. (Mincer, 1989, 31)

Doucouliagos and Hopkins (1993) also hold that human capital formation, productivity and economic growth are interrelated and interdependent. Investment in education and training aids economic growth, but also increases as a result of growth. Reduced productivity can hinder human capital formation, and productivity will decline as a result of lower human capital formation.

1.1.2 Global change and education

Changes impacting on Australia as part of the rapidly evolving global economy imply a major role for education and training. The occupational structure of the economy must change as it continues to open up to international competition. Labour intensive production of physical goods and the associated low skilled and unskilled jobs is moving to low wage countries such India and China. A relatively high wage country such as Australia will require more people skilled in generic skills, adaptability, problem-solving and creativity; that is people with skills which can sustain higher wages (Maglen, 1994).

Economic success for the whole economy in the future will depend on the skills of what Reich (1991) terms 'symbolic analysts'. 'Symbolic analysts' are adept at the 'management' skills of problem solving, problem identification and strategic brokering. These people will generate economic activity to employ other workers in service industries as well as those directly employed.

1.1.3 Summary of the impact of education on macroeconomic indicators

Overall, then, the evidence regarding the impact of education and training on macroeconomic indicators is mixed. This mixed result applies particularly to the evidence from the economic studies, such as the 'rate of return' studies and Maglen's (1990) comparison of macroeconomic indicators from a number of countries. As mentioned above, the economic studies in this area suffer from a number of problems. Chief among these problems are first, they necessarily rely on historical data rather than future expected trends; for example, the 'rate of return' studies use income that has been earned over a working lifetime. Second, they suffer from difficulties in isolating the impact of education from other changes which may have taken place, particularly technological improvements which impact on the productivity of capital.

The literature which is most positive about the impact of education and training on economic well-being comes from writers such as Porter (1990), Lundvall (1992) and Reich (1991) whose works can be placed broadly in the disciplines of management, education and sociology. These writers stress the importance of education and training in dealing with change and facilitating adaption to the world of the future. This thesis will further examine the concept of change as the mechanism whereby education and training impacts on economic variables.

1.2. Micro enterprise level

International support for the relationship between education, change and enterprise performance comes from the World Bank's (1995) report on workers from developing countries:

> Education is essential for raising individual productivity... [General education] augments the ability to perform standard tasks and use information and adapt to new technologies and practices. ... Enterprise-based training in Taiwan has been associated with a significant rise in output per worker, with the largest gains realized in firms that simultaneously invested in training and technology. (World Bank, 1995, 36)

Major changes to practice can be termed 'innovations' to the business or enterprise which makes them, even if the practice is widespread in other enterprises. An innovation may be defined as:

> ... any thought, behaviour or thing that is new because it is qualitatively different from existing forms. Strictly speaking, every innovation is an idea, or a constellation of ideas; but some innovations, by their nature must remain mental

> organisations only, whereas others may be given overt and tangible expression. (Jones, 1963, 387)

The term innovations as used in this thesis broadly equates with changes to practice which are expected to improve profitability or long term viability.

Wozniak (1984) develops a theoretical model of the decision to adopt interrelated innovations in a dynamic economic environment and concludes:

> that innovative decision-making is a human capital intensive activity. ... Thus, the incentive for agents to acquire the ability to invest in innovative ability (education or retraining) increases as the technological environment becomes more dynamic. (Wozniak, 1984, 78)

Employee training programs increase worker productivity in manufacturing in the United States. Bartel (1994) found that businesses that were operating at productivity levels below that of comparable businesses were able to bring their productivity to expected levels by implementing new employee training programs. In another example from manufacturing, but this time related to the impact of change on growth and profitability, technologically innovative Australian manufacturing businesses increase their sales on average by more per year than manufacturing businesses which do not make technological innovations, according to a survey by the Australian Bureau of Statistics (1995c).

A number of studies summarised in World Bank (1995) find that small businesses with better educated managers are more likely to grow and/or survive. Cooper, Gimenogascon and Woo (1994) examined over 1000 new business ventures in all industries and geographic regions of the United States. They found that the entrepreneur's level of human capital as represented by education influenced both the probability of business survival and the rate of business growth. A similar Australian study over a twelve year period of over 10 000 business ventures which started in 1973 found there was a significant relationship between the study of business/management courses and success, and between the duration and relevance of formal education and business survival (Williams, in McMahon, 1989, 62).

Bergman (1995) and Business Council for Effective Literacy (1993) summarise research on the benefits of training for United States companies. They found that increased productivity, product quality and profitability flow from improved employee performance in areas such as literacy, communication and problem-solving. Training has been shown to increase motivation, willingness to take responsibility, ability to work independently, ability to work in teams, confidence, company loyalty, self-esteem, and job satisfaction. Training supports what Bergman (1995) terms "high-performance" work practices such as total quality management, self-managed work teams, flexible production lines, and just-in-time inventory. One of the literacy training programs quoted by Business Council for Effective Literacy (1993) resulted in a 75% drop in defects per unit and allowed inventory to be reduced by a factor of 2.5:1.

1.2.1 Summary of the impact of education on enterprises

The literature reviewed here suggests that education and training does improve the performance of individual businesses. Writers such as Wozniak (1984), emphasise the link between education and innovation, or change. This path from education and training, through change, to improved business performance is consistent with the view which emerged from the previous section in relation to how education and training impact on economic indicators at the macroeconomic level.

1.3. Education and agricultural indicators

Figure 1 below is a summary table of research studies which consider the relationship between education and agricultural indicators. They were found from a literature search in electronic periodical data bases on education, business and agriculture. The majority of the studies examine the impact of education on productivity, usually measured by yield of product per unit of land, while some examine the relationship between education and income or adoption of innovations. The studies are discussed in this section, 1.3.

Figure 1 Education and agricultural indicators: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Cruise, J. and Lyson, T. Beyond the Farmgate: Factors Related to Agricultural Performance in Two Dairy Communities. *Rural Sociology*, 56, 1, 41-55.	1991	US, dairy	yield, education, management practices, access to markets and extension	interviews and mail questionnaire	2 communities 51 & 53	regressions, descriptive stats	education as years of schooling
Fane, G. Education and the Managerial Efficiency of Farmers. *Review of Economics and Statistics*. 57, 452-461.	1975	US	total farm sales, education, macro agricultural variables	agricultural census from 2 years	averages for 407 counties	multiple regression	education as years of schooling, ignores individual farm variations
Huffman, W. Allocative Ability: The Role of Human Capital. *Quarterly Journal of Economics*. 91, 59-79.	1977	US	yield, education, geographic, weather	agricultural census, by county	average data	multiple regression	education as years of schooling
Huffman, W. Decision Making: The Role of Education. *American Journal of Agricultural Economics*. 56, 85-97.	1974	US	nitrogen use, education, extension contact, size	agricultural census, by county	average data	multiple regression	education as years of schooling
Jamison, D. and Lau, L. *Farmer Education and Farm Efficiency*. The John Hopkins University Press. Baltimore.	1982	Asia, Africa, Europe, Latin America	yield, education, extension, adoption	previous studies	18 studies, 37 data sets	meta analysis	primary education based on Lockhead et al 1980. Question re compatibility of data sets.
Lockheed, M., Jamison, D. and Lau, L. Farmer Education and Farm Efficiency: a Survey. *Economic Development and Cultural Change*. 29, 1, 37-76.	1980	Africa, Asia, Latin America	productivity, education, extension	previous studies	37 data sets	meta analysis	primary education. Question re compatibility of data sets.

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Moock, P. R. Education and Technical Efficiency in Small-Farm Production. *Economic Development and Cultural Change*. 29, 723-739.	1981	Kenya	yield, education, physical inputs, debt, age, extension	interviews	152	multiple regression	primary education
Moore, K. *Learning on the Farm. The Educational Background and Needs of New Zealand Farmers*. New Zealand Council for Educational Research. Wellington.	1990	New Zealand	education, management practices, training	interviews	110 (93% of a county)	descriptive stats, cross tabs	education as years of schooling
Phillips, J. Farmer Education and Farmer Efficiency: A Meta-Analysis. *Economic Development and Cultural Change*. 43, 1, 149-156.	1994	Africa, Asia, Latin America	productivity, education,	previous studies	22 new data sets	meta regression analysis	primary education expands Lockheed et al 1980
Phillips, J. and Marble, R. Farmer Education and Efficiency: A Frontier Production Function Approach. *Economics of Education Review*. 5, 3, 257-264.	1986	Guatemala	productivity, education, farm variables	interviews	1548	OLS regression, descriptive stats	primary education
Rose, K. and Thompson, R. *Dairy Farming in Tasmania: A Report on a Survey of Tasmanian Dairy Farmers 1992-1993*. Department of Primary Industry and Fisheries Tasmania, Hobart.	1993	Tasmania, dairy	productivity, farming practices	interview and mail questionnaire	not stated	descriptive stats	no statistical tests
Welch, F. Education in Production. *Journal of Political Economy*. 78, 37 - 59.	1970	US	productivity, education, extension, research spending	census data, US Extension Service data	averages by state (49)	multiple regression	seminal work on education & productivity link education as years of schooling

Much of the literature of the impact of education on productivity comes from research in agriculture (Maglen, McKenzie, Burke & McGaw, 1994), and is reviewed in the following sections of this chapter. Studies have considered inter alia, the impact of education on productivity, farm income, farm survival and sustainability. Welch (1970), in a seminal work on the impact of education on productivity, says that education improves the quality of labour and increases production from a given set of non-labour inputs, improves a farmer's ability to process information and allocate inputs across competing uses, and strengthens the selection of purchased inputs in the short run and the scale of operation in the long run.

Lockheed, Jamison and Lau (1980) conducted a meta analysis using 37 data sets from 18 separate studies of small farmers from Malaysia, Thailand, Korea, Kenya, Brazil and the Philippines. They found that farmers with more years of school education have more productive farms, with higher crop yields. Jamison and Lau (1982) reviewed 31 of the data sets and found an increase in productivity as a result of four years of education ranging between 6.5% and 25.8%. Phillips (1994) expanded on Lockheed, Jamison and Lau's (1980) study with an additional 22 data sets from Asia and Latin America. He confirmed the range of productivity gains. Phillips and Marble (1986) found that there is a threshold level of four or more years of education before there is an impact on farmer productivity in Guatemala, as does Moock (1981) who investigated West Kenyan maize farmers.

The conclusion that education increases farmer productivity and/or willingness to adopt innovations applies both to studies in developing countries and developed nations. New Zealand farmers with more years of schooling displayed greater management efficiency, as measured by the extent to which a range of management practices from using a cash flow budget to using scales to weigh lambs for monitoring feed, are carried out (Moore, 1990). United States farmers with above average levels of education operate nearer minimum cost, given the scale of operation (Fane, 1975). Huffman (1977; 1974) finds that United States corn farmers with more education adjust more quickly and efficiently to changes in economic conditions such as changes in the relative costs of fertilizers.

Cruise and Lyson (1991) compared two dairy farming communities in the northeastern USA with similar soil, climate and farm size. The community with more opportunities for formal education and better access to information sources used more efficient management and agricultural practices and had higher productivity. In another study of dairy farmers, Rose and Thompson (1993) concluded that increases in productivity on Tasmanian dairy farms over a five year period were probably due to improved management practices.

However, not all research has supported the link between education and profitability. A study of Australian grazing farms found that education, age, sources of information and computer ownership had no apparent effect on the rate of return to capital in 1990-91 (Johnston, 1993). The study concluded that the relationship between farm profitability and these variables is extremely complex. Johnston (1993) cautions that the results of the study could have been affected by a mix of weather and commodity prices in 1990-91 which meant that 87% of grazing farm businesses had a rate of return of less than zero.

It is worth noting that all these studies broadly measure education as length of 'general' education in primary schools, secondary schools and/or tertiary colleges. None consider the impact of specialist agricultural education on agricultural indicators.

Education is only of value to a farm business, or any organisation, if it alters the way in which individuals within that business behave. In Chapter 1, it was emphasised that there is a the need for businesses to change in order to survive and prosper in the increasingly dynamic world environment. In the next section, triggers for changes to practice are examined and the role of education and training in the change process is discussed.

2. Research Question 2: What 'triggers' major changes to practices?

The literature reviewed to date suggests that education and training impact on economic indicators of business performance, such as profit, via the mechanism of change. This section explores literature about the decision-to-change process. It starts by considering literature relating to the impact of change on macroeconomic indicators, such as Wozniak (1987):

> ... a long term commitment to develop technically sophisticated and well-informed decision-makers is required if a dynamic technological environment is to sustain economic growth. Economic agents can and must learn to adapt to the expanding economic opportunities provided by emerging new industries and technologies. (p 110)

Productivity growth is a consequence of technological change (Mincer, 1989). This is true at the national level, and at the level of the individual enterprise. Jayne, Khatri, Thirtle and Reardon (1994) review earlier literature about productivity growth in agriculture and conclude that it has long been argued that sustained productivity growth in agriculture requires technical change, policy reform, institutional and organisational innovation. Indeed, investment in research and development together with farmer education traditionally has been used to explain agricultural productivity growth.

The survival of an individual enterprise operating within an environment of technological change depends on its ability to adapt to changes in its environment. Fann and Smeltzer (1989) finds this is true for small business in all areas of the economy, whilst Morgan (1988) suggests that to succeed, enterprise managers of the future will require skills in operating in a turbulent world of complex and intertwined technological and social revolutions. To put this in the context of agriculture, individual farm managers require skills to translate technological and other innovations into productivity growth on their farm, and to respond to opportunities for 'new' products.

Buttel, Larson and Gillespie (1990) suggest that early adopters of an agricultural innovation reap most of the benefits from that innovation because by the time most farmers 'catch on', the early adopters have made their profit and moved on to something else.

The following section considers the extent of innovation in the non-agricultural sectors of the economy before discussing the processes which lead to innovation, and innovation in agriculture in particular.

2.1. The extent of innovation

2.1.1 How innovative is Australian business?

The Australian Bureau of Statistics (1995b and 1995c) conducted a limited survey of selected industries in 1994 to determine the level of technological, organisational and commercial innovation. They found that an average of 21% of businesses in non-manufacturing industries undertake innovative activities, the range being from 46% in electricity, gas and water to 14% in finance and insurance. Twelve percent undertake technological innovation and 14% undertake non-technological innovation. In manufacturing innovation is more widespread, with 43% of all businesses undertaking some innovative activity.

Technological, organisational and commercial innovation increases with the size of business, which Australian Bureau of Statistics (1995b and 1995c) measure by employment. In non-manufacturing industries 17% of business with less than five employees undertake innovation, compared with 86% of those employing 1000 or more. The pattern is similar for manufacturing industry, with a range from 30% of those employing less than five to 96% of those employing 1000 or more. Both technological and non-technological innovations are more prevalent in larger businesses.

2.1.2 *How innovative is farm business?*

Figure 2 Farm business innovation: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Gibbs, M., Lindner, R. and Fischer, A The Discovery of Innovations by Farmers. *The Journal of the Australian Institute of Agricultural Science*. 53, 4, 245-261.	1987	South Australia, wheat-sheep	time of awareness of innovations, farm characteristics, information sources	respondent diaries and interviews	48	descriptive stats, correlations	sample biased toward 'progressive', or more innovative, farmers
Moore, K. *Learning on the Farm. The Educational Background and Needs of New Zealand Farmers*. New Zealand Council for Educational Research. Wellington.	1990	New Zealand	education, management practices, training	interviews	110 (93% of a county)	descriptive stats, cross tabs	education as years of schooling
Weston, R. and Cary, J. A *Change for the Better? Stress, Attitudes and Decision Making of Dairy Farmers 1976 to 1978*. School of Agriculture and Forestry, University of Melbourne, Melbourne.	1979	Victoria, dairy	financials, stress, attitudes, aspirations, decision making	interviews, 2 points in time	94	descriptive stats, correlations, plots	

There are very few studies which consider the general level of innovation of farm businesses. Most innovation studies in agriculture and other fields concentrated on the diffusion or adoption of a single innovation or a group of related innovations. The results of three studies which do report results relating to general 'innovativeness' on farms are outlined below.

Moore (1990) found that 16% of New Zealand farmers had never made a management change which lifted production levels, 57% had made minor changes, and 27% had made significant changes.

The extent of innovation varies with the economic cycle, consistent with the need for sufficient resources to be available for change to occur (see section 2.9 below). For example, in Australia, Weston and Carey (1979) found that 22% of dairy farmers planned changes at the depth of the economic cycle, rising to 46% two years later on the upswing of the cycle.

Gibbs, Lindner and Fischer's (1987) longitudinal study of South Australian wheat farmers considered only awareness of innovations, not subsequent adoption. They found that all but two of the sample of 48 became aware of at least one innovation over a 12 month period. Most became aware of between one and six possible new practices.

These three studies provided a very small amount of information about the extent of changes to practice in agriculture, and point to the need for more research in the area, such as the present study.

2.2. Organisational innovation

The theory of organisational innovation suggests that innovation is the organisation's response to constantly changing commercial and technical conditions, for example new competitors and technological advances such as the Internet. The response involves workplace 'learning by doing' and adaption of processes and routines in the light of experience, and, importantly, from observing and interacting with other organisations. One of the origins of organisational innovation theory is the literature of 'learning by doing' or learning from experience, which developed mainly from studying manufacturing industry where there are many repetitive tasks. Arrow's (1962) seminal work in the area found there is learning associated with task repetition, and that the learning is subject to sharply diminishing returns.

> ... technical change can be ascribed to experience, that it is the very activity of production which gives rise to problems for which favourable responses are selected over time. (Arrow, 1962, 156)

'Learning by doing' and adaption of practices in the light of experience, and from observing and interacting with other organisations, is 'organisational learning', which according to Mathews (1994) takes place within organisations, but more commonly across 'interfirm' networks which may consist of competitors and/or suppliers and customers. These networks may cross national boundaries.

Lundvall's (1992) major work on organisational innovation proposes a model of technical change in which change originates within the organisation, with the proviso that the change may be internal to a network of organisations, rather than a single organisation. Lundvall's model contrasts with the traditional economic models of technical change which view new technology as an exogenous shock to the equilibrium of an economy and the equilibrium of organisations within the economy. Traditional economic theory holds that adjustment to a new equilibrium is via the price mechanism. Lundvall's (1992) model is able to explain the phenomenon of continuous technical change which is observed in modern economies, unlike the traditional economic models. Organisational learning is a dynamic process whereby there is a continual cycle of learning and change, which leads to further learning and change.

According to Lundvall (1992), innovation is a cumulative process which builds on existing knowledge and practices through interactive learning. Institutions provide an environment where interactive learning takes place. Networks of institutions also allow interactive learning to occur. Lundvall (1992) argues that everyone in institutions contributes to innovation through their learning. Learning partially emanates from routine activities; learning-by-doing, learning-by-using and learning-by-interacting, as well as emanating from learning activities such as research and development. Organisations which adapt and change as a result of these learning activities are learning organisations.

Organisations which are incapable of generating the changes needed for adaption and survival suffer from 'organisational stasis', which is the opposite of organisational learning (Mathews, 1994).

Diffusion of an innovation in Lundvall's (1992) model is via interactive learning within and between institutions. These interactive learning networks add up to a 'learning economy'. Dalum, Johnson and Lundvall (1992) suggest that the interactive learning which takes place in learning networks is one of the critical factors in the generation of the wealth of a nation.

2.2.1 Social processes and change in organisations and the economy

Change, or adaption, in organisational innovation is a social process involving interaction and collaboration between individuals within organisations and within networks of organisations (Mathews, 1994; Lundvall, 1992; Senge, 1993). Learning organisations occur because of

> ... the vision of individuals, groups and organisational networks committed to and capable of continuous learning through information exchange, experimentation, dialogue,

> negotiation and consensus building. (Kochan & Useem, 1992, 391)

The interaction between the individuals who make up the organisation and organisation network can be cooperative and collaborative or competitive, perhaps involving conflict. Mathews (1994) suggests that collaboration and cooperation are just as important as competition for economic success in a learning economy made up of learning organisations and learning networks.

Senge (1993) considers that learning organisations are more flexible and responsive to change. A small business such as a farm business which has several managers working together in the business, and has a learning culture which promotes participation in education and training experiences is a learning organisation. Farmer community and industry networks, and product discussion groups can form the basis of farmer learning organisations.

The values of society are fundamental to productivity growth. One of the ways in which values impact on productivity is via attitude to change.

> ...how technical change, and new ideas, are viewed, the attitudes of individuals towards work and the people they work for, ... are all key determinants of productivity advance. (Blandy & Brummitt, 1990, 11).

2.2.2 Summary of organisational change

The literature reviewed in this section suggests that interaction between individuals within organisations and between those from different organisations is a vital part of the innovation, or change, process. Values and attitudes also have a role to play in this process. Interaction and the role of values, attitudes and beliefs are discussed in relation to decision making behaviour in sections 2.6 Interaction and change and 2.7, Values attitudes and beliefs, below.

2.3. Decision making

Human capital theories about education and productivity are based on the assumption of neo-classical economics that humans are rational, profit maximising decision makers (Gillmor, 1986; Stoneman, 1983). Some variations of those theories consider bounded decision making under constraints such as available resources and information (Napier, Cameron & Camboni, 1988; Gillmor, 1986). A related variation is that of 'satisficing', which says that individuals operate rationally within limits and only expend sufficient time and effort in gaining information relevant to the decision as is necessary to determine whether alternative solutions are satisfactory, or not satisfactory (Robbins, 1993). The level of information regarded as sufficient for satisficing decisions will depend on the decision maker's objectives and factors such as age, education, income, experience and personal variables, including attitudes (Murray-Prior, 1996; Ilbery, 1978).

The search-based model of Lloyd and Dicken (1977) is an example of a satisficing decision making model. In this model, farmers search until they find a satisfactory or 'satisficing' (but not necessarily optimum) solution. The model holds that farmers only consider making a change if their stress tolerance threshold is exceeded. They then first try a solution which has worked before. If that is not successful or is not a possible solution, farmers then use a trial and error strategy, or imitate the behavior of others with a similar problem. They choose the first satisfactory solution encountered.

More complex mathematical models of decision making have been developed, for example to explain the element of randomness that characterises decision making (Ilbery, 1978). Murray-Prior (1996) summarises farmer decision models which include risk aversion and uncertainty. However, it is argued these complex mathematical models are unable to handle the complexity of situations faced by individual farms which are each constrained by different sets of resources, infrastructure and market contexts (Malcolm, 1992).

Information from Australian manufacturing industry suggests that profit maximising may be a critical factor in innovation (Australian Bureau of Statistics, 1995c). Improvment of product quality and range and increasing or maintaining market share, all of which could be argued to be proxies for profit maximising, rank highest as the objective of innovation for businesses of all sizes.

2.3.1 Farmers' goals and decision making

Several research studies hold that farmers have personal or lifestyle goals which may conflict with economic goals. For example,

> Research has consistently demonstrated that the land user balances economic criteria against other personal, family and social utilities in the decision-making process. (Nowak, 1982, 215)

Studies found in the literature search of educational, business and agricultural electronic periodical databases which have reached a similar conclusion to Nowak (1982) are outlined in summary form in Figure 3 below. This Figure also includes some studies which have found economic goals to be important and some which have found economic goals rank below personal or lifestyle goals.

Figure 3 Farmers' goals and decision making: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Cary, J. and Holmes, W. Relationships Among Farmers' Goals and Farm Adjustment Strategies: Some empirics of a multidimensional approach. *Australian Journal of Agricultural Economics*. 26, 114-130.	1982	Queensland, beef	goals, past farm size adjustment and adjustment intentions	mail survey and interviews	82, 21	ranking process, regression	
Frank, B. Adoption Process of Cattlemen in North Queensland. In *Australia Pacific Extension Conference Proceedings* Surfers Paradise October 12-14. Queensland Department of Primary Industries. Brisbane. 286-290.	1993	Queensland, cattle	situational & personal variables, management, adoption of 5 practices	interviews	68	tests of association, cross tabs, correlation	
Gillmor, D. Behavioural Studies in Agriculture: Goals, Values and Enterprise Choice. *Irish Journal of Agricultural Economics and Rural Sociology*. 11, 19-33.	1986	Ireland and England	goals, values, location	mail survey	95 & 95	comparison by locality, ranking	
Heffernan, W. Assumptions of the Adoption/Diffusion Model and Soil Conservation. In B. English, J. Maerzold. B. Holding and E. Heady (eds) *Future Agricultural Technology and Resource Conservation*. Proceedings of the RCA Symposium held Dec. 5-9 1982 in Washington D.C. Iowa State University Press. Ames, Iowa.	1982	US	goals	interviews	not stated	discusses results of several of Heffernan's previous studies	
Kerridge, K. Value Orientations and Farmer Behaviour. *Quarterly Review of Agricultural Economics*. 31, 1, 61-72.	1978	Western Australia, sheep-wheat	values, age, education, family size, experience, size, financials	interview/ questionnaire	71	cross tabs, discriminant analysis	

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Murray-Prior, R. Strategy and the Role of Decision Aids. *Workshop Papers, 22nd National Conference, Australian Farm Management Society. Making the Lifestyle your Business.* 19 March, Launceston.	1996	Australia, wool	farm survival, risk aversion		not stated		discussion of study
O'Brien, B. A Study of Farmer Decision-making; Implications for Policy Makers. In M. Littmann, (ed.) *Rural Extension in an Era of Change.* Australasian Agricultural Extension Conference Proceedings. Brisbane, 122 - 129.	1987	Victoria, grain	decision making process	focus groups, hypothetical decision	12 groups	qualitative analysis	
Patrick, G., Blake, B. and Whitaker, S. Farmers' Goals: Uni- or Multi-Dimensional? *American Journal of Agricultural Economics.* 65, 2, 315-320.	1983	US	goals	interviews	86	multi dimensional scaling distance matrix	
Salmon, P. *On-Line Computer Applications in Research into Attitude Change; Applications in farm management education.* ERDC Report No. 31, AGPS, Canberra.	1981a	Australia	attitudes, decision process	computer simulation of decisions	not stated, but small number		
Scoullar, B. Human Factors in Farm Management: An Explanation of Decision-Making Models among Dairy Farmers in South Cheshire and their Implications for Extension Work. Ph.D. Thesis, University of Reading.	1978	UK, dairy	information sources, decision process	interviews	153	frequencies	
Thomas, J., Ladewig, H. and McIntosh, W. The Adoption of Integrated Pest Management Among Texas Cotton Growers. *Rural Sociology.* 55, 3, 395 - 410.	1990	US, cotton	adoption of integrated practices, information sources, group participation, attitudes	phone interviews	772	multiple regression, logistic regression	

Many of the research studies listed in Figure 3 above find that farmers have multiple goals which often conflict with each other. For example, Patrick, Blake and Whitaker (1983) and Cary and Holmes (1982) found that Indiana and Queensland farmers respectively have multi-dimensional goals related to both family/lifestyle and farm objectives. Missouri farmers, in a study by Heffernan (1982), ranked "providing opportunity for better home and family life", "provides opportunity to be my own boss" and " gives me a chance to work in a natural environment" ahead of goals relating to the income from farming. In a study of Irish and English farmers Gillmor (1986) found that while both groups rank making a satisfactory income highly, 'goals' such as "doing work you like" and "independence" also ranked highly.

Returns to capital on investment in farm business have been less than for investments elsewhere in the Australian economy over the last decade (Martin, 1996). Economic theory would predict this difference in returns to investment to cause a shift of investment out of agriculture and a decline in agricultural capital (land) value (Jackson & McConnell, 1994). As this has not occurred, the difference in returns can be interpreted as a premium for values relating to the farming lifestyle (Mandaletti, 1996), or as confirming that farmers have multi-dimensional goals.

Scoullar (1978) studied the decision making process of British dairy farmers and found that earlier studies of farm managerial behaviour were largely unsuccessful because they considered only economic and technical efficiency goals. The earlier studies ignored farmers' often conflicting other goals, for example, goals relating to expenditure on family priorities and leisure time.

Salmon (1981a) found only a very small proportion of farmers mention profitability as an important factor in choosing between alternative farming enterprises, in a simulation exercise familiarity with an enterprise such as sheep or beef was the most common factor mentioned.

In contrast to Nowak's (1982) conclusion from a review of studies relating to farmers' goals, and to Patrick, Blake and Whitaker (1983), Heffernan (1982) and Salmon (1981a), a number of studies found that economic goals are important for farmers. However, economic goals are not for maximum income, but rather farm survival or a satisfactory income. Farm survival is an overriding objective for Australian wool producers (Murray-Prior, 1996) and Victorian farmers (O'Brien, 1987). The Victorian farmers rated economic survival ahead of tradition, stewardship (care of the land), peer pressure, new technology, available resources, the local environment and available information as factors affecting decision making. Making a satisfactory income and ensuring income for the future were the most important goals for all the Queensland graziers in Cary and Holmes' (1982) study. Tasmanian dairy farmers do have economic objectives in mind when choosing whether or not to expand their dairy operations. They only expand if expected returns from other enterprises are less than returns from dairying (Rose & Thompson, 1993). Kerridge (1978) found that the majority of Western Australian wheat-sheep farmers expressed desire to make a satisfactory income, but only 13% want to maximise income. Older farmers and those with smaller farms were more likely to value farming as a way of life over income goals.

2.3.2 Other models of farmer decision making

A systems approach is an alternative to using profit maximisation and satisficing models. The systems approach has been applied to agriculture, for example by Van Beek (1993) in Queensland; Thomas, Ladewig and McIntosh (1990) who examined integrated pest management systems on farms in Texas; and Frank (1993) who investigated the influence of environmental, technical, social and economic factors on the adoption of innovations by cattle producers in north Queensland. Farms are viewed as systems in a holistic, 'soft' systems approach which incorporates human behaviour into the scientific systems approach of the 1950s and 1960s. The systems approach accepts uncertainty and less than full knowledge when used to explain farm decision making. It uses perceiving, predicting, comparing and deciding to describe steps in the decision process, and says that systems must interact with values, standards and perceptions of reality (Holt, 1989).

Another model of decision making considers the diffusion of innovations. Diffusion and farming systems theory both view the farmer as a decision-maker whose rate of adoption and adoption behaviour are influenced by personal characteristics and by farm organisational characteristics (Thomas, Ladewig & McIntosh, 1990). The following section (2.5) examines the diffusion of innovations model and related models of decision making which explain the decision process in the context of a learning process. The remainder of section 2 examines factors surrounding the decision to adopt or adapt an innovation.

2.4. Diffusion of innovations

Diffusion is the process by which innovation is communicated over time among members of a social system (Rogers, 1995). Rogers's (1962) seminal work on diffusion of innovations has its origin in research into the diffusion of agricultural innovations.

The study of diffusion of innovations has been constrained by a standardised approach which is based on a linear model of diffusion in which communication is *from* the source *to* the receiver (Rogers, 1995). Rogers (1995) suggests that a convergence model which emphasises information-exchange among participants in a communication process in order to achieve a mutual understanding is a more accurate model of most diffusion processes. Such a convergence model has some similarity with Lundvall's (1992) model of organisational diffusion of innovations and the diffusion of innovations within learning networks.

Figure 4 Diffusion of innovations: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Jones, G. The Diffusion of Agricultural Innovations. *Journal of Agricultural Economics.* 15, 387-409.	1963	UK	adoption, location, income, socio-economic, size, information/advice sources, age, education	machinery censuses, supported by studies . of smaller groups	census, and 55, 52		early landmark paper
Lawrence, G. and Vanclay, F. Biotechnology and Globalisation. The Contribution of Biotechnology to Agrofood Restructuring in Australia. In *Proceedings of the XVth European Congress on Rural Sociology*, Wageningen, The Netherlands.	1993	Australia	diffusion of biotechnological innovations	case studies of innovations	not stated	qualitative	
Midgley, D. F and Dowling, G. R. *A Predictive Test of the Impact of Innovative Predispositions and Contingent Factors on Adoptive Behaviour.* Working Paper 90-031. Australian Graduate School of Management, University of New South Wales, Sydney.	1990	Australia, consumer behaviour	attitudes, purchase decisions, communication with others	questionnaires	not stated	correlations	
Rogers, E. *Diffusion of Innovations*, 4th edition. The Free Press. New York.	1995	reviews studies from many countries and disciplines					review text, establishes 'generalisations' about diffusion process

Studies from the literature search, which relate the rate of diffusion of innovations and the characteristics of innovations and the characteristics of adopters, are outlined in Figure 4 above. The studies listed here are typically general studies which consider a relatively large number of characteristics of innovations and adopters. Other studies are listed in Figures at the start of sections 2.5 to 2.9 which discuss some of the characteristics of innovations and the characteristics of adopters.

It is claimed that innovation adoption behaviour in an interactive context depends on individual characteristics and the social context in which a person lives and works:

> ... adoption behaviour is inherently contingent on the interaction between person, situation, innovation and interpersonal communication. (Midgley & Dowling, 1990, 3)

The characteristics of the innovation itself affect its speed of diffusion or the rate of adoption. Researchers including Rogers (1995) and Jones (1963) and reviewers of research in the area such as Vanclay (1992a) and Buttel, Larson and Gillespie (1990), have concluded that these characteristics of innovations include economic, technical, complexity, divisibility, conspicuousness and compatibility with existing practice. These characteristics of innovations are discussed in the sections 2.6 to 2.9 in relation to the characteristics of those who adopt innovations.

The characteristics of early adopters were identified by Rogers (1995) as being higher education levels, larger businesses, being closer to the infrastructure and/or information sources, and less geographically isolated from others who may adopt the innovation. These characteristics have been confirmed by other research, and are discussed in more detail in the remainder of section 2.

2.4.1 Overview of the adoption or decision to change process

There are many models of the adoption or decision making process, which describe the process in a series of similar steps or stages. Four models are presented in Figure 5:

- the innovation-diffusion as described by Rogers (1995), Brown (1981) and Rogers and Shoemaker (1971),
- the problem-solving process of Havelock (1971),
- Klausmeier's (1985) purposeful learning without instruction model, and
- Argyris and Schon's (1974) process of learning.

Figure 5 Models of the decision process

<table>
<tr><th>Innovation-diffusion model
Rogers (1995), Brown (1981) and Rogers and Shoemaker (1971)</th><th>Problem-solving process
Havelock (1971)</th><th>Purposeful learning without instruction model
Klausmeier (1985)</th><th>Process of learning
Argyris and Schon (1974)</th></tr>
<tr><td>knowledge</td><td>perception of a problem</td><td rowspan="3">motivation</td><td rowspan="3">discovery or diagnosis of a problem</td></tr>
<tr><td rowspan="3">persuasion</td><td>diagnosis</td></tr>
<tr><td>data collection</td></tr>
<tr><td>searching for possible solutions</td><td>goal setting</td><td>invention of a solution</td></tr>
<tr><td>decision</td><td rowspan="3">selecting and implementing a solution</td><td>tries to attain goal</td><td rowspan="3">production of the solution</td></tr>
<tr><td rowspan="2">implementation</td><td>confirms/rejects tries</td></tr>
<tr><td>reaches goal</td></tr>
<tr><td>confirmation</td><td>measuring effectiveness</td><td>remembers and applies outcomes, or modifies goal, or withdraws</td><td>monitoring the implementation</td></tr>
</table>

These four models identify similar stages in the decision process:

- All have an 'awareness' stage ('knowledge', 'perception of a problem', 'motivation' or 'discovery or diagnosis of a problem').

- All describe a process of gathering information and evaluating that information in light of goals or objectives ('persuasion', 'diagnosis, data collection and searching for possible solutions', 'goal setting' and 'invention of a solution').

- The four models have a decision and implementation stage ('decision and implementation', 'selecting and implementing a solution', 'tries to attain goal, confirms/rejects tries and reaches goal', and 'production of the solution').

- Each model concludes with a review or monitoring stage. This says that the decision making process does not finish with implementation of the decision, because the decision can be discontinued after implementation. The review or monitoring stages are 'confirmation', 'measuring effectiveness', 'remembers and applies outcomes, or modifies goal, or withdraws', and 'monitoring the implementation'.

The decision maker can decide not to proceed with an innovation at any stage of the process. Initial knowledge can be ignored, data gathered may suggest that change is not appropriate or necessary, possible solutions can all be deemed unsatisfactory, and confirmation or monitoring can lead to the decision being discontinued.

Caution in adopting an innovation can be rational behaviour, because innovations are not always successful or beneficial in the long run. For example, Frank (1993) found that cattle producers in north Queensland who adopted a number of new practices for reducing cattle losses suffered adverse consequences as the practices led to soil erosion. Lawrence and Vanclay (1993) examine the diffusion of biotechnological research and development in agriculture. They give examples of unsucceesful innovations such as the cane toad which was released in Australia for controlling the cane beetle, but is now a pest itself, and then categorise rational reasons for not adopting a new practice. Their categories of rational reasons for non-adoption are: conflicting information, risk, implementation costs, intellectual outlay, loss of flexibility, complexity and incompatibility with other farm or personal objectives.

The boundaries within which decision makers search for information and possible solutions are determined by the decision maker. These perceived boundaries are a function of personal, social and institutional factors and generally are different from the objective boundaries, which are set by natural, economic, technical and institutional constraints.

Hollick (1990) developed a model of decision making in which the perceived and actual boundaries do not coincide. This model points out the scope for influencing the perceived boundaries of farmers or other decision makers. Interaction with others is one way in which decision makers' perceptions of boundaries can be altered toward the actual boundaries.

From an examination of the four models presented here, it can be seen that external information or advice can be sought by the decision maker, or come to the decision maker's attention, at any stage of the process. External information may be the source of knowledge or perception that there is a problem. Information is sought at the data collection or invention of a solution stage. Advice from others informs the decision or solution selection stage, and further information is used to monitor the implementation of the decision.

Information and advice inputs into the decision making process can come from two types of communication channels: mass media and interpersonal. These are discussed in sections 2.5 and 2.6 below.

2.5. Communication channels and awareness

The four models listed above suggest that potential adopters must be aware that a problem or a 'better' way of doing things exists, and then perceive a need for change, before change can occur.

During the initial awareness stage mass media (that is print and electronic media) is an important source of information. The next most important sources of information for awareness after mass media are other farmers and 'expert' advisers (Rogers, 1995). Longo (1990) interviewed 450 farmers in Brazil who used both mass media and interpersonal information channels and found that whilst mass media brought about awareness, it seldom led directly to adoption. An Australian study by Gibbs, Linder and Fischer (1987) found that the mass media were responsible for 55% of awareness of innovative practices.

Awareness alone is not sufficient to bring about a change. Woods, Moll, Coutts, Clark and Ivin (1993) undertook an extensive review of Australian research on the dissemination of information to farmers and adoption of new practices. They concluded there is a role for support by extension officers or others beyond the awareness stage:

> Awareness alone is not enough to induce change in complex farming practices. Activities should go beyond the awareness and interest stages to decision making and the evaluation and trial stages. (Woods, Moll, Coutts, Clark & Ivin, 1993, 11)

By way of comparison, Australian Bureau of Statistics (1995c) found that the most important sources of awareness of innovations in Australian manufacturing industry are customers, research and development in the business group and external market sources in the industry. The importance of input from these groups into the innovation process confirms Lundvall's (1992) suggestion that interorganisational networks play a strategic role in the innovation process.

Jones (1963), in an important work which first set out the factors affecting the diffusion of innovations, says that the relative importance of information channels changes over the adoption (or decision) process. Whilst mass media channels are the main sources at the initial awareness stage, interpersonal channels of communication are more important at the persuasion, implementation, and monitoring stages. Jones's (1963) work is based on the spread of five agricultural innovations in England and Wales. More recent studies confirm this finding, and are discussed in section 2.6 Interaction and change below.

2.6. Interaction and change

Rogers' (1995) examination of studies of the diffusion of innovations in a wide variety of contexts confirms the positive impact on adoption of interpersonal communication with other farmers, consultants, input suppliers and other 'experts'.

The literature suggests that a large number of interactions may occur as farmers make decisions. Thomas, Ladewig and McIntosh (1990) (see Figure 3), for example, found that Texan cotton growers used government and private extension agents, chemical salespersons and other farmers in deciding whether or not to adopt integrated pest management practices.

Figure 6 lists studies of interaction in the decision-to-change process found from the literature search. Note that some studies relevant to this topic appear in figures listing research studies earlier in this chapter.

Figure 6 Interaction and change: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Anderson, A. *Processes and Implications of Knowledge Transmission in Australian Agricultural Extension.* School of Management, Hawkesbury Agricultural College. Richmond, New South Wales.	1982	NSW	farm & individual characteristics	previous study	43	descriptive comparison of extension users and non-user group from previous study	small sample, variables likely to be interrelated, e.g. farm size, income, herd size.
Ashton, D. Crop Monitoring Groups. *Farm Surveys Report 1995.* Australian Bureau of Resource Economics, Canberra. 86-88.	1995	Australia, grain	group membership, farm and individual characteristics, opinions	interviews	992	descriptive stats	analysis not rigorous
Korsching, P., Stofferahn, C., Nowak, P. and Wagener, D. Adopter Characteristics and Adoption Patterns of Minimum Soil Tillage: Implications for Soil Conservation Programs. *Journal of Soil and Water Conservation.* 38, 428-431.	1983	US	conservation practices, time of adoption, personal, social and economic	interviews	193	compares 3 locations, means of adopters & non-adopters, t tests	
Phillips, T. *Development of Methodologies for the Determination and Facilitation of Learning for Dairy Farmers.* University of Melbourne. Melbourne.	1985	Australia & New Zealand, dairy	use of others in learning projects	interviews, card sort	29	descriptive stats, qualitative analysis	
Presser, H. and Cornish, J. *Channels for Information and Farmers' Goals in Relation to Adoption of Recommended Practices.* Bulletin No. 1 Rural Sociology Department, University of Melbourne. Melbourne.	1968	Australia	information channels, goals, awareness, adoption	questionnaire	not stated	descriptive stats	no statistical tests

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Salmon, P., Bock, I., Turnbull, E. and Trethewie, R. *The Human Crisis in Agriculture. A Study of Dairy Farmers in the Shire of Yackandandah, Victoria*. School of Agriculture and Forestry, University of Melbourne.	1977	Victoria, dairy	individual farm adjustment to low prices and high costs	hand delivered and collected questionnaires, focus groups	151	descriptive stats and qualitative analysis	
Underwood, C. *Identifying Farmers' Information Sources - Questions on Methodology. The Quest for Information volume II.* Queensland Department of Primary Industries. Brisbane.	1985	Queensland dairy	decision making process	card sort and questionnaire/ recall	52	review of card sort vs questionnaire/ recall	
Underwood, C. *The Learning Strategies of Queensland Dairy Farmers: Implications for Extension*. Queensland Department of Primary Industries. Brisbane.	1984					missing?	
Warriner, G. and Moul, T. Kinship and Personal Communication Network Influences on the Adoption of Agricultural Conservation Technology. *Journal of Rural Studies*, 8, 279-291.	1992	Canada, crops	conservation & intra-farm communication	mail survey, 2 samples, random and conservation program attendees	582, 85	logistic regression	

There is evidence that interpersonal sources of information are more influential in adoption of new practices than are mass media sources. Thomas, Ladewig and McIntosh (1990) found that extension agents and chemical salespersons were more important sources of information for Texan cotton producers in influencing the adoption of integrated pest management practices than printed sources, such as extension bulletins, handbooks and an integrated pest management newsletter. Midgley and Dowling (1990), studying decision making in a different context, that of consumers' purchase decisions, suggest that, other things including attitude to change being equal, the critical factor in adoption is sufficient interpersonal influence to convince a person to adopt. The longitudinal method which they employ allows measurement of attitude or intention at the start of the decision process, and consideration of what they term "the complex communication process intervening between this construct and observable behaviour" (Midgley & Dowling, 1990, 3).

In research supporting Lundvall's (1992) theory of learning organisation networks, there is evidence that farmers who are active in 'networks' are more likely to make changes to practice. Rogers (1995) concluded that early adopters have greater social participation after examining studies in agricultural and non-agricultural settings in developed and developing countries. Korsching, Stofferahn, Nowak and Wagener (1983) found that Iowa farmers who are involved in farmer and community organisations are more likely to adopt conservation practices. Thus, farmers who participate in agricultural and community organisations are more likely to adopt innovations.

Phillips (1985) outlines the roles of others in each of four stages which precede action by farmers. These four 'Phases' evolved from his research into dairy farmers' 'learning projects':

> Phase 1 - Attaining the idea from an intimate, often the farmer's wife. Or a casual meeting with an idea eg field day (reflection).
> Phase 2 - Information is collected, sorted and analysed. Mainly from the outer circle of "paid experts"... [but possibly from other circles] (inquiry).
> Phase 3 - Validation ... Invariably acquaintances are used because they offer that outside unbiased viewpoint, yet are well known enough to be trusted. ...
> Phase 4 - ... the learner seeks support of an intimate before the decision is made. ... The learning was often a joint venture between intimates... (Phillips, 1985, 248-249)

Each layer of social distance fulfills a vital component of the strategy. Intimates act as a checkpoint for information and decision-making, reflecting the importance of intimacy, trust and support in decision-making. There is security in checking the final decision by seeking information from a wide range of people, and in the deliberate attempt to seek an alternative opinion. Socially closer people are used to test ideas and deliberately search for opposition to a selected solution (Rogers, 1995; Phillips, 1985).

The decision process, or as Phillips (1985) describes it, the learning process, involves cyclical contact with individuals. For example, intimates such as spouse or friends may be contacted initially, then periodically as new pieces of information are found from experts, then again immediately before action is taken. An earlier study by Presser and Cornish (1968) confirms that individuals or 'groups of connections' may be contacted at more than one phase of the decision process. They found that other farmers are the most important source of information at both the awareness and decision stages of the change process.

Underwood (1984) also found multiple interactions as well as use of print media, as farmers make decisions. She describes a typical learning (or change) project for Queensland dairy farmers as involving reading, thinking, observing, discussions with family, extension officers, other farmers and commercial representatives and attending field days/ meetings/short courses.

Phillips's (1985) phases above nominate roles for those inside and outside the farm business. The most important criteria when choosing a particular helper in a learning (or innovation decision) process is a person with whom the learner expects to feel comfortable and relaxed. The least important factors are the helper's expertise, education and relevant experience, and recommendations of others according to Tough (1971), who writes about adult learning.

Scoullar (1978) found that the farmer's family are used more frequently than others as information sources at every stage of the decision process. Family members may be involved in the decision to change process more often than is generally reported: Underwood (1985) finds that traditional research methods requiring recall of information sources underestimate the use of family members when compared to replication methods such as that used by Scoullar.

Lundvall (1992) suggests that interaction within an organisation is essential for organisational innovation. The work of Warriner and Moul (1992) supports the importance of interaction within a farm business organisation in the adoption of new practices. Their Canadian study finds a positive connection between adoption of conservation tillage practices and farming with another family member (other than a spouse) as opposed to farming alone or as a couple. Other studies which show the importance of interaction between husband and wife in decision making on family farms are a New Zealand study by Moore (1990) and Australian studies by Underwood (1985) and Anderson (1982).

Enterprise-specific or local area discussion groups are a form of networking for farmers. They facilitate interaction between farmers and with expert advisers to agriculture, such as field officers and extension workers. Farmers perceive the benefits of belonging to enterprise-specific discussion groups to be exchange of ideas, access to advice and (resultant) increased yields (Ashton, 1995).

Interaction with others emerges from all the studies reviewed in the section to this point as an important feature of the decision-to-change process. The studies suggest that social and emotional connections, such as family, friends and other farmers or colleagues within an organisation, may be consulted more than once in the process, and are particularly important. The last mentioned study by Ashton (1995) suggests that groups or networks of farmers may facilitate change-inducing interaction. Another article, by Hollick (1990), suggests that the inclusion of 'experts' in farmer groups or networks increases the effectiveness of these groups in bringing about change.

Hollick (1990) reviewed research on the adoption of conservation practices in Australia and developed a model of the process. He found that landcare group interaction with change agents such as extension officers is more effective in prompting adoption of conservation practices than one-to-one interaction with landcare professionals.

After reviewing studies of adoption of conservation practices in Australia and overseas, Chamala (1987) also advocated discussion groups as an effective way of promoting adoption. He cites a program to encourage the adoption of direct drilling in Western Australia which used discussion groups, as an example of good practice. Waters-Bayer and Farrington (1990) reviewed programs of participatory farmer group research and development in Asia, Africa and Latin America and concluded these programs were more effective in encouraging the adoption of new practices than traditional one-to-one contact between farmers and extension officers. O'Brien (1987) (see Figure 3) studied farmer decision making using focus groups of grain producers in Victoria, and finds that extension officer lead discussion groups promote adoption by reducing individual risk taking and overcoming fear of the unknown. The grain farmers regarded local discussion groups as the most positive means of disseminating new ideas and solving local problems.

Groups exposed farmers to different ideas in a non-threatening way, provided an opportunity to test ideas on others and increased extension agencies' understanding of farmers' problems (Salmon, Bock, Turnbull & Trethewie, 1977). "The use of groups in problem-solving and decision-making increases and speeds adoption leading to greater effectiveness" (Sproule, Godyn & Burfitt, 1991, 101).

Woods, Moll, Coutts, Clark and Ivin (1993) propose a model for change on farms which they term 'information delivery in a community problem solving framework'. It gives groups of farmers a central place. The model is designed to allow outside 'change agents' such as extension officers and researchers to influence farmer behaviour, but allows for farmer input and involvement at every step. The model has ten steps:

- analysing the situation,
- identifying problems,
- creating awareness,
- understanding information and making decisions,
- addressing constraints,
- establishing trials,
- internal evaluation,
- disseminating results,
- achieving integration, and
- external evaluation and future planning.

The following two subsections examine the role of interaction in the decision process, first, with peers and second, with experts.

2.6.1 The role of peers in the decision making process

Figure 7 Peers and the decision making process: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Abd-Ella, M., Hoiberg, E. and Warren, R. Adoption Behaviour in Family Farm Systems: An Iowa Study. *Rural Sociology*. 46, 1, 42 - 61.	1981	US	farm size, education, aspirations, social participation	interviews	844	multiple regression	
Bardsley, J. *Farmers' Assessment of Information and its Sources. An Investigation Using Interactive Computer Techniques*. School of Agriculture and Forestry, University of Melbourne. Melbourne.	1982	Victoria	information sources	interactive computer simulation	51	qualitative	
Benedetti, H. *The Role of Small Discussion Groups in Farm Management Extension*. Department of Farm and Business Management, Faculty of Agricultural Economics, University of New England. Armidale, New South Wales.	1969	Australia and New Zealand	discussion group structure, topics	mail survey and interviews	all discussion group program leaders	qualitative	
Bultena, G. and Hoiberg, E. Factors Affecting Farmers' Adoption of Conservation Tillage. *Journal of Soil and Water Conservation*. 38, 2, 281 - 284.	1983	US	tillage method, size, income, personal and ecological characteristics	phone survey	425	ANOVA and cross tabs	
Craig, R. Talking it Over - Discussion and Decision-Making in the Farm Family. *Newsletter*. Australian Farm Management Society. 10,2, 6-13.	1983	Australia, wheat	family discussion	mail questionnaires	434	cross tabs	no statistical tests

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Dillman, D., Engle, C., Long, J. and Lamiman, C. Others Influencing Others: Who You Target Makes a Difference. *Journal of Extension*. 27, Spring, 19 - 22.	1989	US	attendance & adoption	interviews, enrolment lists	2 groups: 174, 140	descriptive stats	
Fulton, A. The Implications of Farmer Reliance on Private Consultants. *Extension Net*. 2, 5, 7.	1995	Tasmania, potato	information sources, practices chosen	interviews	100	descriptive stats	on going project
Hurley, F., Fitzgerald, B., Harvey, J. and Oppenheim, P. *Problems of Change: A Study of the Decision Making Process*. Ballarat College of Advanced Education. Ballarat, Victoria.	1987	Victoria, grain	decision process	focus groups	70	qualitative analysis	
McKay, K. *Rural Landcare: Triggers, Barriers, Perceptions and Priorities*. Tasmanian Farmers and Graziers Association. Unpublished Paper.	1993	Tasmania	adoption, perceived barriers	focus groups	10 groups	qualitative analysis	
Rockwell, S., Dickey, E. and Jasa, P. The Personal Factor in Evaluation Use; A case study of a steering committee's use of a conservation tillage survey. *Evaluation and Program Planning*. 13, 4, 389 - 394.	1990	US, extension officers	opinions on delivery and content	case study	4	compare with existing data	
Solutions Through Research Group *Australian Agricultural Risk Management Research*. Report prepared for Commonwealth Department of Primary Industries and Energy.	1993	Australia	training needs	focus groups and telephone survey	15 groups; 2259		

Many of the studies found that other farmers are a major source of information and influence in farm decision making on a wide variety of topics in Australia and in other countries (Fulton, 1995; Woods, Moll, Coutts, Clark & Ivin, 1993; Moore, 1990; Dillman, Engle, Long & Lamiman, 1989; O'Brien, 1987; Phillips, 1985; Bultena & Hoiberg, 1983; Presser & Cornish, 1968). For example, Craig (1983) found that most farmers consult neighbours on major decisions. The following quote from Rogers (1995) stresses the importance of the role played by social interaction in the uptake of new practices or innovations:

> Information about an innovation is often sought from near-peers, especially information about their subjective evaluations of the innovation... The diffusion of innovations is essentially a social process in which subjectively perceived information about a new idea is communicated. The meaning of an innovation is thus gradually worked out through a process of social construction. (Rogers, 1995, xvii)

Rogers (1995) reviewed innovation studies and found that earlier 'knowers' of an innovation have more social participation than those who find out about the innovation later. Abd-Ella, Hoiberg and Warren (1981) found that the probability of adoption of recommended farming practices increased with participation in organised groups. The high level of agreement with the following statement from a survey of Australian farmers illustrates the importance of peers in adoption of innovations.

> 93% agreed "I am always looking around seeing what's working and what's not for other producers." (Solutions Through Research Group, 1993, 27)

Bardsley's (1982) research confirms that other farmers are important for background information for decision making and practical issues on farming.

Jones (1963) found that conspicuous practices are more likely to be adopted by neighbouring farmers. Rogers (1995) found that adoption depended on the observability of results of the innovation to others. Lack of visible success of an innovation in a district deters further adoption in that neighbourhood (Hurley, Fitzgerald, Harvey & Oppenheim, 1987).

Anderson (1982) found that once farmers perceived a problem exists, they initially relied on their own knowledge and their information network of other skilled farmers. Specialists were only consulted if these do not yield a satisfactory solution.

Interaction with others allows communication of information about innovations. More effective communication occurs when two individuals are homophilous (the degree to which they are similar in certain attributes) than when they are hetrophilious (Rogers, 1995). An extension officer and a farmer likely to be hetrophilious; neighbouring farmers are more likely to be homophilous.

Anderson (1982), using a relatively small sample of New South Wales farmers, found that progressive farmers (or early adopters) tend to be less socially distant from extension officers and other experts (early adopters and extension officers are more homophilous than are late adopters and extension officers). Anderson's (1982) findings are consistent with more effective communication occurring between the relatively homophilous progressive farmers and experts than between the less homophilous less progressive farmers and experts. Anderson (1982) also found that technology spread quickly within a homogeneous group of 'progressive' farmers, but technology did not diffuse/trickle down to the majority.

Related conclusions on the relative importance of other farmers as information sources are Buttel, Larson and Gillespie (1990) who review adoption studies and conclude that farmers with low socio-economic status rely more on other farmers for information, and Thomas, Ladewig and McIntosh (1990) who find that those with smaller farms use neighbours as their major information source

Rockwell (1990) describes a successful tillage conservation program in the United States which uses farmers who have adopted tillage conservation practices to encourage non-adopters to switch practices. This strategy uses a homophilous information source to encourage adoption.

Membership of groups such as landcare groups is a major catalyst for adoption of new practices (McKay, 1993; and research reviews by Campbell & Junor, 1992 and Chamala, 1987). Interaction with peers encourages individuals to examine their own values, beliefs and attitudes relevant to innovations in light of the values, beliefs and attitudes of the group.

> [Groups] ... have socio-psychological advantages. .. The use of groups in problem-solving and decision-making increases and speeds adoption leading to greater effectiveness. (Sproule, Godyn & Burfitt, 1991, 101).

Changing individual attitudes, values and beliefs is not sufficient to ensure a change in behaviour. Change of community attitudes, values and beliefs may also be necessary to ensure adoption and continuation with the new practice. Discussion groups can be 'reference groups' and so be a way of changing community/farmer attitudes and values, which facilitates adoption (Woods, Moll, Coutts, Clark & Ivin, 1993; Benedetti, 1969).

The studies reviewed in this section, taken together, present strong evidence of the major role played in the decision-to-change process by interaction with peers. Further, it seems that interaction which takes place in a group context is particularly effective in facilitating the adoption of new practices.

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The studies on adoption of conservation practices suggest that groups may be more effective because of their power to change community attitudes and values. The role of values and attitudes is explored further in section 2.7 below. The role of others in providing support while change is undertaken and in ensuring continuation with the new practice is the subject of section 4.

2.6.2 The role of 'expert advisers' in the decision making process

Figure 8 Expert advisers and the decision making process: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Miller, C. L. Contract Farming, Agribusiness and Global Relations in North West Tasmania. Doctoral thesis. Griffith University. Brisbane.	1994	NW Tasmania, crop	location, processing company, consultants	interviews	359 crops	correlations	
Newman, C. Change in Farmer Practices Following Spray Application Field Days. In Heap, J. (ed.) *Proceedings of the Ninth Australian Weeds Conference*, Adelaide Convention Centre, August. Crop Science Society of South Australia and Wheat Research Council of Australia, Adelaide. 147-152.	1990	Western Australia	awareness of field day, reasons for attending, planned changes, actual changes, information sources	questionnaire following field day and telephone survey 2 years later	46 and 33	descriptive stats	
Reeve, I. and Black, A. *Australian Farmers' Attitudes to Rural Environmental Issues*. The Rural Development Centre, University of New England. Armidale, New South Wales.	1993	Australia	attitudes to conservation, farm & individual characteristics	mail questionnaires	2000	factor analysis and multiple regression	
TAFE Curriculum Services Tasmania *Training Needs in the Vegetable Industry*. Hobart.	1984	Tasmania	training needs	mail questionnaires	246	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Meat and Wool Industry*. Hobart.	1986	Tasmania	training needs	mail questionnaires	315	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Dairy Industry*. Hobart.	1987a	Tasmania	training needs	mail questionnaires	197	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Horticultural Industry*. Hobart.	1987b	Tasmania	training needs	mail questionnaires	54	descriptive stats	
Wozniak, G. Human Capital, Information, and the Early Adoption of New Technology. *The Journal of Human Resources*. 22, 1, 101-112.	1987	US	adoption of chemicals, education, experience, information, size	previous study	310	logit & probit regressions	

There is a large body of evidence that suggests that contact with 'experts' such as extension officers increases the probability of adoption of innovations. Wozniak (1987) found that the probability of being an early adopter of a profitable innovation (the use of certain chemicals) increased with frequency of contact with extension service information sources. Huffman (1974), using United States Agricultural Census data (see Figure 1), found that availability of information from extension officers improves allocative efficiency, that is allocation of physical, financial and human resources among alternative uses (allocative efficiency is discussed further in section 2.8 Education and training and adoption of innovations below).

Contact with experts may lead to the adoption of profitable innovations: Miller (1994) found that high income vegetable growers in Tasmania used a wide range of advisers compared to lower income growers.

Experts such as extension officers, private consultants and field officers employed by purchasing and input supply companies are an important source of information and influence on adoption according to a number of studies (Fulton, 1995; McKay, 1993; Bardsley, 1982; Presser & Cornish, 1968).

Higher levels of education tend to be associated with more favourable attitudes toward expertise from outside the farm in relation to conservation practices in Australia (Reeve & Black, 1993) and farm management practices in New Zealand (Moore, 1990). Moore (1990) also found that farmers with better management skills were more likely to use farm consultants. As suggested in the previous section (2.6.1), the perceived degree of social distance between farmers and experts affects how farmers use extension workers according to Phillips (1987) who studied the adoption of new practices by dairy farmers in Australia and New Zealand.

The relative use of peers, intimates such as family, and experts as information sources in decision making varies from study to study in the literature. For example, Fulton (1995) found that potato growers used experts more than other farmers in production decisions. Although about two thirds of Tasmanian farmers use extension officers or consultants more than once per year, other farmers were a more frequently used source of information according to a series of mail surveys of Tasmanian farmers (TAFE Curriculum Services Tasmania, 1987a; 1987b; 1986; 1984). Moore (1990) finds that 74% of New Zealand farmers do not use a farm adviser or consultant.

The variation in findings could be explained by different decisions: technical or strategic for example, or different stages of the decision process, as discussed in section 2.4.1. Other farmers are important for background information for decision making and for farming practical issues. Extension officers and private consultants tend to be used for detailed technical advice, especially in areas where there is rapid change (Fulton, 1995; Bardsley, 1982).

Newman (1990) found that Western Australian farmers' confidence in and relative use of expert advisers for chemical application increased with contact with the advisers. Initial contact was at a field day. Newman also found that use of other farmers for information and advice fell as use of experts increased.

Several studies from the previous section suggested that farmers are more likely to adopt innovations if they can actually see that their peers have adopted the innovation (for example, Rogers, 1995; Jones, 1963). It is not surprising, therefore, that expert advisers who want to act as change agents can speed persuasion and the decision process by sponsoring visible demonstrations or trials of innovations (Rogers, 1995).

The literature in this section suggests that experts do have a role to play in persuading farmers to make changes to their practices, and for transferring the results of new research into new practices on farms. Education or training of people working with farmers is thus a major opportunity for improving technology transfer. People such as extension officers need skills in developing farmer skills, communication and an appreciation of farm management and rural sociology in order to maximise their effectiveness in this role of 'change agent'.

2.6.3 Information channels and early adopters

While interpersonnal communication channels are the most important in the adoption of innovations, studies over time and in a wide variety of contexts have consistently found that early adopters find mass media communication channels more important than do later adopters. Early adopters also find 'cosmopolite' channels (for example, experts) relatively more important (Rogers, 1995).

Preliminary results of a study of the adoption of new production technologies in the Australian wool industry showed that early adopters were more likely to use mass media as a source of information beyond the awareness stage, and rate mass media sources more highly (O'Keeffe & Marks, 1994). Rogers (1995) concluded that mass media channels are relatively more important than interpersonal channels for earlier adopters than late adopters after examining a number of studies on the adoption of innovations from agricultural and non agricultural settings ranging from the adoption of 2,4-D weed spray in the United States to public health practices in Peru.

2.7. Values, attitudes and beliefs

Figure 9 Values, attitudes and beliefs: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Earle, T., Rose, C. and Brownlea, A. Socioeconomic Predictors of Intention Towards Soil Conservation and Their Implication in Environmental Management. *Journal of Environmental Management*. 9, 225-236.	1979	Queensland	intention to adopt, farm, socio-economic and education	interviews	178	linear discriminant analysis	
Ervin, C. and Ervin, D. Factors Affecting the Use of Soil Conservation Practices: Hypotheses, Evidence, and Policy Implications. *Land Economics*. 58, 3, 277-292.	1982	US	conservation practices, farm personal, education	questionnaire	92	multiple regression	
Fliegel, F. A Multiple Correlation Analysis of Factors Associated with Adoption of Farming Practices. *Rural Sociology*. 21, 284 - 292.	1956	US	agricultural practices, size, farm family, attitude to adoption	interviews	170	multiple correlation analysis	
Gould, B., Saupe, W. and Klemme, R. Conservation Tillage: The Role of Farm and Operator Characteristics and the Perception of Soil Erosion. *Land Economics*. 65, 2, 167 - 182.	1989	US	tillage practices, land characteristics, financial, debt, education, age	State Farm Survey	327	logit regression	
Mandaletti, C. Financing the Lifestyle of Farm Business. *Workshop Papers, 22nd National Conference Australian Farm Management Society. Farming: Making the Lifestyle Your Business.*, 19 March, Launceston.	1996	Australia	financial options, returns to capital	ABARE farm survey (interviews)	not stated, but large	financing options, macro data	

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Mason, R. and Halter, A. Risk Attitude and the Forced Discontinuance of Agricultural Practices. *Rural Sociology*. 45, 3, 435 - 447.	1980	US, seed growers	adoption, risk attitude, size, age, education, financials	interviews	144, 50 on risk	interviews, multiple regression	
Morris, C. and Potter, C. Recruiting the New Conservationists: Farmers' Adoption of Agri-Environmental Schemes in the U.K. *Journal of Rural Studies*, 11, 51-63.	1995	UK	conservation practices, age, information sources, group membership,	questionnaire	101	descriptive stats comparing adopters/non-adopters	
Napier, T., Cameron, S. and Camboni, S. Willingness of Land Operators to Participate in Government-Sponsored Soil Erosion Control Programs. *Journal of Rural Studies*. 4, 4, 339-347.	1988	US	willingness to participate in conservation, farm size, age, succession, risk, experience	interviews	552	descriptive stats and multiple regression	
Taylor, D. and Miller, W. The Adoption Process and Environmental Innovations: A Case Study of a Government Project. *Rural Sociology*. 43, 4, 634-648.	1978	US	conservation practices, individual, farm attitudes	interviews	89, 71	longitudinal, multiple regression	
Underwood, C. and Salmon, P. *Nature and Extent of Self Directed Learning in Agriculture*. School of Agriculture and Forestry, University of Melbourne. Melbourne.	1980	Queensland, field officers	learning projects, learning strategies	interviews	30	qualitative and descriptive stats	
Vanclay, F. The Social Context of Farmers' Adoption of Environmentally Sound Farming Practices. In G. Lawrence, F. Vanclay and B. Furze, *Agriculture, Environment and Society*. Macmillan, Melbourne. 94 - 121.	1992b	Queensland and Victoria	attitudes to soil conservation, yield, socioeconomic variables	interviews	92, 113	descriptive stats	
Van Tassell, L. and Keller, L. Farmers' Decision-Making: Perceptions of the Importance, Uncertainty, and Controllability of Selected Factors. *Agribusiness*. 7, 6, 523-535.	1991	US users of farm business analysis program	decision influences, ranking	mail questionnaire	500	ratings	

Sociological and psychological research, presented in this section, presents a perspective on decision making in which attitudes, values and beliefs are important. Typically, new practices need to fit with the individual's beliefs and values if they are to be adopted (Guba & Lincoln, 1989).

Decision makers seek information and assess alternative 'solutions' or implementation strategies in light of perceived benefits and costs of the information and solutions. Perception of benefits and costs depends on values, attitudes and beliefs. Adoption and/or intention to adopt depend perception of a problem and on a favourable attitude being formed toward a specific strategy. A number of studies, particularly in the area of conservation practices, support this point. Examples are a study of the adoption of tillage conservation practices in Wisconsin (Gould, Saupe & Klemme, 1989), a study of participation in sale of row-cropping rights to the government in Ohio (Napier, Cameron & Camboni, 1988) and an Australian study of the adoption of soil conservation practices in the Darling Downs area (Earle, Rose & Brownlea, 1979).

An understanding of how values, attitudes and beliefs might impact on the decision to change process is useful in analysing the factors which influence farmers to make changes to their practices. Two views on the relationship between values and attitudes and change are outlined briefly below. The first is from a recent text on transformative learning (Cranton, 1994) and the second is an older theory that underpins a number of studies of farmer decision making (Kelly, 1955).

Change can be triggered by new information which conflicts with an individual's previously accepted knowledge, followed by a process of acceptance of the new information. Sometimes the trigger will be questioning of the value of a source of information, and hence the information provided by that source. Another level of trigger for change is questioning of social norms, perhaps by exposure to different norms. Critical reflection of values and beliefs following a life crisis, social or political changes or other event which prompts reflection also trigger change (Cranton, 1994).

Kelly's (1955) personal construct theory holds that personal constructs, which determine beliefs, values and actions, are determined by previous experiences. Individuals continually test their internal model of the world (their constructs) with observed outside events, and modify their model in the light of those observations. Their aim in this continual testing is to gain a better understanding of their environment. The theory is in the humanist tradition (Phillips, 1985; Salmon, 1981a). Personal construct theory has been used to explain how values, attitudes and beliefs influence decision making on farms in the work of Phillips (1985), Underwood (1984), Salmon (1981a) and Underwood and Salmon (1980). Kelly (1995) sees that personal constructs are about personal conceptual understanding, as well as beliefs and values.

Both these brief theory outlines from Cranton (1994) and Kelly (1955) suggest that before farmers make changes to their practice, it may be necessary for them to change their values, attitudes and beliefs.

2.7.1 Farm decision making and values, attitudes and beliefs

There are a number of works in the literature reviewed here which examine how values, attitudes and beliefs of farmers influence their decision making. Chamala (1987) is one such work:

> ... farmers tend to select, from the package of practices developed by scientists, those that are consistent with their needs, economic conditions and attitudes towards different practices. (Chamala, 1987, 400)

The influence of attitudes and values on adoption of innovations has been acknowledged for some time (for example, Thomas, Ladewig and McIntosh, 1990; Chamala, 1987; Phillips, 1985; Fliegel, 1956). One attitude which has been examined extensively in relation to decision making is attitude to risk. Most decision making in agriculture is carried out under uncertainty. Farmers do not have sufficient information about the quality and cost of farm inputs, financial markets, technology, output markets and environmental issues according to an Australian study by Murray-Prior (1996) and a United States study of users of a farm business analysis program (Van Tassell & Keller, 1991). Attitude to risk plays an important role in decision making (Vanclay, 1992a; Mason & Halter, 1980). Ilbery (1978) reviews studies of the behaviour of farmers in developing countries in relation to risk aversion and concludes that attitude to risk influences decisions.

Studies have found that goals, values and attitudes influence a range of farm decisions, such as enterprise choice; for example, Ilbery (1978) outlined a number of studies on factors including goals, values and attitudes which influence enterprise choice. Also, Gillmor (1986) (see Figure 3) found that both goals and values influence the choice between enterprises such as hops and cattle in physically homogeneous locations. Gillmor (1986) regarded goals and values as intertwined, and hence it was not possible to isolate the influence of each on a decision. As discussed in section 2.3.1, farmers' goals are a mix of economic, personal and social goals.

Individuals selectively expose themselves to those ideas which are in accord with their interests, needs or existing attitudes, while ignoring ideas which conflict with these interests, needs or existing attitudes. Thus, farmers will tend to ignore or 'not see' innovations which conflict with their perceived needs and existing values and attitudes (Rogers & Shoemaker, 1971). A supporting comment to the concept that attitudes and values impact on the absorption of new information and ideas comes from writers in adult learning, Zemke and Zemke (1981), who said that information which contrasts sharply with existing beliefs is integrated more slowly. Many adults have strongly held attitudes, values and beliefs which may have to be 'unlearnt' or altered before new learning can take place (Merriam & Caffarella, 1991).

Since many conservation practices do not have short run economic pay-offs (Napier, Cameron & Camboni, 1988), adoption of conservation practices does not necessarily lead to increased productivity or profitability for the adopter. Thus other, non-economic, motivations must be present for adoption of conservation practices to occur. Most research into adoption of conservation practices has considered values, attitudes and beliefs regarding conservation as motivating factors for adoption. Examples are studies by Morris and Potter (1995), Vanclay (1992b), Napier, Cameron and Camboni (1988), Ervin and Ervin (1982), Earle, Rose and Brownlea (1979) and Taylor and Miller (1978). These studies suggest that farmers are more likely to have an attitude of concern about land degradation in general than they are to perceive land degradation to be a problem on their property. Those who perceive a problem on their property are more likely to adopt conservation practices, regardless of the actual level of degradation.

Whilst developing a favourable attitude toward a new practice is ususally necessary for adoption, it is not sufficient to ensure adoption. Vanclay (1992b) found that although Darling Downs farmers have appropriate attitudes and believe soil conservation is economic, 45% had not adequately protected their farms from land degradation. Farmers are more likely to respond "according to notions of good farm management which exist in the farming subculture and the local peer group" (Vanclay 1992b, 100). Chamala (1987) and Bultena (1983) also suggest that perceived community norms are important in adoption of conservation practices.

Vanclay (1992a) suggests that failure to adopt conservation practices is often rational behaviour. Reasons for failure to adopt being rational include the existence of conflicting information, risk associated with new techniques, implementation costs and required capital outlay, intellectual outlay, loss of flexibility, complexity of new techniques, and/or incompatibility with other aspects of farm management or personal objectives. In subsistence cultures the risk of adopting an innovation that fails was death (Deutsch, 1971). At its most severe in Australia today it can be farm business failure.

2.7.2 Using groups to alter values, attitudes and beliefs

The literature reviewed in this section confirms that holding favourable values, attitudes and beliefs toward a practice facilitates farmer change to that new practice, with the proviso that there must also be sufficient resources available to implement the new practice. The conclusion from the literature reviewed in earlier sections is that groups, preferably including 'expert(s)' as well as peers, should be used to provide farmers with the opportunity to test their values and attitudes against those of the peers. This will assist in the process of evolution of community and individual values, attitudes and beliefs.

2.8. Education and training and adoption of innovations

Education and training influence the development and adoption of innovations at a national level. Fitzgerald (1994) stressed that education and training were necessary for coping with economic change and adapting to new technology, as does Porter's (1990) work:

> There is little doubt from our research that education and training are decisive in national competitive economic advantage. The nations we studied that invest heavily in education (Germany, Japan and Korea) had advantages in many industries that could be traced in part to human resources. What was even more telling was that in every nation, those industries that were the most competitive were often those where specialised investment in education and training had been the greatest. (Porter, 1990, 628)

Figure 10 lists research studies found in the literature search which consider the relationship between education and training and the adoption of innovations, or making changes to practice. Many other studies which are referred to in this section appear in earlier figures in the chapter which list research studies.

Figure 10 Education and training and adoption of innovations: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Bartel, A. P. and Lichtenberg, F. R. The Comparative Advantage of Educated Workers in Implementing New Technology. *The Review of Economics and Statistics* 69, 1, 1-11.	1987	US, manufacturing	education	census of manufacturing workers	census	OLS multiple regression	
Cassidy, G., Wilson, T. and Thompson, J. *Gross Margins Extension Project 1983 Evaluation.* Queensland Department of Primary Industry, Brisbane.	1983	Queensland	adult learning		1 extension project	in Woods et al	
Clampet, W. Extension Programs and Technology Transfer in the New South Wales Rice Industry. In *Australia Pacific Extension Conference Proceedings* Surfers Paradise October 12-14. Queensland Department of Primary Industries. Brisbane. 282-285.	1993	NSW, rice growers	adoption of several innovations		50 groups, 10-20 in each	descriptive stats	no statistical tests
Clearfield, F. and Warner, D. An Agricultural Videotext System: The Green Thumb Pilot Study. *Rural Sociology.* 49, 2, 284 - 297.	1984	US	adoption of videotext		200	on microfiche	
Daniels, J. and Woods, E. Helping Farm Managers Make Better Financial Decisions. *Proceedings of the Australia-Pacific Extension Conference.* Gold Coast, Australia. 389-392.	1993	Queensland, computer workshop attendees	decision process	semi-structured interviews	20 & 32	card sort technique, 2 groups attenders and non attenders	no statistical tests
Ekanayake, S. and Jayasuriya, S. Change, Adjustment and the Role of Specific Experience: Evidence from Sri Lankan Rice Farming. *Australian Journal of Agricultural Economics.* 33, 2, 123-135.	1989	Sri Lanka	age, education, farm, financial	written records	63 & 61	OLS regression	

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Jamison, D. and Lau, L. *Farmer Education and Farm Efficiency*. The John Hopkins University Press. Baltimore.	1982	Asia, Africa, Europe, Latin America	yield, education, extension, adoption	previous studies	18 studies, 37 data sets	meta analysis, based on Lockhead et al (1980)	some problems with compatibility of data sets
Khaldi, N. Education and Allocative Efficiency in U.S. Agriculture. *American Journal of Agricultural Economics*. 57, 650-657.	1975	US	productivity, education	macro data	averages, macro data	Multiple regression OLS,	average macro data
Kunzru, O. and Tripathi, H. A Comparative Study of Adoption of Dairy Farm Technologies Between Non-Members and Members of Dairy Co-operative Villages. *Indian Journal of Animal Sciences*. 64, 5, 501-507.	1994	India, women farmers	adoption of practices, education, size, attitudes	interviews	192	Interviews, 2 samples, co-ops and non-co-ops	
Mason, G., Prais, S. and van Ark, B. Vocational Education and Productivity in the Netherlands and Britain. *National Institute Economic Review*. 140, 45-63.	1992	UK, Netherlands	education, skills, productivity	survey of plants	36 plants	descriptive stats	
Nettle, R. (Intensive Pasture Management Courses - Tasmania: Their Evaluation. In *Dairy Horizons - The Challenge for Extension. Proceedings*. A Dairy Research and Development Corporation Conference, November, Melbourne. 24-26.	1992)	Tasmania, dairy	adoption, productivity	interviews	not stated	farm audit and survey, descriptive stats	
Pudasaini, S. The Effects of Education in Agriculture: Evidence from Nepal. *American Journal of Agriculture*. 65, 509 - 515.	1983	Nepal	education, age, productivity, modernising environment	interviews	354	multiple regressions	
Riesenberg, L. and Obel Gor, C. Farmers' Preferences for Methods of Receiving Information on New or Innovative Farming Practices. *Journal of Agricultural Education*. 30, 3, 7 - 13.	1989	US	information delivery preferences, size, age, education	mail survey	176	bivariate analysis	

Numerous studies have found a positive relationship between general education level and early adoption of innovations in developing and developed countries. These include India (Kunzru & Tripathi, 1994), Sri Lanka (Ekanayake & Jayasuriya, 1989), a meta analysis of a number of developing countries by Jamison and Lau (1982) and the United States (Clearfield & Warner, 1984; Abd-Ella, Hoiberg & Warren, 1981; Jones, 1963). The only Australian study from the literature search which found that better educated farmers are earlier adopters of innovations is almost 30 years old (Presser & Cornish, 1968). Rogers' (1995) extensive review of research into the diffusion of innovations presented a considerable body of evidence to support the relationship between education and early adoption of innovations.

There is a threshold level of education before education impacts on adoption. Jamison and Lau (1982) reviewed a number of studies of adoption of innovations in developing countries and concluded that at least four years of primary school education is necessary before education increases the probability of adoption.

A number of the studies showed that educated farmers were more likely to be innovative and flexible in response to changes in the internal and external farm environment. Gould, Saupe and Klemme, (1989) found that better educated farmers were more likely to adopt conservation practices.

In summary, there is a large body of evidence that establishes that education has an impact on productivity (see section 1.3) and on adoption of innovations. Education is defined as years of schooling in most studies (Rogers, 1995; Clearfield & Warner, 1984; Abd-Ella, Hoiberg & Warren, 1981; Presser & Cornish, 1968; Jones, 1963). Education is confined to primary education in many studies, especially those in developing countries (Kunzru & Tripathi, 1994; Ekanayake & Jayasuriya, 1989; Jamison & Lau, 1982). None of these studies consider returns to agricultural education or returns to non-formal training in general (in terms of productivity or profitability, for example) nor do they consider the impact of agricultural education on adoption of innovations, although a number of studies (outlined in the following section 2.8.1) consider the impact of individual short courses and other training 'events' on practice.

2.8.1 Training programs and changes to practice

From the last section, education has an impact on business outcomes such as productivity and profitability. As well, education facilitates the adoption of innovations, or making changes to practice. It is suggested here that the impact of education on business outcomes occurs via the impact of education on the adoption of innovations. That is, education affects decisions regarding new practices. Research on specific education and training courses and methods of training delivery have found impacts on changes to practice, or innovation. Field days and/or conferences are an influence on the decision to make a change to practice (Dillman, Engle, Long & Lamiman, 1989). Tasmanian farmers who attended whole farm planning courses were more aware of landcare issues, and more likely to adopt landcare practices following the course than farmers who had not attended whole farm planning courses (McKay, 1993).

Woods, Moll, Coutts, Clark and Ivin (1993) discuss evaluations of many Australian training courses, seminars and field days, including the impact of those training 'events' on participants' practice. Some examples of the impact of specific training programs on farm practice are:

- Queensland farmers who have taken a computerised financial records course are more likely to use cash flow budgets (Daniels & Woods, 1993).

- 85% of participants in a chemical spraying field day had changed their spraying practice in the two years following the field day (Newman, 1990).

- 63% of participants in a pig producer workshop made changes to their practice following the workshop. 40% of those who made changes became aware of the change at the workshop (Spencer, 1993).

- Adoption of block grazing practices in Tasmania rose from 20% to 79% of dairy farms over a ten year period during which 60% of all dairy farmers attended a course which recommended block grazing. Productivity per hectare increased by 61% over the same period (Nettle, 1992).

- 64% of participants in a one day 'school' on using gross margins in decision making used the system after the 'school' (Cassidy, Wilson & Thompson, 1983).

After reviewing evaluations of various types of one-off meetings and programs, including field days, demonstration days, displays, conferences, seminars and workshops, Woods, Moll, Coutts, Clark and Ivin (1993) conclude:

> ... it is not so much that one type of one-off group meeting is better than another. The key critical success factor is to what extent are adult learning principles incorporated. (pp 54-55)

Adult learning principles follow from the andragogical model of learning which assumes that adults must know why they need to learn something before undertaking to learn it, that they want to make their own decisions, not have them imposed and that they will learn things they believe are directly applicable to their situation (for example, Knowles, conferences are an influence on the decision to make a change to practice (Dillman, Engle, Long & Lamiman, 1989). Tasmanian farmers who attended whole farm planning courses were more aware of landcare issues, and more likely to adopt landcare practices following the course than farmers who had not attended whole farm planning courses (McKay, 1993).

Woods, Moll, Coutts, Clark and Ivin (1993) discuss evaluations of many Australian training courses, seminars and field days, including the impact of those training 'events' on participants' practice. Some examples of the impact of specific training programs on farm practice are:

- Queensland farmers who have taken a computerised financial records course are more likely to use cash flow budgets (Daniels & Woods, 1993).

- 85% of participants in a chemical spraying field day had changed their spraying practice in the two years following the field day (Newman, 1990).

- 63% of participants in a pig producer workshop made changes to their practice following the workshop. 40% of those who made changes became aware of the change at the workshop (Spencer, 1993).

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Adult learning principles follow from the andragogical model of learning which assumes that adults must know why they need to learn something before undertaking to learn it, that they want to make their own decisions, not have them imposed and that they will learn things they believe are directly applicable to their situation (for example, Knowles, 1990; Tennant, 1991). Facilitators should regard themselves as a partner in the learning process, and use a facilitating or collaborating rather than lecturing style. Facilitators should act as a catalyst, resource and importantly as a co-inquirer who will also learn from the group. The learner-centered teaching style of the humanistic educators such as Carl Rogers (see Boud, 1987), which emphaises respect for learners and empathy, is consistent with adult learning principles.

Education and training which is based on adult learning principles is particularly important if the training aims to bring about changes to knowledge which has been gained through a high level of experiential learning, over a period of time. Such knowledge is the most difficult to change, and is often associated with complex practices relating, for example, to overall farm management rather than livestock handling.

The importance for effective training of incorporating adult learning principles into training programs is discussed further in section 4.4 below.

2.8.2 Adaption

Innovation is a continual process whereby the form and function of the innovation and the environment into which it might be adopted are modified throughout the life of the innovation (Brown, 1981). This process of continual modification is known as adaption. Innovations are adapted to suit individual situations, or 'reinvented', by adopters (Rogers, 1995; Russell, 1990b; Eveland, 1986).

More educated people are better able to adapt innovations to their advantage. Education and training play a key role in the diffusion of innovations and their adaption to suit particular work sites in all industries according to economists Sloan (1994) and Chapman and Stemp (1992).

Learning about a new technology can take two forms: experiential learning and observational learning (Hildebrand, 1988). Experiential learning is done by those using the technology, and is described by learning by doing or interactive organisational learning. Observational learning occurs by observation and other methods such as reading and hearing about the innovation. Observational learning is learning done by those not using the technology.

Early adopters may have learned of the innovation by reading and listening, reflecting and then by doing. The early adopters adapt an innovation to conform with their particular context, including values, attitudes and beliefs, as well as their physical context. In adapting the innovation, early adopters are engaging in experiential learning. The existence of the adapted innovation facilitates the observational learning of later adopters who have similar, but not necessarily identical, contexts.

Nelson and Phelps (1966) argued that education is especially important for those functions which require adaption to change. Bartel and Lichtenberg (1987) concluded from a study of manufacturing that highly educated workers have a comparative advantage in implementing and adjusting to new technology, as distinct from any advantage in adopting innovations. This advantage is due to a superior ability to receive and decode information, compared to less educated workers. The adjustment of new technology to suit a particular situation is characterised by a high degree of uncertainty; the enhanced "signal extracting" ability of educated workers is more important the greater the degree of uncertainty in the production environment.

Education, then, facilitates adaption of new technologies and practices. The more educated are therefore likely to be early adopters, and so be in a position to exploit the innovation earlier. They will reap the benefits of the innovation, such as, improved productivity and profitability, before later adopters. If more educated managers are consistently early adopters, then they can be expected to have consistently superior business performance.

2.8.3 How does education and training impact on the decision to change?

Several ways in which education can impact on the decision to change emerge from an examination of literature in the area. They are first, in the selection and allocation of inputs into the production process, second in awareness of possible innovations, and third, in fostering a favourable attitude toward change.

Education assists in decision making, particularly in selecting quality inputs and allocating inputs between competing uses. Welch (1970), in a seminal work, found that education can affect productivity in two ways, firstly via a worker effect which is due to improved quality of labour which increases production from a given set of non-labour inputs, and secondly via an allocative effect which is due to improved ability to process information, select inputs and allocate inputs across competing uses.

Khaldi (1975) and Huffman (1974) examined allocative decision making by United States farmers and confirmed Welch's (1970) finding that education improves the outcome of the decision. In Welch's (1970) and Khaldi's (1975) studies the outcome is higher productivity, while for Huffman's (1974) farmers it is applying the optimum amount of nitrogen. Pudasaini (1983) found that education has a much higher value on a multiproduct farm where allocative options are greater, than on a single product farm. Huffman (1977), also using United States agricultural data, found that education improved individuals' response to changes in economic conditions by its influence on allocative choices.

Rosenzweig (1995) reviews studies on links between education and productivity in a variety of agricultural and non-agricultural settings and concludes that returns to education occur only for innovations which are not simple to use; that is returns to education are high when returns to learning are also high. Education impacts on productivity only if there are complex innovations which required a relatively high level of learning for implementation to be successful.

> ... there is no evidence that schooling investments, in the absence of learning opportunities, are profitable, unless such investments themselves induce innovation. (Rosenzweig, 1995, 157)

If complex innovations require a high level of learning which in turn required investment in education, then given that not all farmers have a high level of education, more complex innovations could be expected to be diffused more slowly. Many diffusion and adoption studies have found that more complex innovations are diffused at a slower rate (Reeve & Black, 1993; Clampett, 1993; Vanclay, 1992a; Buttel, Larson & Gillespie, 1990; Jones, 1963).

As mentioned earlier, education assists people deal with uncertainty and use new information:

> ... decision-makers with more education can more quickly grasp changes and adjust more quickly and accurately to them (Huffman, 1974, 95-96).

Rogers (1962) found that educated farmers adopt innovations earlier because there is less uncertainty, and so less risk, for educated farmers; they are better able to discriminate between promising and unpromising ideas, and less likely to make mistakes. Nelson and Phelps (1966) and Thomas, Ladewig and McIntosh (1990) suggested that education assists people receive, decode and understand information. Schultz (1975) argued that education improves ability to deal with disequilibria. Welch (1970) holds that education increases ability to extract signals from information, where signals are indications of the likely benefit of an innovation to that individual:

> ... educated persons ... can distinguish more quickly between the systematic and random elements of productivity responses. (p 47)

People with more years of formal education engage in more complex learning projects (Phillips, 1987). A higher skill level contributes to productivity through better maintenance of equipment, consistent product quality, workforce flexibility and less learning time on new jobs (Mason, Prais & van Ark, 1992).

The second of the three ways in which education can impact on the decision to change is via earlier awareness of possible innovations. Rogers (1995) reviewed innovation studies and concluded that early 'knowers' of an innovation have more education than later 'knowers'. Early 'knowers' are more adept at recognising and selecting new 'quality inputs', which is consistent with Welch's (1970) finding that education assists in the selection of inputs.

Better educated farmers rate publications and media more highly as information source than do those who are less educated (Riesenberg & Obel Gor, 1989). The mass media are an important source of awareness of innovations (Rogers, 1995; Longo, 1990; Jones, 1963). More educated farmers have more contact with expert advisers and other information sources (Thomas, Ladewig & McIntosh, 1990). The better educated therefore are aware of a greater number of possible innovations through use of the mass media and contact with expert advisers, as well as being better able to evaluate innovations and select those most likely to have a beneficial impact on their farm business.

Third, education fosters a favourable attitude to change. Foster (1987) and Holsinger (1984) reviewed social-psychological research on the effect of education on economic development and productivity. Both concluded that education altered values and attitudes away from the traditional, and this encourages development. Phillips (1994) and Lockheed, Jamison and Lau (1980) examined a total of 59 sets of farm data from developing countries, and their work supports the hypothesis that education is more effective in improving productivity in a 'modernising' environment than in a 'traditional' environment. Two studies from the developed world in the area of conservation (Ervin & Ervin, 1982; Earle, Rose & Brownlea, 1979) found that education level was a predictor of intention to adopt conservation practices. This is consistent with education fostering the development of favourable attitudes and values toward change.

2.8.4 Summary

The literature discussed in this section strongly suggests that education has multiple impacts on the decision to change in terms of selecting and allocating inputs, increasing awareness of potentially successful innovations and promoting a favourable attitude to change. Therefore, having a low level of education must be a disadvantage to farm managers, because a low education level hinders the acquisition and processing of information which could improve farm profitability and viability.

2.9. Change and other characteristics

The speed of diffusion of an innovation depends on other characteristics of the innovation in addition to its complexity (discussed in section 2.8.3) and some other characteristics of potential adopters in addition to those reviewed so far (interaction with peers and experts, use of mass media information channels, values, attitudes and beliefs and education). Literature relating to these 'other' characteristics is reviewed only briefly below since it is of only secondary interest to this thesis. A number of the studies cited in this section also consider some of the characteristics already discussed in this chapter and hence appear in earlier figures listing research studies. Additional studies found in the literature search listed in Figure 11 below.

Figure 11 'Other' characteristics and adoption of innovations: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Brown, L., Malecki, E. and Spector, A. Adopter Categories in a Spatial Context: Alternative Explanations for an Empirical Regularity. *Rural Sociology*. 41, 1, 99 - 118.	1976	US	geographic spread of innovations	interviews and census records	562	factor analysis	
Feder, G. and Slade, R. The Acquisition of Information and the Adoption of New Technology. *American Journal of Agricultural Economics*. 66, 312-320.	1984	India	innovation, information access, farm size, education	interviews	548	logit regression	
Fulton, A. Farmer Decision Making in Northern Tasmania. Talk given on October 13, Department of Primary Industry and Fisheries. Launceston.	1994	Tasmania, potato	information sources, practices chosen	interviews	100	descriptive stats	on going project
Griliches, Z. Hybrid Corn: An Exploration in the Economics of Technological Change. In *Econometrica*, 25, 501-522.	1957	US	adoption of corn variety over time by state	census data	US Agricultural Census	logistic growth functions	seminal study
Hooks, G., Napier, T. and Carter, M. Correlates of Adoption Behaviours: The Case of Farm Technologies. *Rural Sociology*. 48, 2, 308 - 323.	1983	US	agricultural practices, attitudes, education, contact with extension	mail survey	469	multiple correlation, stepwise regression	

2.9.1 Innovation characteristics

The rate of diffusion of an innovation increases with its profitability according to various authors (Rogers, 1995; Griliches & Mansfield, cited in Jensen, 1982; Griliches, 1957), or its perceived profitability (Jensen, 1982).

The more divisible an innovation, the greater the opportunity to trial it on a small scale at the same time as continuing with existing practices. Trialing a new practice while also continuing with existing practices entails a lower risk to the whole farm business than replacing an existing practice entirely. As successful trials lead to adoption, the more divisible an innovation, the greater the chance of adoption. This finding is common to a number of studies (Rogers, 1995; Vanclay, 1992a; Moore, 1990; Chamala, 1987).

The more visible an innovation the more likely it is to be adopted (see also sections 2.3 and 2.6 above). Innovations with a high 'experience component'; that is, those which cannot easily be observed but rather need to be experienced, such as new management practices, spread more slowly than innovations with a high 'search component' which are conceptually easier to imagine working, such as a applying a new chemical (Midgely & Dowling, 1990). Thus, those changes which are less visible, such as changes to financial management and marketing, spread more slowly than innovations such as new equipment or new ways of ploughing, which are easily observed.

2.9.2 Other adopter characteristics

Many of the studies from the literature search found that early adopters are likely to be younger than later adopters (Morris & Potter, 1995; Parminter, 1993; Thomas, Ladewig & McIntosh, 1990; Moore, 1990; Korsching, Stofferahn, Nowak & Wagener, 1983).

Several studies found that, compared to late adopters, early adopters are not only better educated, but also have bigger farms and are wealthier (Rogers, 1995; Wozniak, 1987; Clearfield & Warner, 1984). Lack of sufficient or appropriate resources, which may be measured by variables such as income or farm size, is a significant barrier to change in a large number of studies (Frank, 1993; McKay, 1993; Cruise & Lyson, 1991; Gould, Saupe & Klemme, 1989; Napier, Cameron & Camboni, 1988; O'Brien, 1987; Korsching, Stofferahn, Nowak & Wagener, 1983; Bultena & Hoiberg, 1983; Hooks, Napier & Carter, 1983; Ervin & Ervin, 1982; Abd-Ella, Hoiberg & Warren, 1981). Information gathering requires economic and time resources which smaller farms are less likely to have available (Feder & Slade, 1984). Lack of sufficient financial resources is also a barrier to innovation in Australian manufacturing industry (Australian Bureau of Statistics, 1995c).

Farm businesses with debt are more likely to adopt conservation practices according to the United States study by Gould, Saupe and Klemme (1989) and an Australian Bureau of Agricultural and Resource Economics study quoted in Campbell and Junor (1992).

A number of studies find that innovations spread more quickly to others who are geographically close (Fulton, 1994; Miller, 1994; Brown, Malecki & Spector, 1976). One reason is the need for infrastructure to support innovations which may be present in some areas and not others (Brown, 1981; Brown, Malecki & Spector, 1976). In an agricultural context infrastructure could include expert advisers, input suppliers, warehouses, transport and marketing infrastructure.

In summary, the chance of a change being made depends on the characteristics of the innovation, the characteristics of adopters and their social and physical context. Potential adopter characteristics relating to education and training and interaction with others were discussed in previous sections. In this section in was noted that more profitable and more visible innovations will spread more quickly than innovations which are less profitable and less visible. As well, potential adopters need an appropriate level of economic resources to implement an innovation before they will adopt.

2.10. Changes to practice - summary

The literature reviewed here suggests that the decision to make a change to practice is a complex one, and that there are a number of factors which influence the likelihood of a change being made. The factors relate to the type of change or innovation being considered, the characteristics of the farm business where the change is contemplated, and to the characteristics of the individual. It is the latter group of factors that is of primary interest to this thesis.

Individual characteristics which have been identified as influencing the decision to change are age, education and specific training sessions undertaken, use of mass media information sources, values, attitudes and beliefs and interaction with peers, experts and others in the farm management team. Education and training appear to be an influential factor in adoption of innovations not only in its own right, but also via its impact on use of mass media information sources, values, attitudes and beliefs and interaction with peers and experts. The literature also suggests that the decision-to-change process does not stop with the decision to adopt or to change, but that there is an on-going review of the decision which could result in discontinuation.

Discussion relating to education and training is resumed in the section after next (section 4), which examines factors which foster participation in education and training. The following section (3) considers factors which foster continuation with the decision to implement a new practice.

3. What are the support mechanisms and mentors as change is undertaken?

> People are the major source of information, validation and support in the decision making of farmers. (Phillips, 1987, 449)

3.1. The place of support in the change process

The models of the decision process outlined in section 2.4 above include final stages which are the implementation and accompanying confirmation of a decision. The stages are Rogers's (1995) implementation and confirmation; Havelock's (1971) selecting and implementing a solution and measuring effectiveness; Klausmeier's (1985) tries to attain goal, confirms/rejects tries and reaches goal; and Argyris and Schon's (1974) monitoring the implementation.

Underwood and Salmon's (1980) model, which is based on Kelly's (1955) personal construct theory, has four continuous stages: reflection, enquiry, action and evaluation (which is followed by reflection). The evaluation stage and subsequent reflection illustrate that the decision to implement is an on-going one; it is possible to choose to discontinue with an innovation at any time.

The interaction with intimates, peers and experts which occurs during the earlier stages of the decision process continues during and after implementation. Rogers (1995) describes the confirmation stage as when:

> ... an individual (or other decision-making unit) seeks reinforcement of the innovation-decision already made or reverses a previous decision to adopt or reject the innovation if exposed to conflicting messages about the innovation. (p 181)

Thus social support is important to ensure that, once implemented, an innovation is not discontinued. Decision makers continue to collect information about an innovation after implementation, and it is this which comprises the confirmation stage (Rogers & Shoemaker, 1971).

Phillips (1985), whose four phases which precede action are discussed in section 2.6, emphasised the importance of intimates in providing support for decision making.

> Trust, support, a closeness of human relationships and a very similar view of the world (constructs) meant the learner used the intimate as a gate keeper, to assist with and protect him in coping with change and decision making. (Phillips, 1985, 250)

An innovation may be discontinued either because a better innovation is found to replace it, or because there is 'disenchantment' with the innovation. Those adopters who discontinue with the innovation because of disenchantment are likely to be late adopters. Typically, they have less education, lower social status and less contact with change agents, such as extension officers and farmer opinion leaders (Rogers & Shoemaker, 1971).

3.2. Farmer change-support sources

Both social and physical infrastructure are necessary to support those making changes to their practice according to Vanclay (1992a), Cochrane (1974) and Mosher (1971), all of whom review adoption research. Examples of physical infrastructure include input suppliers such as stock and station agents, output purchasers such as processing companies and advisers (financial and technical). The remainder of this subsection concentrates on social infrastructure and support.

Extension officers have a role to play in supporting farmers once they have decided to implement change. Extension officers can ensure that implementation is feasible and is seen to be feasible by farmers; they can provide information, opportunities for skill acquisition and monitoring of trials to assist farmers evaluate the 'action' (Hollick, 1990).

On-going groups such as landcare and product discussion groups, provide social support by allowing farmers to confirm that their values, attitudes and practices fall within group norms (see section 2.6.1 above).

> Groups provide the best opportunity to go beyond the awareness stage, and to incorporate all phases of the problem solving cycle. They allow decision support systems and comparative analysis to be used, both of which can be effective in motivating change, and overcoming on-farm constraints. Networks of groups could also be effective in impacting on off-farm constraints (for example, policy). (Woods, Moll, Coutts, Clark & Ivin, 1993, 61)

The literature, then, suggests that support during and after the implementation phase is a vital part of the change process. The support may come from 'technical' or 'expert' sources, including extension officers and consultants, or it may come from 'social' sources, such as other farmers. By providing support to farmers, groups can play a valuable role during and after the implementation phase, just as they can in other phases of the decision-to-change process.

The final two sections of this chapter return to the topic of education and training. Section 4 addresses the fourth research question and considers factors which foster participation in training, while the final section (5) examines future training needs in agriculture.

4. What are the reasons which foster participation in training?

> Formal farmer training was introduced in Australia in the mid 1880s, but its subsequent history has been dogged by a variety of factors not least of which has been the disinterest of farmers themselves in such training. (Bell & Pandey, 1987, 57)

4.1. Small business managers and training

Farms are not the only category of small business which have a low participation in education and training. Studies of small business, such as that of Lynas and Ormond (1986), consistently show a lack of orientation toward training. McMahon (1989, 54-65) lists Australian surveys and inquiries into small business training, many of which identify a low level of participation in training.

Studies of executives of small manufacturing firms in Iowa (Swanson, 1990) and of Australian small businesses (Lynas & Ormond, 1986) found that the challenge in attracting small business managers is to prove that additional education and training is relevant and could influence participants' firms' profit. Only 50% of Lynas and Ormond's (1986) Australian sample had ever attended any training relevant to their business.

Relevant training is more important to small business managers than accreditation. Although almost two-thirds of Swanson's (1990) manufacturers had attended at least one educational seminar in the last year, Swanson (1990) found that they were not interested in the accredition given by 'for-credit' courses.

The next three sections (4.2 to 4.4) examine literature which considers factors which foster and inhibit participation in education and training, particularly by farmers. The first factor considered is formal educational achievement, followed by cultural and economic barriers to participation. Finally, the influence on participation of the method by which training is delivered is discussed.

4.2. Prior education as a barrier to training

> Farmers who complete[d] Grade 10 at school ... demonstrated a significantly greater need for learning and a better understanding of facts than the farmers with a lower level of education. (Daniels & Chamala, 1989, 30)

Figure 12 Prior education as a barrier to training: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Anderson, A. *Processes and Implications of Knowledge Transmission in Australian Agricultural Extension*. School of Management, Hawkesbury Agricultural College. Richmond, New South Wales.	1982	NSW	extension users and non-user group	previous study	43	descriptive comparison of extension users and non-user group from previous study	small sample, variables likely to be interrelated, e.g. size, income, herds.
Daniels, J. and Woods, E. Helping Farm Managers Make Better Financial Decisions. *Proceedings of the Australia-Pacific Extension Conference*. Gold Coast, Australia. 389-392.	1993	Queensland	decision process	simulations	20 & 32	card sort technique, 2 groups attenders and non attenders	no statistical tests
House Rosler Davis Pty. Ltd. *Review of Shearer and Shedhand Training*. Report for the Australian Wool Corporation. Australian Wool Corporation. Melbourne.	1993	Australia, shearers and shedhand employers and trainers	training needs	mail survey	not stated	tabulations	
McKenzie, P. and Long, M. Educational Attainment and Participation in Training. Paper presented at the Efficiency and Equity in Education Conference. Canberra. September.	1995	Australia, all industries	education, training behaviour	ABS survey of employers		cross tabs, descriptive stats	
Phillips, T. Farmers' Perception of Extension - Learning Model Using Information Networks. M. Littmann, (ed.) *Rural Extension in an Era of Change*. Australasian Agricultural Extension Conference Proceedings. Brisbane, 449-453.	1987	Australia & New Zealand, dairy	use of others in learning projects	interviews	40	descriptive stats, qualitative	
Smith, K. and Kahler, A. Iowa Adult Farmers' Perception of the Value of Educational Programs. *Journal of the American Association of Teacher Educators in Agriculture*. 23, 3, 41 - 50.	1982	US	training, information sources, training methods	interviews	219	ANOVA, t tests	

Research studies found in the literature search of the electronic databases cited in this section are listed in Figure 12 above. This figure includes some already listed in figures of research studies in section 2.

Low actual or perceived literacy levels and lack of confidence as a learner are barriers to participation in training. Adult learning literature suggests that anxiety in adult learning is increased by an unsatisfying or unsuccessful school experience (Salzberger-Wittenberg, Henry and Osborne, 1983 quoted in Tennant, 1991). In the past, post-compulsory education was not considered to be relevant for children who were to inherit family farms. Indeed, staying on at school was sometimes seen as undesirable because education could encourage these children to move away to other jobs (Phillips, 1987).

Education and training lead to a demand for further education and training. McKenzie and Long (1995), using the Australian Bureau of Statistics' 1993 Survey of Training which covers all industries, found that, controlling for other factors, employees with more education have a higher incidence of participation in formal training courses. Better educated farmers are more likely to use extension services for one-on-one advice and/or training (Smith & Kahler, 1982; Anderson, 1982). Shearers exposed to some training on a topic want more training on that topic according to a survey by House Rosler Davis Pty. Ltd. (1993).

Since those with a higher level of education and training are more likely to participate in further education and training, it follows that those with a lower level of education and training are less likely to participate in further education and training. That is, a low level of prior education appears to be a barrier to participation in education and training.

4.3. What encourages training in agriculture?

Figure 13 Factors which encourage training: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Johnson, B., Bone, Z. and Knight, C. Farmers and Learning: Attitudes to Learning, Tertiary Education and Recognition of Prior Learing. Orange Agricultural College, University of Sydney, Orange.	1996	New South Wales	attitudes to learning, education and recognition of prior learing	focus groups and family interviews	6 focus groups; 15 families	qualitative	
Clarke, B. *Rural Post-Secondary Education.* A Report to the Working Party of the Commonwealth Tertiary Education Commission. Commonwealth of Australia, Canberra.	1987	Australia	barriers to participation	interviews	100		
Kilpatrick, S. Future Training Directions in Australian Agriculture: A Survey of Key Stakeholders. In *Rural Training Programs: Effectiveness and Profitability. Final Report.* University of Tasmania, Launceston, 124-147.	1996	Australia	training needs, barriers to participation, delivery methods	phone interviews	20	qualitative	
Lees, J. W. and Reeve, I. J. *Competencies for Farming: a compendium of profiles.* The Rural Development Centre, University of New England. Armidale, New South Wales.	1991	Australia	competencies for farming	focus groups, mail follow-up	5 groups	DACUM focus group	
Moore, K. *Learning on the Farm. The Educational Background and Needs of New Zealand Farmers.* New Zealand Council for Educational Research. Wellington.	1990	New Zealand	education, management practices, training	interviews	110 (93% of a county)	descriptive stats, cross tabs	
Stevenson, J. *The Training Implications of Skill Formation in Small Business in the Tourist Industry,* Centre for Skill Formation Research & Development, Griffith University, Brisbane.	1995	Australia, hotels		observation		not relevant here?	

The New Zealand study by Moore (1990) confirmed the findings of Swanson (1990) and Lynas and Ormond (1986) that small business managers choose to participate in training because it is relevant to their particular situation. Moore (1990) found that training, and the information and skills it is perceived to provide, must be regarded as relevant by the target group if they are to participate. Current research on the transferability of so-called generic skills between contexts suggests that skills are highly context-reliant (Stevenson, 1995). Farmers demanding training in specific skills that are relevant to their particular context is consistent with context-reliant skills.

Learning requires personal experimentation and a willingness to challenge personal constructs (Kelly, 1955), as discussed in section 2.7. Salmon (1981b) found that those who had ceased to experiment do not come to courses - they believed that their model of management was the best they could hope for.

Cultural and economic factors can act as barriers to participation in training. They form the content of the following two sub sections.

4.3.1 Cultural barriers

Education and training traditionally has been regarded as unimportant for farmers. Historically, there has been an assumption that if you provide people with land they will know by instinct how to be effective farmers (Lees & Reeve, 1991). The following quote from Moore (1990) illustrates the traditional view of the relative unimportance of education in farming:

> Most farmers continue to put local knowledge, the willingness to work hard (for extended hours) and the ability to work reliably without close supervision ahead of trade or university qualifications in farming when listing the important characteristics of a farm manager. (Moore, 1990, 5)

Clarke (1987) interviewed approximately 50 farmers and 50 representatives of educational and rural organisations from across Australia. He found that a negative view of the value of education is a major barrier to rural participation in post-secondary education. Johnson, Bone and Knight (1996) found that the negative attitude toward formal education still persists in the farm community.

Less academic sons traditionally have worked on and inherited the farm. They are less disposed towards formal courses which are viewed as too theoretical for 'practical' farming. This finding emerged from a series of focus groups of Australian farmers which was the initial stage of developing competencies for farming to be used in competency-based vocational education and training courses in Australia (Lees & Reeve, 1991). Johnson, Bone and Knight's (1996) recent study of farmers in New South Wales found that the physical activity and learning by doing that characterise farmers' day to day work means that farmers lose facility in reading and writing skills and they, therefore, feel unable to cope with study.

A number of other perceptions which farmers have of the knowledge, skills and attitudes required to be successful emerge from Lees and Reeves' (1991) study. Farmers see farming as requiring independence and self-sufficiency; taking courses is inconsistent with these characteristics according to Johnson, Bone and Knight (1996) and Lees and Reeve (1991).

The formal discipline of agriculture is not seen as especially relevant to the major difficulties which farmers face. These difficulties are Australia's variability of climate on a year by year basis, uncertainty and change in export markets, variable interest rates and the economic climate (Lees & Reeve, 1991). The possible impact of post-compulsory education and training on farm outcomes is not as immediately obvious.

Available formal courses have not been regarded as wholly relevant. At least up until the 1990s, agriculturists and farm management teachers have not selected the same things for inclusion in courses that farmers would select according to Australian (Lees & Reeve, 1991) and United States (Bell & Pandey, 1987) reviews of the content of farmer education courses. The lack of perceived relevance of formal agricultural courses may explain the lack of interest and low rates of participation in the courses.

The 'excuses' or reasons given for not attending training sessions reflect the low value the culture places on training relative to 'working hard'. For example, Moore (1990) found that 38% of New Zealand woolgrowers who did not attend a seminar that could be expected to be relevant to their farm business said they were too busy to attend. Clarke (1987) found that workload and lack of resources to replace farm labour while engaged in training are barriers to farmer participation in education and training.

A recent survey of key stakeholders in agriculture and agricultural education confirms that there are the cultural barriers to training in agriculture, and stresses the need to reduce or remove those barriers:

> Many point to the lack of a training culture in agriculture, and the difficulty in attracting farmers to training. Agriculture must develop a training culture if it is to adapt to challenges and succeed in the future. (Kilpatrick, 1996, 139)

4.3.2 Economic barriers

There is a high opportunity cost of formal agricultural education for farmers and their families (Lees & Reeve, 1991). That is, the loss of labour on the farm during time spent studying has a high value when compared to possible future benefits that may arise from agricultural education. Low and/or uncertain returns to (or benefits of) formal education exist because there is no pay scale for those with formal qualifications in agriculture; income depends on farm returns which vary with climate and market factors which mask returns to education. This does not mean that returns to education do not exist, rather, it means that the returns may not be obvious to all.

Economic barriers are lower for larger farms, which are expected to have a larger pool of labour available, and are expected to make higher incomes than smaller farms. The proportionate cost of education in terms of lost labour and percentage of income spent on education is less for larger farms. Studies which examine the relationship between participation in training and economic resources such as farm size or income are scarce; the literature search found only two relevant studies. Anderson (1982) found that larger farms were more likely to participate in learning activities, while Smith and Kahler (1982) found that those with more profitable farms placed a higher value on education and training. Although they collected information on participation in educational activities, they did not report any results on the relationship between farm profitability and participation in training.

4.4. Training methods and participation

> ... it is assumed that learning is predominantly an interactive and, therefore, a socially embedded process which cannot be understood without taking into consideration its institutional and cultural context. (Lundvall, 1992, 1)
>
> Farmers much prefer small group learning/training environments in which they can question, discuss and debate ... (Moore, 1990, 5)

The andragogical model of adult learning (Knowles, 1990) provides some answers for the failure of formal courses to attract large numbers of farmers, and for the limited success of the trickle down effect to spread innovations in agriculture. Taking the andragogical model and applying it to farmers implies that farmers are independent, they do not see the experiences of 'better-off' neighbours as applicable to their situation, and they are often content with the lifestyle generated by the current way of doing things, and so are not motivated to change.

Figure 14 Training methods and participation: research studies

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Carter, B. and Batte, M. Identifying the Most Appropriate Program Delivery Methods for Outreach Education. In *Australia Pacific Extension Conference Proceedings* Surfers Paradise October 12-14. Queensland Department of Primary Industry. Brisbane. 157-161.	1993	Ohio				missing??	
Crosthwaite, I, Vance, P. and Ada, R. Information needs of a Grain Industry in Crisis. In M. Littmann, (ed.) *Rural Extension in an Era of Change*. Australasian Agricultural Extension Conference Proceedings. Brisbane, 173 - 175.	1987	Queensland, grain	future needs	group and individual interview	49	description	
Fulton, A. The Implications of Farmer Reliance on Private Consultants. *Extension Net*. 2, 5, 7.	1995	Tasmania, potato	information sources, practices chosen	interviews	100	descriptive stats	on going project
Newman, C. Change in Farmer Practices Following Spray Application Field Days. In Heap, J. (ed.) *Proceedings of the Ninth Australian Weeds Conference*, Adelaide Convention Centre, August. Crop Science Society of South Australia and Wheat Research Council of Australia, Adelaide. 147-152.	1990	Western Australia	awareness of field day, reasons for attending, planned changes, actual changes, information sources	questionnaire following field day and telephone survey 2 years later	46 and 33	descriptive stats	
Nieto, R. and Henderson, J. *Assessing the Educational and Financial Needs of Small-Scale Dairy Farmers in Socopo, Venezuela. Summary of Research 64*. Department of Agricultural Education, Ohio State University. Columbus.	1991	Venezuela, dairy	training and financial needs, age, education, income, experience	interviews	137	descriptive, correlations	

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Raferty, J. *A Survey of the Educational and Training Needs of the Pastoral Industry of South Australia. Final Report.* South Australian Department of Further Education. Adelaide.	1981	Australia	training needs	survey		descriptive	
Riesenberg, L. and Obel Gor, C. Farmers' Preferences for Methods of Receiving Information on New or Innovative Farming Practices. *Journal of Agricultural Education.* 30, 3, 7 - 13.	1989	US	information delivery preferences, size, age, education	mail questionnaire	176	bivariate analysis	
Salmon, P. *On-Line Computer Applications in Research into Attitude Change; Applications in farm management education.* ERDC Report No. 31, AGPS, Canberra.	1981a	Australia	attitudes, decision process	computer simulation of decisions	not stated, but small number		
Solutions Through Research Group *Australian Agricultural Risk Management Research.* Report prepared for Commonwealth Department of Primary Industries and Energy.	1993	Australia	training needs	focus groups and telephone survey	15 groups; 2259		
TAFE Curriculum Services Tasmania *Training Needs in the Vegetable Industry.* Hobart.	1984	Tasmania	training needs	mail questionnaire	246	tabulations	
TAFE Curriculum Services Tasmania *Training Needs in the Meat and Wool Industry.* Hobart.	1986	Tasmania	training needs	mail questionnaire	315	tabulations	
TAFE Curriculum Services Tasmania *Training Needs in the Dairy Industry.* Hobart.	1987a	Tasmania	training needs	mail questionnaire	197	tabulations	
TAFE Curriculum Services Tasmania *Training Needs in the Horticultural Industry.* Hobart.	1987b	Tasmania	training needs	mail questionnaire	54	tabulations	
Underwood, C. *Identifying Farmers' Information Sources - Questions on Methodology. The Quest for Information volume II.* Queensland Department of Primary Industries. Brisbane.	1985	Queensland dairy	decision making process	card sort and questionnaire / recall	52	review of card sort vs questionnaire / recall	

Figure 14 above sets out research studies of farmers' preferred learning and training delivery methods found in the literature search. These studies are in addition to those studies already listed in section 3 which consider learning and training delivery methods. The section then summaries aspects of training delivery methods and types of training which have been found to be effective from the literature.

It is important that adults are comfortable with those who share their learning experience (Tough, 1971). Adults learn best in small groups of peers who respect each other and share common interests, that is in groups that are homophilous. Moore (1990) found farmers prefer small group learning settings where there is the opportunity to question, debate and discuss. He found that a demonstration in a small group setting is the most popular learning experience, followed by discussion groups and learning from other farmers.

A recent study by Johnson, Bone and Knight (1996) pointed out that farmer training groups should be homophilous. They stated that while farmers are beginning to use groups as a basis for learning, it is the 'leading' group of male farmers (about a quarter of all farmers) who are participating. Other farmers, including those farmers who are women, either claim they have difficulty being accepted into the groups, or are reluctant to participate because their own low self esteem leads to a fear of failure.

After reviewing research studies of one-off group meetings for farmers, Woods, Moll, Coutts, Clark and Ivin (1993) presented a check list of characteristics of successful one-off group meetings which follows self-directed adult learning principles. Some of these principles included consulting with the target audience about content in advance, using hands-on sessions and making the task relevant, providing a helpful and optimistic atmosphere and choosing a location that is suitable and convenient for the target audience. Familiar contexts such as on properties are preferred to training in institutions such as colleges (Raferty, 1981).

Underwood (1985) maintains that training works most effectively if agricultural knowledge is regarded as a pool to which both farmer and extension officer contribute and from which both obtain information. There is also a process of joint learning and knowledge transmission between farmer and extension officer (Underwood, 1985; Salmon, 1981a). This concept of a shared pool of knowledge and joint learning may be idealistic. It does not take into account issues such as reciprocity of trust and the differential power which farmers and extension officers bring to the negotiation of any learning projects which may occur.

Adult learners prefer active involvement in the dissemination of information and new technology (Carter & Batte, 1993; Oakley, 1988). They learn best with others who share common beliefs and values, and who they perceive as having similar socio-economic status (Moore, 1990; Oakley, 1988). Interpersonal methods of receiving information on innovations, such as field trips and on-farm demonstrations, are preferred by farmers over mass media channels according to United States and Australian surveys (Riesenberg & Obel Gor, 1989; TAFE Curriculum Services Tasmania, 1987a; 1987b; 1986; 1984). This is consistent with adoption of innovations research which found that diffusion is faster if trials are possible and the innovation is conspicuous, and that innovations spread more quickly among homophilous individuals.

Training is effective in bringing about change when farmers participate in analysing the situation and identifying needs and alternatives. This means that farmers set the agenda for the research, plan and implement their own trials, with external assistance available. Reviews of farmer extension and training delivery methods advocate groups such as landcare and discussion groups, which provide this kind of learning structure (Woods, Moll, Coutts, Clark & Ivin, 1993; Waters-Bayer & Farrington, 1990). Acker and Lev (1993) also advocated this method of 'participatory action research' where participants were more likely to apply what they have learnt because of a sense of identification and ownership.

Short courses or single day seminars and workshops are preferred over longer courses according to research reviewers (Pollard, 1992; Crosthwaite, 1987) and surveys of farmers (TAFE Curriculum Services Tasmania, 1987a; 1987b; 1986; 1984; Raferty, 1981). Workshops are a very effective method of identifying problems, understanding the situation, creating awareness, facilitating understanding, decision making and motivation and evaluation (Woods, Moll, Coutts, Clark & Ivin, 1993).

The Tasmanian TAFE surveys, Riesenberg and Obel Gor's (1989) United States survey and a study of Tasmanian potato growers also found that farmers rate seminars, discussion groups and farmer meetings highly as a preferred training method (Fulton, 1995; Riesenberg & Obel Gor, 1989; TAFE Curriculum Services Tasmania, 1987a; 1987b; 1986; 1984).

Farmers found field days useful for learning about new developments and for interaction with other farmers (Solutions Through Research, 1993; Nieto & Henderson, 1991). Woods, Moll, Coutts, Clark and Ivin (1993) suggest that field days are particularly valuable for creating awareness of innovations, evaluating trials and disseminating results. They say that field days also rated well for facilitating understanding, decision making and motivation. Newman (1990) found that field days can be effective in influencing farmers to change their practices (see section 2.6 above). Local field days attracted farmers who attended few training programs or information sessions (Newman, 1990).

4.4.1 Summary of effective delivery methods and types

This review of the literature suggests that small groups are an effective way of encouraging farmers to participate in training. The opportunity for interaction with peers and experts is a feature of small group methods, such as seminars and discussion groups. There is evidence that groups are even more attractive to farmers if they consist of others who are homophilous, or similar in terms of socio-economic status and values, attitudes and beliefs. Other methods of delivery which encourage farmer interaction, such as field days, are also successful in attracting farmers and in influencing farmer behaviour.

There is some evidence that training which requires a relatively short commitment, for example, seminars and short courses, is more attractive to farmers than longer courses.

Farmers are more likely to attend training if they perceive that it is relevant. Involving farmers in selecting the topic(s) for training helps ensure that training is relevant, as does using an action learning approach.

Education and training are identified in section 2. as being influential in bringing about changes to practice or adoption of innovations which are likely to be beneficial to a farm business. Section 4. has considered factors which foster participation in education and training. The final section of this chapter looks forward and reviews literature relating to future training directions.

5. What are the future training directions?

Training needs in agriculture and the related field of agribusiness have been surveyed regularly in Australia. An earlier example of such surveys is Sri Pathmanathan (1978) who reviewed previous studies of agribusiness needs in Australia and overseas, and examined training needs in the wheat and beef industries. Sri Pathmanathan found that the areas of greatest need are management, marketing and communication. He noted a lack of courses which provided integrated agriculture and management education. These needs and this gap in course provision are still evident today, as the following quote demonstrates.

> A recent survey of more than 2200 farmers across Australia ... found that about 70% of farmers are keen to build on their management skills. And marketing was something most farmers said they wanted to know more about. (Johnston, 1994, 11)

Farm managers are not the only small business managers who could benefit from management training. Several reports, summarised in McMahon (1989), recognised the need for management training for Australian small business, as does Karpin (1995) who considered leadership and management skills needed by all levels of Australian business. Training needs extended beyond the operators of small business to those who advise small business, such as bankers and accountants (Ralph, 1982).

A survey of key stakeholders in agriculture and agricultural education found that training needs in agriculture extent beyond farmers and new entrants to farming to other members of the agriculture value chain, which extends from input suppliers and researchers, through the farm, food processors and marketers to the final consumer (Kilpatrick, 1996). Conley and Gray (1990) reported a discussion among those working in agricultural extension, and concluded that education of front line people working with farmers is a major opportunity for improving technology transfer. The discussion here suggests that these 'front line' people need skills in developing farmer skills and communication and an appreciation of the discipline of rural sociology.

5.1. Farmer training needs

> Future training should address the need for more robust processes in decision making. In addition to quantitative tools, training needs to include communication (for example, between husband and wife) and information integration skills (considering multiple information sources used). (Daniels & Woods, 1993, 392)

As discussed in the Chapter 1, farmers need to be able to make strategic responses to social and environmental issues, to changes in government policy, changes in market demand and to changes in agricultural policies of other countries (Pollard, 1992; Woodford, 1989).

According to key stakeholders in agriculture, the skills needed by farmers to successfully deal with change fall into three broad categories; technical skills, management and marketing skills and communication skills (Kilpatrick, 1996). Research studies and surveys of farmers' future training needs found from the literature search are set out in Figure 15.

Figure 15 Future training needs: research studies and surveys

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Blackburn, A. Implications for Education and Training. In *Incorporating Risk into Decision Support and Farm Business Management Systems*. Proceedings of a National Workshop, Melbourne 9-11 November. 142-147.	1992	Australia	content of risk management program	focus group of agricultural extension officers	1 group	qualitative	
Conley, D. and Gray, S. (eds) *Technology Transfer and Commercial Arrangements. Proceedings of a Workshop, Eagle Hawk Hill Motel, Canberra Nov 21-23 1989*. Australian Wool Corporation. Melbourne.	1990	Australia	skills to transfer information to farmers	discussion at workshop	1 group	qualitative	
Johnston, T. Training for Farmers. *Australian Farm Journal*. June, 11.	1994	Australia, broadacre	financial performance, education, age, computer ownership	interviews (ABARE survey)	several thousand	descriptive stats	poor year could distort results
Kaine, G., Wright, V. and Lees, J. *The Strategic Management of Farm Businesses*. The Rural Development Centre, University of New England. Armidale, NSW.	1993	Australia	financial strategies	interviews		analysis of financial management	
Kilpatrick, S. Future Training Directions in Australian Agriculture: A Survey of Key Stakeholders. In *Rural Training Programs: Effectiveness and Profitability. Final Report*. University of Tasmania, Launceston, 124-147.	1996a	Australia	training needs, barriers to participation, delivery methods	telephone interviews	20	qualitative	

Study	Year	Location/ product	Variables	Data source	Sample	Analysis method	Comments
Kilpatrick, S. Future training needs of Whole Farm Planning course graduates In *Rural Training Programs: Effectiveness and Profitability. Final Report*. University of Tasmania, Launceston, 117-118.	1996b	Australia, Tasmania	training needs	interviews	16	qualitative	
Moore, K. *Learning on the Farm. The Educational Background and Needs of New Zealand Farmers*. New Zealand Council for Educational Research. Wellington.	1990	New Zealand	education, management practices, training	interviews	110 (93% of a county)	descriptive stats, cross tabs	
Salmon, P., Fountain, R. and Hawkins, H. *Human Adjustment in Australian Agriculture 1972*, University of Melbourne, Melbourne.	1973	Australia	farm management training needs	mail questionnaire	50 202	descriptive stats	
Solutions Through Research Group *Australian Agricultural Risk Management Research*. Report prepared for Commonwealth Department of Primary Industries and Energy.	1993	Australia	training needs	focus groups and telephone survey	15 groups; 2259	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Vegetable Industry*. Hobart.	1984	Tasmania	training needs	mail questionnaire	246	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Meat and Wool Industry*. Hobart.	1986	Tasmania	training needs	mail questionnaire	315	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Dairy Industry*. Hobart.	1987a	Tasmania	training needs	mail questionnaire	197	descriptive stats	
TAFE Curriculum Services Tasmania *Training Needs in the Horticultural Industry*. Hobart.	1987b	Tasmania	training needs	mail questionnaire	54	descriptive stats	

Improved technical skills needed by farmers vary from skills required for good land management to computer skills. For example, soil management is relevant to conservation practices. Tasmanian farmers' identified various aspects of soil management as their most important training need (TAFE Curriculum Services Tasmania, 1987a; 1987b; 1986; 1984). A need for more training in technical skills, however, is cited infrequently compared to a need for management and communication skills. This is true for both 'experts' on agriculture (for example, Kilpatrick, 1996) and farmers themselves (see the studies cited in the following subsections).

5.1.1 Management skills

Many studies identified a need for improved farm management skills according to a review of future farm management education directions in Australia (Woodford & Collins, 1993). Key stakeholders in agriculture regard improved management skills (especially financial and risk management) as critical for farmers (Kilpatrick, 1996). Extension officers also perceived a need for farmers to improve management skills (Sproule, Godyn & Burfitt, 1991). A survey of farm businesses found that only around two thirds of farms prepare and follow farm plans in Australia (Solutions Through Research, 1993). About three quarters of New Zealand farms regularly set goals for the farm business (Moore, 1990).

Johnston (1994) found that 70% of farmers want to build on their management skills. The perceived need for management skill development has increased considerably since 1972 when only 25% of Australian farmers expressed an interest in management training (Salmon, Fountain & Hawkins, 1973). About half the farmers who have attended a Whole Farm Planning course, which includes physical, financial and human resource management, were likely to identify a need for further financial and general management training (Kilpatrick, 1996b).

Farmers themselves perceive a need for improved risk management skills, specifically in marketing, financial management and sustainable production risk management (Johnston, 1994; Solutions Through Research, 1993). Blackburn (1992) also argued that farmers need better risk management skills, including knowing how to access information and computer skills for manipulating information.

Interpreting market signals and responding accordingly is an important skill (Pollard, 1992; Blackburn, 1992). Farmers need to alter their marketing techniques to reduce risk, for example by diversifying their product, using forward selling or establishing direct sales (Solutions Through Research, 1993). Key stakeholders also identify marketing skills as an area for improvement (Kilpatrick, 1996a), as do some of the Whole Farm Planning course participants surveyed by Kilpatrick (1996b).

In summary, there is evidence from farmers, agricultural 'experts' and commentators that Australian farm financial and production risk management should be improved (Kilpatrick, 1996; Kaine, Wright & Lees, 1993; Solutions Through Research, 1993).

5.1.2 Communication skills

The acquisition of better communication skills will allow farm businesses to exploit the advantages of interactive learning identified by Lundvall (1992) in section 2.2 above, and confirmed by the studies of interaction in decision making listed in section 2.6. Communication is important within the farm business, with other farmers, with advisers and with others in the marketing chain (Kilpatrick, 1996; Pollard, 1992).

Kilpatrick (1996) and Pollard (1992) identified a need for community development and leadership skills in the farming community. Negotiating skills for interacting with agribusiness, other farmers and policy makers also are required.

Farmers' human resource management skills for supervising and working with employees and family members are generally inadequate (Pollard, 1992). Better communication skills for communication within family farm management teams are needed according to recent papers by a rural lawyer (McGown, 1996), an agricultural educator and researcher (Napier, 1996) and an agricultural consultant (Cooke, 1996).

In summary, the literature points to the need for farmers to train more in the areas of management and communication skills. Training in communication skills is required for increasing the effectiveness of interactions with others working in the farm business, input suppliers and those further along the agricultural value chain.

Management and communication skills are not easily observed in practice. The discussion of experiential and observational learning in section 2.8.1 suggests that later adopters prefer observational learning. Those who prefer observational learning are less likely to adopt new management and marketing practices which may consist of complex procedural practices that are not easily observed.

6. Conclusion

The literature reviewed here suggests that general education does have an impact on farm productivity and profitability. Because of a lack of research into the impact of agricultural education on farm profitability, there is little or no evidence that specific agricultural education improves farm profitability.

Farm businesses which make changes to practice (or adopt innovations) appear to be more profitable than other farm businesses. The literature suggests that general education increases the probability of making changes to practice which improve the productivity and hence profitability of the farm business. The impact of education is both direct and indirect. Education impacts directly by assisting in selection of quality inputs including information and advice from experts, by increasing the efficiency of information processing, and by improving the ability to efficiently allocate inputs among alternate uses. Education impacts indirectly by, for example, increasing participation in further training.

There is a role for others in providing information and support at all stages of the decision process from awareness to implementation and review of the decision. Interaction with others is also an important aspect of training, and is one of the factors which encourages participation in training. Future training will be more successful if it takes adult learning principles into account. Finally, farmers should be encouraged to take training in management skills, including financial and risk management, marketing and communication skills.

CHAPTER 3

METHODOLOGY

1. Introduction

A multi-mode methodology was chosen to address the five research questions outlined in Chapter 1. The methodology reflected the need for quantitative data at a whole agricultural industry level and more detailed, qualitative data at the level of the individual farm business.

The five research questions are addressed with data obtained from two data collection approaches. Both the approaches collected data from farm business units, rather than individual farmers. Because of this, the actions referred to in this thesis are actions by 'farm businesses', rather than actions by 'farmers' or 'farm managers'. The first approach is a large quantitative survey which links the financial data of the particular farm businesses to the educational qualifications of managers, farm business participation in training and information about major changes to practice made by that farm business. It took the form of an additional suite of questions included in the Australian Bureau of Statistics' 1993-94 Agricultural Financial Survey. This was a stratified sample of 2500 of the approximately 107 500 farm business units in Australia, and is described in section 3 below.

The second approach is a semi-structured face-to-face interview survey of farmers about the process of change in their farm business and their training participation and experiences. This survey provided more detailed information about process of change in individual farm businesses, including how training influences farm management practices. This second approach took the form of a semi-structured face-to-face interview survey of 65 Tasmanian farmers, 45 of whom were selected because they had completed one of three training courses. The Tasmanian interview survey design is described in section 4 below.

1.1. Purpose of data collection instruments

The purpose of the Agricultural Financial Survey is twofold. First, it establishes a large quantitative data base including, baseline data about farm management education levels, training patterns, reasons for not attending training 'events', future training intentions and changes to practice in Australian farm businesses. Second, it allows analysis of links between these data and financial data including profit, value of assets and financial equity in the farm business.

The purpose of the Tasmanian interview survey is threefold. It provided rich data about influences on the decision-to-change process; it provides data on how training programs impact on the decision making process;

and finally it allows comparison of farm businesses which attend courses with other farm businesses in terms of training and change behaviour, future training intentions and training delivery preferences.

1.2. Data analysis

Descriptive statistics are used to analyse data collected by both instruments. Descriptive statistics such as frequency distributions and means are appropriate for analysing baseline data such as that collected using the Agricultural Financial Survey, and are also appropriate for a sample of the size of the Tasmanian interview survey. Bivariate statistical tests, including chi squared tests and t tests, are used to test frequency distributions and means for significance (Zikmund, 1994). The results from the descriptive statistical analysis are presented in Chapter 4.

Multivariate analysis was conducted to assist in answering the first research question, "What impact has training had on farm profitability?". The results of the descriptive analysis and bivariate statistical tests, along with the literature reviewed in the previous chapter, indicate variables which may explain the variation in farm business profit, in addition to the variables of education and training and changes to practice. A number of variables are trialed in multiple regression models. The multiple regressions appear in Appendix F.

2. Comparison of methodology with similar studies

In this section, the methodology used to address each of the five research questions is considered in turn. The methodology is compared to the methodology used in other studies which address similar questions. The studies mentioned here are among those reviewed in Chapter 2, the literature review.

2.1. Methodology for research question 1

The first research question, "What impact has training had on farm profitability?", could be addressed by using large cross-sectional quantitative data set(s). Large quantitative data sets permit examination of the relationship between profit and educational qualifications and/or training participation. Alternatively, the first research question could be addressed using case study data to examine how training influences practice in farm businesses, and how those practices impact on profitability. This study uses a multi-method approach which incorporates both approaches.

2.1.1 Multivariate analysis

The literature review (Chapter 2) includes several studies which present and test theoretical models which support education and/or training variables determining productivity and/or profitability, for example

Phillips (1994) and Welch (1970). Most of the studies use multiple regressions for data analysis, often supplemented by descriptive statistics, for example, Phillips and Marble (1986) and Lockheed, Jamison and Lau (1980).

2.1.2 Industry-specific education and training

The studies cited in the previous paragraph, and most of the multivariate studies considered in the literature review in Chapter 2, use years of schooling as a measure of education, rather than industry-specific or industry-relevant qualifications such as post-school agricultural qualifications. These studies include a few which have profit or a related financial variable such as sales or financial viability as the businesses performance measure, for example, small business studies by Cooper, Gimenogascon and Woo (1994) and that quoted in McMahon (1989), as well as Fane's (1975) study in agriculture. There are a greater number of studies which use agricultural yield or productivity as the farm business performance measure which is compared to years of schooling, such as Phillips (1994) and Lockheed, Jamison and Lau (1980).

The literature review failed to find any research studies which related the presence or absence of agricultural qualifications or training to farm business profitability or farm productivity, nor did the literature review find any studies which related other industry-specific qualifications to small business profitability. The only study with any reference to industry-relevant qualifications is Williams's large mail survey (in McMahon, 1989, 62) which finds a positive relationship between managers' study of business/management courses and rate of small business growth in a study of 10 000 small businesses.

There are a number of studies of education's impact on subsequent participant behaviour (see Chapter 2 Figure 6 Interaction and change: research studies), and whose methodologies are considered in relation to the second research question in section 2.2. There are also evaluations of individual training programs (see Chapter 2, section 2.8.1. Training programs and changes to practice). None of these consider the impact of the changes to behaviour or practice following the training on financial business performance measures such as profit. Unlike earlier studies, the Tasmanian interview survey collected financial information which allowed comparison of the profitability of those farm businesses whose managers did and did not alter their farm business practice following training.

2.1.3 Other variables which impact on farm performance

The independent variables used in the multiple regressions with individual farm data, in addition to education, include farm specific variables such as size and debt, farmer's age and contact with agricultural extension services. Multiple regressions are used here with the Agricultural Financial Survey data, and were also trialed with the

Tasmanian interview survey (see Appendix F), to investigate the relationship between farm profit, and education and training and other farm specific variables such as value of farm business assets. Descriptive statistics are to be found in Chapter 4 Results.

2.1.4 Cross-section data versus averaged data

Some of studies cited in the literature review used data from an agricultural census, for example Fane (1975) and Welch (1970) which use data from the United States Agricultural Census. The data are aggregate data which are analysed on a region by region (or county by county) basis, rather than cross-sectional data which can be analysed on a farm business by farm business basis. The Agricultural Financial Survey provided farm business cross-sectional data. Individual farm business data provide a more accurate picture of the relationship between education and farm business performance than do regional educational and performance averages, which lose specificity. The remainder of the studies cited in the previous paragraph do use data which allow a farm business by farm business analysis. The agricultural studies are from developing countries, and use interview survey data. However, research surveys do not necessarily have the same 100% response rate that a national statistical office such as the Australian Bureau of Statistics is able to achieve because of legal compliance requirements which apply to the national agencies' surveys.

2.2. Methodology for research questions 2 and 3

The answer to the second research question "What 'triggers' farm managers to make major changes to their farming practices?" was informed by data from the large quantitative Agricultural Financial Survey which revealed trends relating to influences on the process of change and background information on the types of changes made and the characteristics of the farm businesses most likely to make these changes to practice. Detailed information about the process of change in individual farm businesses, including how training influences farm management practices, came from the Tasmanian interview survey.

The third research question, "What are the support mechanisms or who are the people who mentor farmers as change is undertaken?", was also addressed using data from the Tasmanian interview survey, supplemented by quantitative data from the Agricultural Financial Survey.

Tasmanian interview respondents were asked to nominate the two most important changes made to their farm management practice in the last three years, and to recall the change process from initial awareness of the new practice through to implementation. A semi-structured interview is appropriate for eliciting this data as it gives the interviewer the opportunity to ask probe questions of respondents which assist them to recall events and decision processes which took place some time previously.

Research studies of the decision to change process are listed in Chapter 2 in Figure 6 Interaction and change: research studies, Figure 7 Peers and the decision making process: research studies, Figure 8 Expert advisers and the decision making process: research studies and Figure 9 Values, attitudes and beliefs: research studies. Inspection of the Data source column of these Figures shows that the majority of these studies choose to gather data by recall techniques, mostly interviews, although a few use written questionnaires. Underwood (1985) found that traditional research methods requiring recall of decision information sources produce different results when compared to replication methods such as card sorts because steps otherwise overlooked are recalled when the decision process is re-enacted.

2.3. Methodology for research question 4

The two data collection instruments are also complementary in gathering data to address the fourth research question, "What are the factors which foster and inhibit farmer and their workforce participation in training?" The Agricultural Financial Survey provides broad indications of reasons for not participating in training and of the characteristics of those farm businesses which do train.

The Tasmanian interview survey consists of course and non-course samples which allows comparison of the characteristics of the two groups in terms of reasons for not attending training identified by the farm managers as desirable to attend. The course participant sample provides data on the preferred and non-preferred delivery characteristics of the three courses, while both samples give information related to learning preferences for future training.

The research studies reviewed in Chapter 2 in this area are listed in Figure 12 Prior education as a barrier to training: research studies, Figure 13 Factors which encourage training: research studies and Figure 14 Training methods and participation: research studies. A variety of methods of data collection is used, including individual interviews, questionnaires and focus groups. Descriptive statistics and/or qualitative data analysis are the preferred data analysis methods for the studies in this area, as can be seen from the Analysis method column of the three Figures.

The studies with larger samples tended to use written questionnaires, often administered by mail, for example Riesenberg and Obel Gor (1989) and TAFE Curriculum Services Tasmania (1987a; 1987b; 1986; 1984). The studies with smaller samples gathered data via interviews, for example Phillips (1987), or focus groups, for example, Johnson, Bone and Knight (1996). One study, Salmon (1981a), used computer simulation and two, Daniels and Woods (1993) and Underwood (1985), used the card sort technique.

Unlike the Agricultural Financial Survey, none of the studies in this area in the literature review allowed comparison of farm business financial details with preferred training methods as measured by delivery methods chosen by the farm business for training. Only two United States studies by Riesenberg and Obel Gor (1989) and Smith and Kahler (1982) go beyond qualitative analysis and descriptive statistics to use bivariate analysis in analysing data. None of studies examine training participation and preferred training delivery methods of individual farm businesses over a period of time, as the Tasmanian interview survey does.

2.4. Methodology for research question 5

This question concerns future training needs of farm businesses. A number of surveys relating to farmers' and others' assessment of future training needs are presented in Chapter 2 Figure 15 Future training needs: research studies and surveys. The Sample size column of this Figure reveals that the surveys of farmers are split between small interview samples, such as Kilpatrick (1996) and large mail surveys such as Solutions Through Research (1993).

The only study which compared training needs with other farmer or farm business characteristics was Moore's (1990) study of New Zealand farmers, which compared education, management practices and future training demands. Both the Agricultural Financial Survey and the Tasmanian interview survey allowed comparison of farm business characteristics, including financial characteristics, with future training plans.

2.5. Definition of variables

This section defines variables training, profit and change as used in this study.

2.5.1 Profit

The definitions of profit used here are guided by the income measures collected by the Australian Bureau of Statistics in their financial data collection. The Bureau collects farm business unit turnover, gross operating surplus and cash operating surplus. Detailed definitions of the three measures are to be found in Australian Bureau of Statistics (1995, 58-60). Brief descriptions only are given here. Turnover is the receipts of the farm business during the year. Gross operating surplus is turnover, less the value of purchases, selected expenses, rates and taxes and wages, but before interest payments. Cash operating surplus is gross operating surplus less interest payments.

Turnover is income before deduction of expenses and other costs of operating the farm business, and so it is not necessarily an accurate reflection of farm business profitability, which depends on both income and farm business costs. Gross operating surplus is the main profit measure used in this report because it measures the success or otherwise of farm businesses without the influence of debt which directly determines interest payments, and therefore cash operating surplus.

2.5.2 Training

Training is very broadly defined to include field or demonstration days, seminars, workshops, conferences, industry meetings and formal and informal courses. The subject of training relevant to this study ranges from agricultural and technical topics to farm business management and record keeping.

2.5.3 Changes

Chapter 1 of this thesis suggests that whether or not farm businesses make changes to practice is a measure of flexibility and adaptability. It could be argued that farms which are responsive to external and internal farm business conditions (that is flexible and adaptable) will have made at least one change to practice in a three year period.

The approach taken here is to examine changes to farm management practice which the farm managers believe have or will improve farm business profitability. The changes nominated could have taken place at any time over the past three years. The changes may be to financial management, agricultural practices, land management, marketing or any other change which has or will improve farm business profitability. More detailed description of types of change appears below in the description of the Agricultural Financial Survey.

3. The Agricultural Financial Survey (AFS)

The AFS is an annual survey of farm business units conducted by the ABS. The majority of respondents are interviewed face-to-face; remote farm businesses complete a mail survey form or are interviewed by telephone. The sample is a stratified one based on the value of operations by industry. The sample size in 1993/94 was approximately 2500 of an estimated farm business population of 107 538. Australian Bureau of Statistics (1995, 54) describes the sampling method.

An additional section of questions, entitled Changes to Farming Practice, was added to the 1993/94 survey. The section consisted of fourteen questions about changes to farming practice, educational qualifications held by the farm management team, formal and informal training attended and future training intentions. The final version of the questions in the Changes to Farming Practice section of the interview questionnaire are reproduced as Appendix E of this thesis.

3.1. Question development and testing

The questions were developed in conjunction with staff from the Australian Bureau of Statistics. The Bureau required that it has the final say in any question or group of questions included on any of their surveys. They also require that Bureau staff be involved in question design, and that the questions are piloted along with the rest of the survey in their standard piloting procedure.

Question development commenced in February 1994, following initial discussions in late 1993. The questions were piloted in March with 64 farm businesses across several States. Minor modifications were made to the questions in the Changes to Farming Practice section following the pilot. The modifications were again made in conjunction with Bureau staff. The modifications involved reducing the time over which past training participation was to be recorded from three years to one year, because the pilot showed that many farmers could not readily recall training attended three years ago. There was also some minor rewording, for example, including the term 'demonstration days' as an alternative term for 'field days'.

3.2. Response rate

The response rate for the Changes to Farming Practice section was 97.5% of those who responded to the Agricultural Financial Survey, with a slight variation for some questions. (Legislation requires that all those selected in Australian Bureau of Statistics' surveys must participate.) Analysis of those who did not respond to the Changes to Farming Practice section shows that many were mail surveys, which are predominantly remote farm businesses. Over one third of the non responses were very large multi-state farming enterprises. Surveys for such businesses typically are completed by staff in company head office who are unlikely to be able to answer the questions about changes to farming practice and employee training patterns. The lack of data from very large corporate farms is not regarded as a concern since the focus of this project is on family and smaller company farm businesses which do not have the large numbers of staff with a wide range of expertise and qualifications typical of large corporate farming enterprises.

Percentages of farm businesses in this report refer to percentages of those who responded to the Changes to Farming Practice section of the Agricultural Financial Survey 1993/94. Responses are weighted according to the ABS's stratified sample weights to give information which represents the Australian farm business population as a whole. The sampling procedure is explained in Australian Bureau of Statistics (1995a).

3.3. Industry and geographical information

The Australian Bureau of Statistics' thirteen agricultural industry classification is used here to analyse some results on an industry basis. Farm businesses are classified according to their primary enterprise, for example dairy. vegetable or beef, although several classifications recognise the existence of mixed enterprises, for example sheep-beef and grain-sheep-beef. The industries are listed and defined in Australian Bureau of Statistics (1995a).

The only geographical distribution of farm businesses available from the Australian Bureau of Statistics is the six States and the Northern Territory. Since the number of farm businesses sampled in the Northern Territory is very small, the Northern Territory has been excluded from the State by State analysis of results. A small number of farm businesses are multi-state businesses with properties in more than one State. These farm businesses are all amongst the largest in their industry and are included in the analysis except where otherwise stated. Confidentiality requirements of the Australian Bureau of Statistics prevent giving any other information about these farm businesses.

3.4. Description of Agricultural Financial Survey variables

3.4.1 Profit measures

The three income measures used by the Australian Bureau of Statistics are discussed in section 2.5.1 above. Preliminary analysis of the Agricultural Financial Survey data using gross operating surplus and the other measures of profit, cash operating surplus and turnover, suggested that all three measures are strongly correlated. Gross operating surplus is used as the profit measure for the Agricultural Financial Survey data for the reasons specified in section 2.5.1 above.

3.4.2 Other financial variables

The other financial variables used in this study are value of assets (referred to as total value of assets by the Australian Bureau of Statistics) and equity. Value of assets refers to the value of farm business assets including land, capital improvements, machinery, equipment and livestock. Equity is defined as value of assets less gross indebtedness expressed as a percentage of value of assets. Full definitions of total value of assets and gross indebtedness are to be found in Australian Bureau of Statistics (1995a, 61).

3.4.3 Changes to practice

If there had been a change to practice, respondents were asked which of the following categories described the change(s):

- financial management, which includes re-financing of loans or mortgages, changes to financial records or management system, use of computer for financial management or changes to software or hardware, changes to the use of financial information in farm management decisions and employment to staff/family to monitor finances;

- marketing, which includes changes to selling place or buyers of farm output, changes to the way farm output is sold and joining or leaving a marketing group or organisation;
- agricultural practices, which includes change in the way crops are grown or livestock managed, change of crops or livestock (not seasonal changes), changes to chemical use, changes to farm safety practices, change to employment numbers or skills mix (not by training existing employees) and purchase of capital equipment;
- land management, which includes changes to land management practices, changes to soil management, planting trees for land management and whole farm planning; or
- other (no examples were given by the interviewer).

Farm businesses which had made changes fitting more than one category were asked to identify the change that they regarded as most important in terms of profitability.

3.4.4 'Other' changes

Those making 'other' changes were asked to specify the change. Responses are varied; some examples are change in size of farm, working more or less hours, subscription to weekly commodity news, enterprise bargaining allowing employees to perform a wider range of tasks, introduction of quality control practices and diversification into non-farming activities such as the aquaculture, earth moving and tourism. As the proportion making 'other' changes is small, and the variety of changes is large, the 'other' category has not been analysed separately.

3.4.5 Prompts and support for change

The respondents were asked to nominate the most important change, who or what had prompted them to make the change and who had supported them in implementing the change. In each case there was a list of possible response categories including other farmers and various 'experts' such as consultants and government extension officers. A full list appears in the questionnaire in Appendix A.

3.4.6 Number in the farm management team

Farm businesses were asked how many family members or employees were involved in the management of the farm. It was left to the farm business unit to determine what management meant in their particular situation.

3.4.7 Education level

Farm businesses were asked to nominate the highest level of educational qualification of those involved in the management of the farm. It was left to the individual farm business to decide who was in the management team (see section 3.4.6 below for a definition of farm management team).

3.4.8 Training

Farm business were asked how many training 'events' from each of three categories the farm management team attended in the past twelve months (see section 3.4.6 below). The categories are: field days; seminars and workshops; and conferences and industry meetings. They were also asked if any member of the farm management team was studying an agricultural or business management course in the period.

In the pilot survey for the Agricultural Financial Survey, the question about past training asked about training over the past three years. Because of the difficulty experienced by some respondents in recalling training which had occurred more than twelve months ago, the Australian Bureau of Statistics required that the period be restricted to twelve months.

3.4.9 Identifying suitable training

Two questions on the Agricultural Financial Survey asked: "In the last 12 months, were there any of these events that your family or employees involved in the management of the farm would have liked to attend but couldn't?" and "What prevented them from attending these events?" Two explanations exist for reporting no 'missed' training events: (i) identifying one or more events worth attending and attending them all, and (ii) not identifying any events worth attending. Failure to attend any training combined with no worthwhile training 'missed' is defined as failure to identify suitable training.

3.4.10 Future training intentions

The survey asked "in the next 3 years, will any of the family members or employees involved in the management of the farm be attending field days, demonstration days, workshops, seminars or conferences?" If they did plan to attend any training, they are asked for the main area of interest for those training events. The options are financial management, marketing, agricultural practices (including machinery), land management and other; more than one option is allowed.

4. Tasmanian interview survey

The method used was a semi-structured face-to-face interview. The interviewer asked farmers to trace the history of their farm over the last three years, highlighting the highs and lows, and major changes that have occurred. Farmers were asked why decisions to change were made ('triggers') and information about who gave support when the changes were made. The survey also asks about training, other advice received, productivity and profitability.

The Tasmanian survey provides more information about influences on the decision-to-change process than the Agricultural Financial Survey. For each of their two most important changes, farmers were asked:

- how they became aware of the strategy, action or technology,
- what other factors influenced them to change, and
- the critical factor in making the decision to change.

4.1. Sample

There were four sample groups. The first three were participants in one of three courses held since 1990 and the fourth is a group who has not participated in one of these courses (since 1990). The three courses were:

- Farm Chemical Accreditation
- Dairy Farm Management
- Intensive Pasture Management.

Sample selection was restricted to course participants since 1990 for accuracy and ease of recall on questions about the course and changes made to farm management practice as a result of the course.

The unit of interest to this study is the family farm management unit. Retired farmers, hobby farmers and those who did a course with the intention of farming in the future, or for other reasons, were not included in the survey. 'Hobby' farmers are defined as those who do not regard farming income as an important part of their income.

The desired sample size was 65, made up of 15 from each of the three course groups and twenty Tasmanian Farmers and Graziers Association (TFGA) members who had not attended one of the three courses since 1990.

The three courses are each run by a different body, see below. They were chosen by the farmer, educational and development bodies which sponsored this project as being courses which were designed to meet identified training needs.

4.1.1 Intensive Pasture Management course

This course was targeted at dairy farmers. It consisted of a three day course with a half day follow up nine months later. It has been run in several locations in north and north-western Tasmania. Some funding was provided by milk processing companies. All dairy farmers who received low interest loans from Tasmania Development and Resources, the state government development body, were expected to attend this course. The course aims were:

- To optimise farmer participation in a three day course on pasture management.
- To increase participants knowledge and understanding of the pasture/animal/productivity/management system.
- To observe increased farmer confidence in decision-making and change in farming practices toward increased productivity. (Nettle, 1992)

A list of participants in this course since 1990 was provided by the course provider, the Department of Primary Industries and Fisheries. The population size (number of farm management units which had attended the course since 1990) was 122.

4.1.2 Farm Chemical Accreditation course

This twelve hour course was offered by TAFE and facilitated by the Tasmanian Rural Industries Training Board. Successful completion of the course and its final examination is expected to become a requirement for purchase and use of certain chemicals. The course aims were to reduce chemical waste and incorrect use and storage of chemicals.

A list of participants in this course since 1990 was provided by the course provider, the Tasmanian Rural Industries Training Board. Many participants in this course are not farmers, but rather are local government employees or employees of large rural businesses. These people are excluded from the sample. The population size was 441.

4.1.3 Dairy Farm Management course

This course was run by TAFE at two locations in the North West of the state and one in the North East in the relevant time period. It consisted of weekly sessions, each on a different topic of relevance to dairy farmers. Total contact time was 125 hours.

A list of participants in this course since 1992 was provided by the course provider, the North West Institute of TAFE. The course did not run in 1990 or 1991.

A sample size of 15 was desired. The population size was 18 farm management units when numbers are adjusted for multiple course attendees from one farm.

4.1.4 Other farmers

The Tasmanian Farmers and Graziers Association (TFGA) membership list was used to selected a sample of 'other' farmers. Any person or business who sells agricultural produce is automatically included on the membership list. Only those farmers (or farms) who were not on one of the above three course lists were eligible for inclusion in this category. The population size was 3444.

4.2. Pilot of questionnaire

The questionnaire was piloted on four farm management units in the north east of Tasmania. They were drawn from those currently studying the Dairy Farm Management course. Minor changes were made to the sequencing and wording of some of the questions following the pilot. Questions about changes to practice were moved to the first section, and questions about training participation placed later in the questionnaire. Some additional categories were added to lists of prompts or possible responses.

4.3. Sample selection

A list of random numbers was generated for each of the four sampling groups according to the population of that group. Telephone numbers for selected farmers were obtained from the telephone directory or directory assistance. Those for whom a number could not be found, or who did not answer the telephone after approximately six call backs at different times of the day and evening, were excluded (see response rate below).

4.4. Participant contact and conduct of interview

The author conducted three interviews from each of the four sample groups. The remainder of the 65 interviews were conducted by one of two research assistants under supervision from the author. There was close liaison between those who conducted the interviews to ensure consistency of approach.

4.4.1 Initial contact

Selected farmers were contacted by their interviewer by telephone. They were told

- the interviewer was from the University of Tasmania;
- the purpose of the survey was to assess the link (if any) between training and farm profitability;
- the project was sponsored by the TFGA, the National Farmers' Federation and various government bodies;
- why they had been selected for interview (because of the course they had attended or as a random selection from the TFGA membership list);
- the interview would last for about one to one and a quarter hours at their property at a convenient time;
- they would be required to provide some brief financial details about their farm;

- their responses would be confidential.

Further elaboration was given if requested. Early in the conversation the interviewer checked that the person was actively involved in managing a farm, and that the farm was an 'important' source of income, rather than a hobby farm.

Those who said they did not make all the decisions on the farm, or made a similar remark, were encouraged to involve other decision makers in the interview.

A suitable date and time for the interview was arranged with those who agreed to participate. They were mailed an information package containing:

- a letter setting out information about the project as required by the University of Tasmania Ethics Committee; a copy is included as Appendix C;
- a letter confirming the date and time of the interview, and advising that a tape recording would be made; a copy is included as Appendix D; and
- the financial details form; a copy is included as Appendix B.

4.4.2 The interview

Interviews were conducted on farms in either the farmhouse or, in a few cases, in machinery sheds or other farm buildings. The choice of location was left to the participants.

Participants were asked if they objected to the interview being tape recorded (none objected) and given a copy of the questionnaire (as shown in Appendix A) to follow if they wished. The interviewer made extensive notes on the questionnaire form as the interview progressed.

Interviews were either conducted with the selected person alone, or some cases with other family members or employers present. Others' contributions varied from the occasional confirmation of a date to substantial answers. The involvement of family members in the interview appeared to reflect their involvement in the management of the farm. In should be noted at this point that some participants selected from the three courses were the children and employees of farm owners.

The interviewer collected the financial details form at the time of the interview, and asked the participant if they had had any difficulty completing it. In approximately one third of cases the participant asked for more time to complete the form. These people were given a reply paid envelope to return the form, and the interview code number was marked on the form.

A list of code numbers and address of uncollected forms was kept and those not returned after three weeks were followed up by telephone and those still outstanding were sent a reminder letter, replacement form and reply paid envelope a further three weeks later. A follow up telephone call was made approximately ten days after the reminder mailing. All but seven forms were returned.

The tapes were later transcribed and the questionnaires coded by the interviewer. In six cases the tape player malfunctioned and the interview was not recorded.

4.4.3 Response rate

The overall response rate was 75% of those eligible to be included. Of the 136 people selected for the sample, 36% either could not be contacted (i. e., not listed by Telecom, did not answer the phone or had moved) or were not eligible to be interviewed because they no longer farmed or were not involved in the decision making of a farm management unit. Response rates for each sample group are set out in Table 1.

Table 1 Response rate (Tas)

Sample group	TFGA	Chemical	Dairy	Pasture	Total
Interviewed	20	16	13	16	65
Refused or cancelled	9	6	1	6	22
Proportion of those selected and eligible who participated	*69%*	*73%*	*93%*	*73%*	*75%*
Ineligible	7	16	2	3	28
Not located	8	6	1	6	21
Proportion selected but ineligible or not located	*34%*	*50%*	*18%*	*29%*	*36%*

n = 136

The target sample sizes of fifteen for the Farm Chemical Accreditation and Intensive Pasture Management courses were exceeded. This is because members of the farm management units of two farms selected in the TFGA sample turned out to have undertaken the courses. These people were not identifiable when the TFGA membership and course participant lists were compared because of different names or addresses. This reduced the TFGA sample to eighteen.

The farms in the Intensive Pasture Management and Dairy Farm Management course samples all listed milk as their main product, compared to only three farms from the TFGA sample. In order to have more non-course sample dairy farms for comparison, two additional TFGA dairy farmers were selected at random from TFGA dairy members. They have been included in the TFGA sample, making a sample size of twenty.

The target sample for the Dairy Farm Management course could not be reached.

The large number of ineligible Farm Chemical Accreditation course participants is explained by the fact that employees of local government, large farming enterprises and other businesses completed this course.

The rate of return of financial questionnaires was 89% of those interviewed. However only 56 of the financials were substantially complete (86% of those interviewed), and only 50 contained all requested data.

Aspects of the interview survey of Tasmanian farmers relating to profitability have been analysed by industry, rather than as a single data set, in order to detect any differences between industries in the relationship between training, change and profit. Three broad, overlapping, industry groups are defined based on the three main products: dairy, livestock and crop. Livestock farms include beef, sheep and wool. Crop farms are the most diverse group, although potatoes are the most common product, followed by other vegetables. The group also includes pyrethrum and poppy growers, two hop growers and one apple grower. A number of farms fall into more than one category. The 56 respondents for whom completed financial questionnaires were received are distributed as shown in Table 2.

Farms can be in more than one sub-sector. The Dairy Farm Management and Intensive Pasture Management courses are relevant to the dairy industry while the Farm Chemical Accreditation is course chiefly relevant to the crop and livestock industries.

Table 2 Industry distribution of financial respondents (Tas)

Industry sectors of farm business	Number
Dairy only	13
Dairy and crop	3
Dairy and livestock	11
Dairy, crop, and livestock	3
Crop only	8
Crop and Livestock	10
Livestock only	8
Total dairy	**30**
Total crop	**24**
Total livestock	**32**

n=56

5. Relationship between training and change data

In all discussion about the effect on profitability of training and changes made on the farm, it must be remembered that the changes nominated by respondents could have occurred at any time over the last three years, while the training data refers to the past year only. Profit is measured for the third year. The impact of training and changes may not yet have shown up in profit, for example if the training or change occurred recently, the latest profit period is unlikely to reflect the result of the changes made. Also, farmers were asked to nominated changes which they believed had *or would* positively impact on the profitability of their farm business. Changes expected to improve long term profitability will not necessarily be reflected in short term profit.

The Tasmanian survey collected information on profit for three years. Using the difference in gross or cash operating surplus between the first and third years, or average profit as a measure of 'success' were considered, but rejected since training information collected could relate to any time over that three years. As discussed above, recent training is unlikely to have had time to make a positive impact on gross operating surplus.

In order to explore this issue further it is necessary to either examine case study data such as that from the interview survey of Tasmanian farmers, or to follow training and change behaviour for a longer period.

The subject of the relationship between recent profit and recent training behaviour is revisited in Chapter 5 Discussion and Conclusion.

The next chapter, Chapter 4, presents the results of analysis of the data collected using the Agricultural Financial Survey and the Tasmanian interview survey. The final chapter, Chapter 5 Discussion and Conclusion discusses the results in relation to the literature reviewed in Chapter 2 and the material in Chapter 1 Introduction.

CHAPTER 4

RESULTS

This chapter presents the results of analysis of data from the Agricultural Financial Survey questions and the interview survey of Tasmanian farmers. It is arranged in five sections, according to the five research questions. The five major sections are subdivided into the following subsections wherever relevant: education, training, non-financial characteristics such as industry and size of the farm management team, and financial characteristics. The Agricultural Financial Survey results (labeled AFS) appear before the Tasmanian survey results (labeled Tas survey) within each section or subsection of the chapter.

1. What impact has training had on farm profitability?

This section analyses education and participation in training at a national level and in the Tasmanian survey. It examines the profitability of farm businesses according to education and participation in various types of training, taking into account other factors which influence farm profit.

1.1. Education

The Agricultural Financial Survey showed that 15% of Australian farm businesses had a member of the management team with post-school agricultural qualifications, while 19% had no member with year 10 or better (see Table 1).

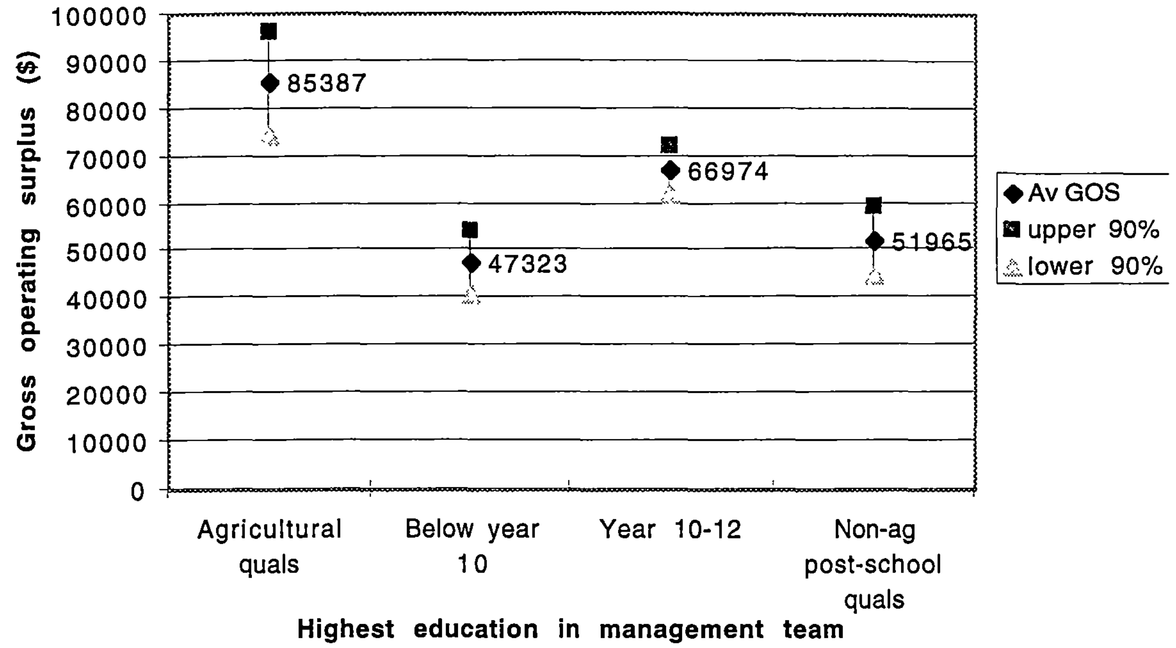
The farm businesses which have agricultural qualifications present in the management team have an average (mean) gross operating surplus in 1993-94 of $85 024 compared to $58 768 for other farm businesses (difference significant at the 95% confidence level).

Figure 1 gives the average gross operating surplus for the other education groupings, and shows that farm businesses with agricultural qualifications have a (statistically) significantly higher average gross operating surplus than each of the other education groups. The figure also shows that those with highest qualification year 10 to year 12 have a significantly higher average gross operating surplus than those with lower education and those with non-agricultural post-school qualifications.

Table 3 Highest educational qualifications in the management team (AFS)

Agricultural post-school qualification	15%
Below year 10	19%
Year 10 to 12	43%
Non-agricultural post-school qualification	22%

Figure 16 Education level and gross operating surplus (AFS)



Note: Values are read from the mid point of small shapes representing the average and upper and lower limits for gross operating surplus (GOS) in all Figures such as this one.

Those farm businesses from the Tasmanian interview survey with at least one member of the management team who has a TAFE, agricultural college or university qualification in agriculture have a higher average profit measured by both gross and cash operating surplus than those where no-one has formal agricultural qualifications (Table 2). This is true even when other factors such as value of assets (land and capital improvements) are taken into account in multiple regressions. Some examples of the multiple regressions are to be found in Appendix F, along with a discussion of the results.

Table 4 Agricultural qualifications and profit measures (Tas survey)

Educational background	Number	Mean gross operating surplus	Median gross operating surplus	Mean cash operating surplus	Median cash operating surplus
No agricultural qualifications	26	$28 493* **	$10 072*	$20 474	$3 691*
Agricultural qualifications	28	$62 655* **	$46 322*	$34 680	$28 756*
T/χ^2 test *(probability < critical value)*		T 1.9456625 (0.0571)	chisq 10.484 0.0012	T .9804879 (.331474)	chisq 4.6593 (0.0309)

** Difference is significant at 90% confidence level.*
***Difference is significant in multiple regressions.*

The Tasmanian sample includes more farms with managers with TAFE qualifications than occur in the farm business population as a whole (as stated in Chapter 3, nineteen of the 65 surveyed were selected because they had completed a TAFE course). The profit results of those who had taken each of the courses are examined in section 1.4.4 below.

Table 5 shows that the gross operating surplus of farm businesses is positively correlated with the value of the assets of the farm business (Australian Bureau of Statistics, Agricultural Financial Survey, 1993-94, unpublished data). The proportion of farm businesses with agricultural qualifications also rises with the value of farm business assets, while the proportion with highest education level below year 10 falls as value of farm business assets rises.

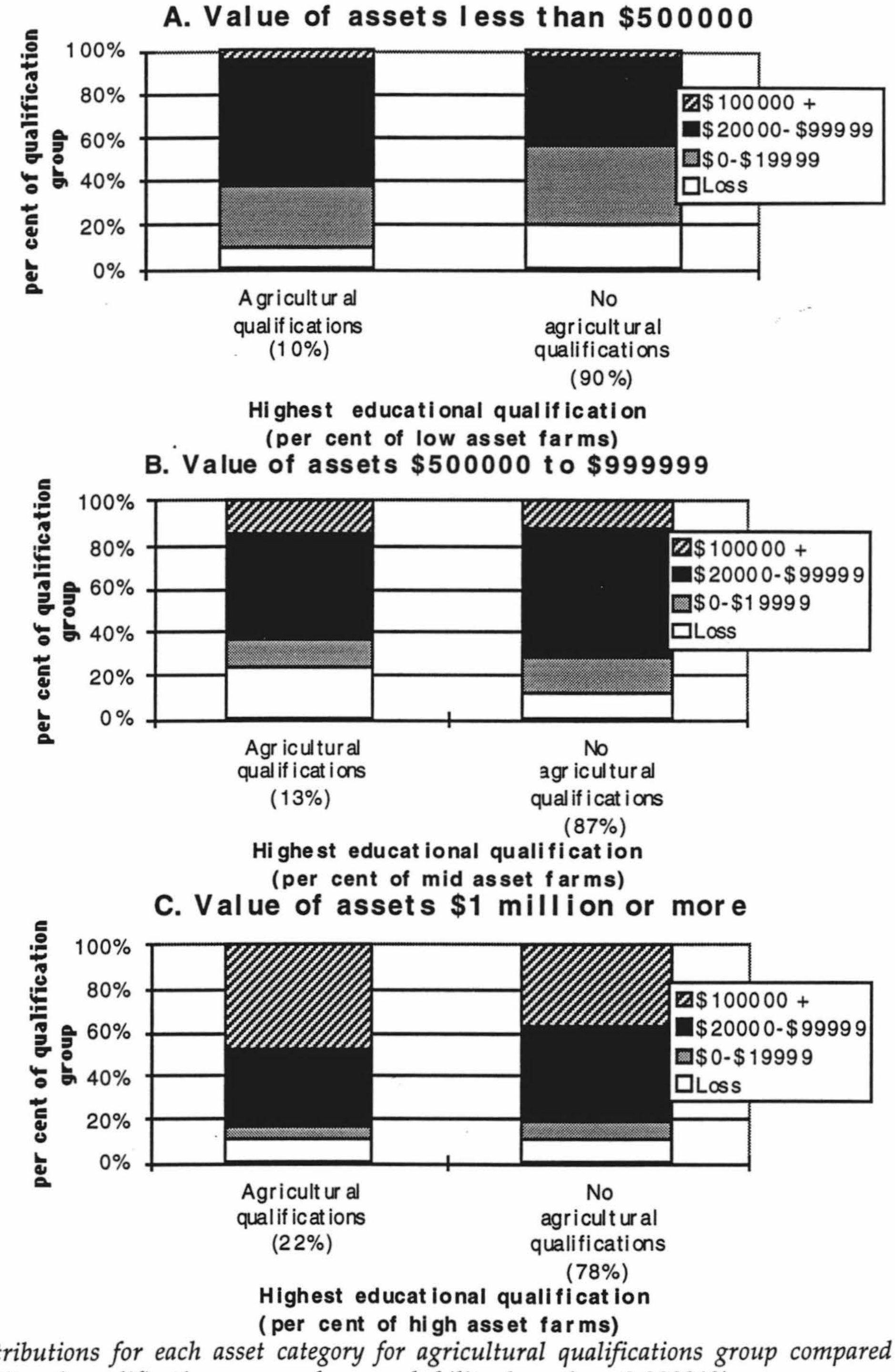
Table 5 Value of assets by highest education level in management team (AFS)

Education level / Value of assets	Below year 10	Year 10 to year 12	Non-agricultural post-school qualifi-cations	Agricul-tural qualifi-cations	% of all farm businesses
Less than $500 000	28%	40%	21%	10%	29%
$500 000 to $999 999	19%	44%	24%	13%	35%
$1 million or more	12%	45%	20%	22%	37%

1.1.1 Value of assets, agricultural qualifications and profit

Figure 17 divides farm businesses into the three approximately equal categories by value of assets; less than $500 000, $500 000 to $999 999 and $1 million or more. Farm businesses with agricultural education in the management team are more likely to earn a higher gross operating surplus in the lowest and highest asset categories. Farm businesses in the mid asset group which have someone with agricultural qualifications are more likely than other farm businesses in this asset group to earn a gross operating surplus of more than $100 000. For each asset group (Figure 17 A, B and C), the proportion of farm businesses with and without agricultural qualifications is shown in brackets.

Figure 17 Agricultural qualifications, assets and gross operating surplus (AFS)

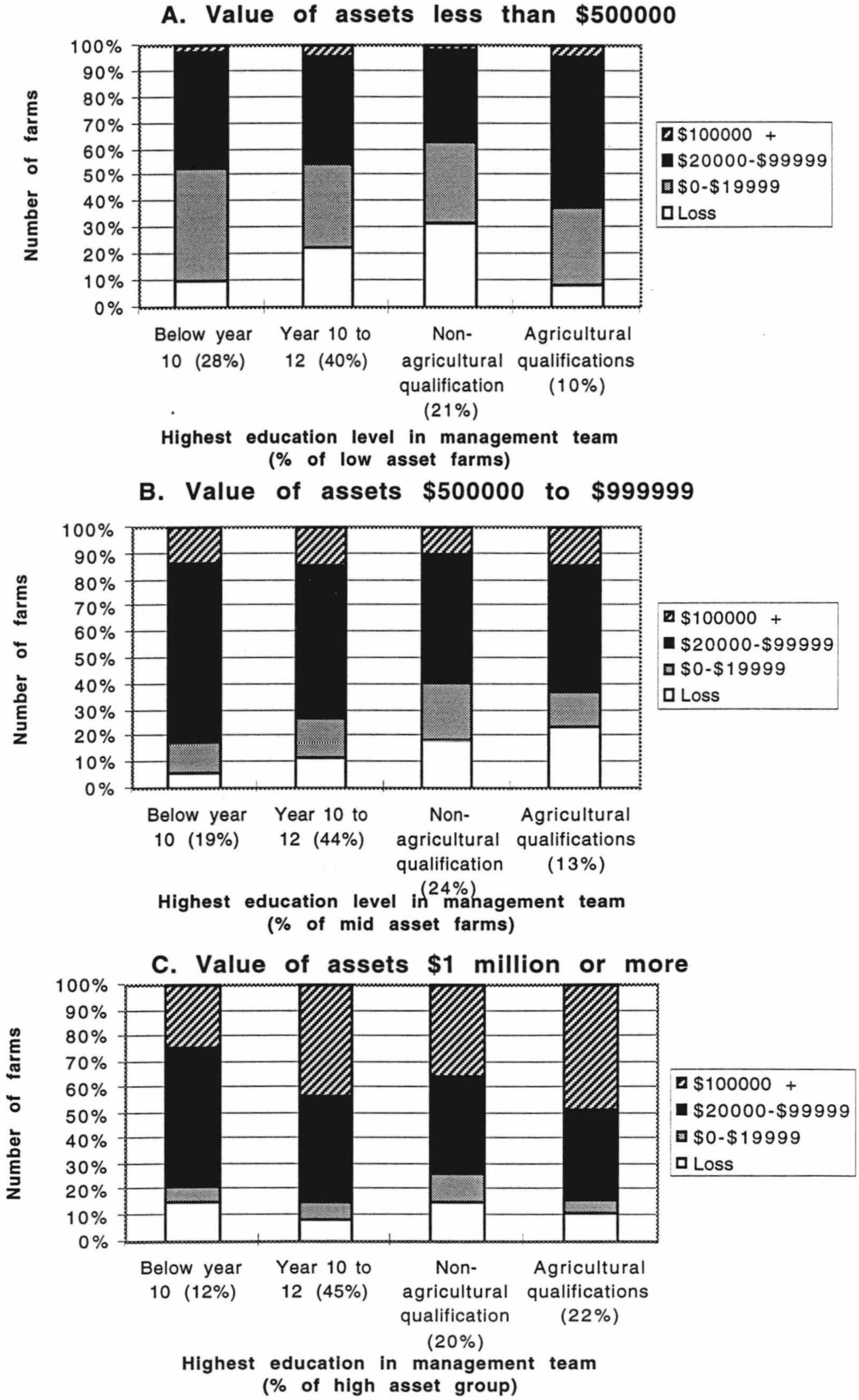


χ^2 distributions for each asset category for agricultural qualifications group compared to no agricultural qualifications group have probability less than 0.00001%.

1.1.2 Value of assets, length of schooling and profit

Inspection of Figure 3 A, B and C suggests that a low level of education only has a negative impact on profit for large farm businesses (value of assets $1 million or more). Farm businesses with non-agricultural post-school qualifications are more likely to earn a lower gross operating surplus than those with year 10 to 12 education in all three asset groups.

Figure 18 Education, assets and gross operating surplus (AFS)

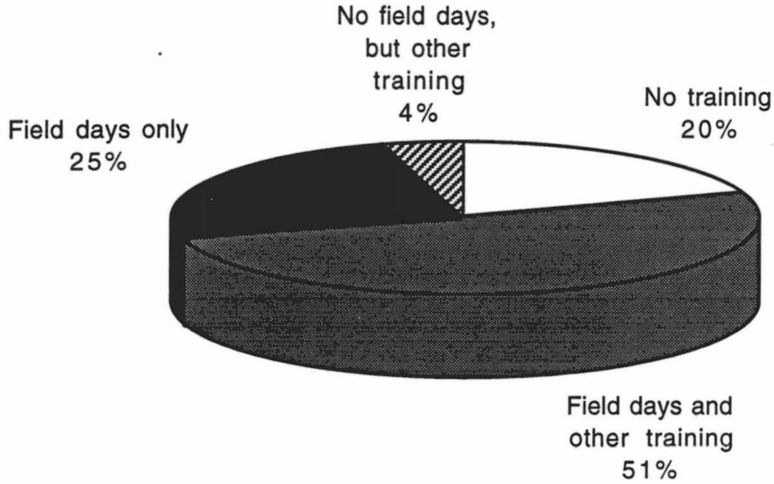


χ^2 distributions for each asset category for agricultural qualifications group compared to year 10-12 group have probability less than 0.00001%.

1.2. Participation in training (AFS)

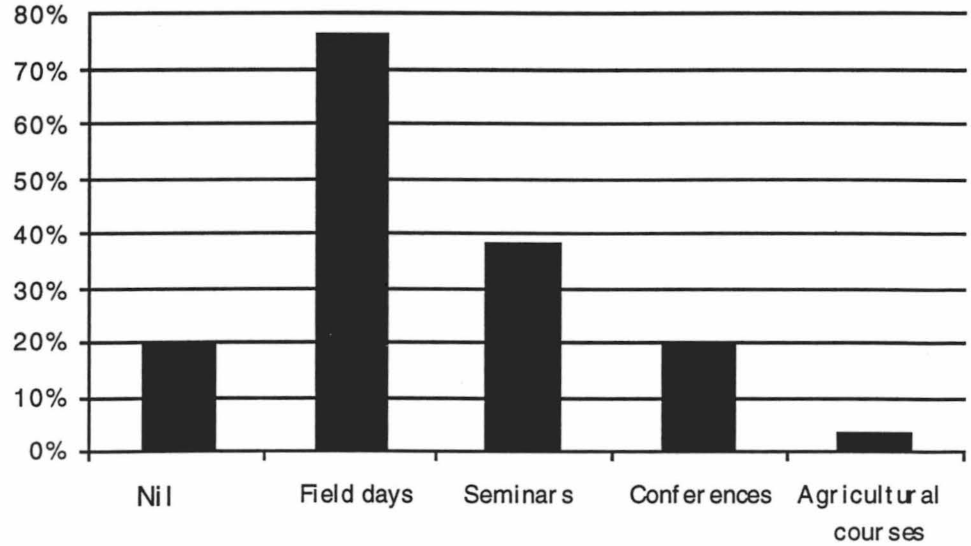
The training participation rate of Australian farm managers depends on how training is defined. If the definition of training is limited to formal award courses run by universities, TAFE institutes and other accredited providers, then only 3% of Australian farm businesses have someone participate in training in a twelve month period (AFS). However, if a broader definition which includes informal training at seminars, conferences, industry meetings and field days is used, 80% of farm businesses participate in training; Figure 4 shows the participation in training of various types.

Figure 19 Distribution of farm business training behaviour (AFS)



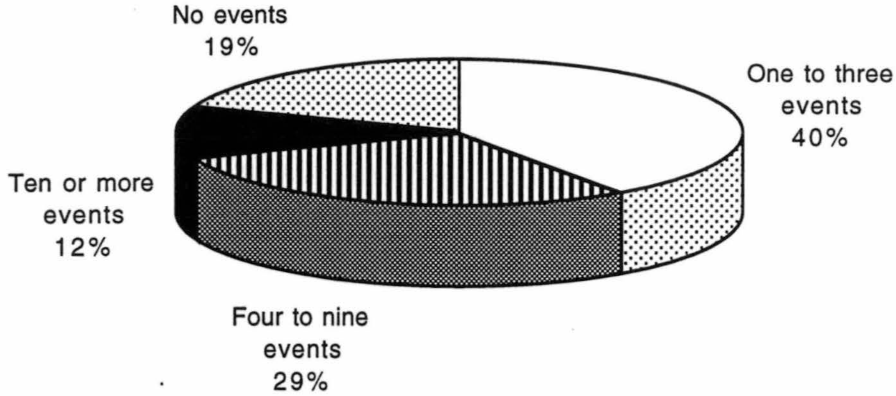
Field days are the most popular form of training, being attended by 76% of all farm businesses, followed by seminars and workshops (38%) and conferences and industry meetings (19%) (see Figure 5).

Figure 20 Methods of farm business training (AFS)



Forty-one percent of farm businesses attend more than three training courses, seminars, workshops, conferences, industry meetings, or field days (hereafter called training 'events') during a twelve month period while 40% participate in between one and three training 'events' (Figure 6).

Figure 21 Number of training 'events' attended (AFS)



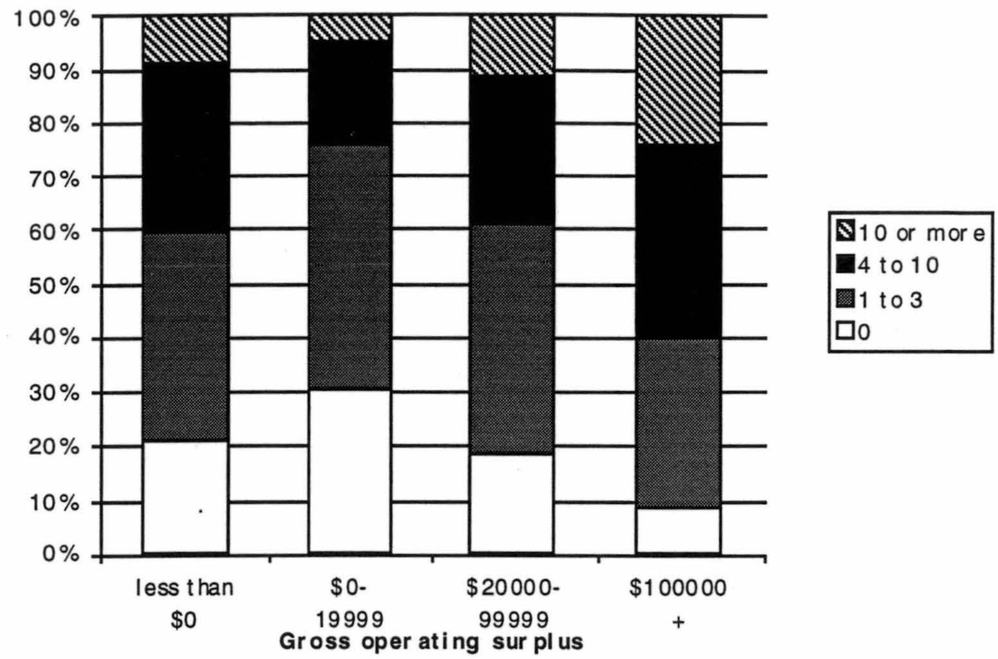
Some of the characteristics of those who attend various types and quantities of training, such as value of farm business assets, influence farm business profitability. These characteristics are explored in the following section.

1.3. Profit and participation in training (AFS)

Farm businesses which participate in at least one training 'event' in a twelve month period have a higher gross operating surplus than those which do not ($68 102 for 'training' farm businesses compared to $39 788 for 'non-training' businesses; the difference is significant at the 95% confidence level).

Farm businesses which make a small profit are less likely to train than those making a larger profit, and farm businesses which make a small profit are also less likely to train than farm businesses which make a loss (Figure 7). This pattern generally applies to each of the various types of training events (see Figure 10 to Figure 14 for other types of training events).

Figure 22 Profit and number of training events (AFS)

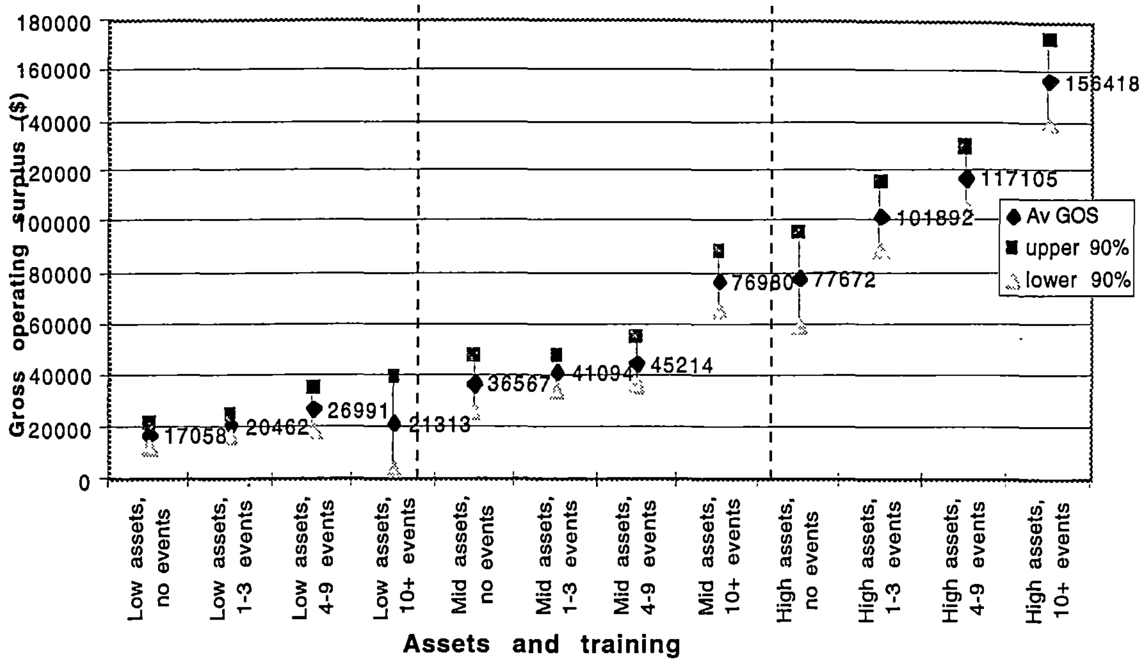


The average gross operating surplus varies with value of assets, as well as with training. Figure 8 shows this variation and also compares farm businesses within asset groups by the number of training events attended.

Farm businesses with assets from $500 000 to $999 999 and of $1 million or more, which had people attend 10 or more events in twelve months, had a significantly higher gross operating surplus than those with similar value of assets which participated in fewer training events. Also, farm businesses with assets of $1 million or more which attended between four and nine training events had a significantly higher gross operating surplus ($117 105) than those which attended no training ($77 072). This may indicate that there is a 'threshold' level of training participation before training has a benefit.

The relationship between number of training events and changes to practice allows further examination of the possibility of a threshold level of training participation before training has a benefit. This is discussed in section 2.4.2.

Figure 23 Training and average gross operating surplus by low, mid and high value of assets* (AFS)



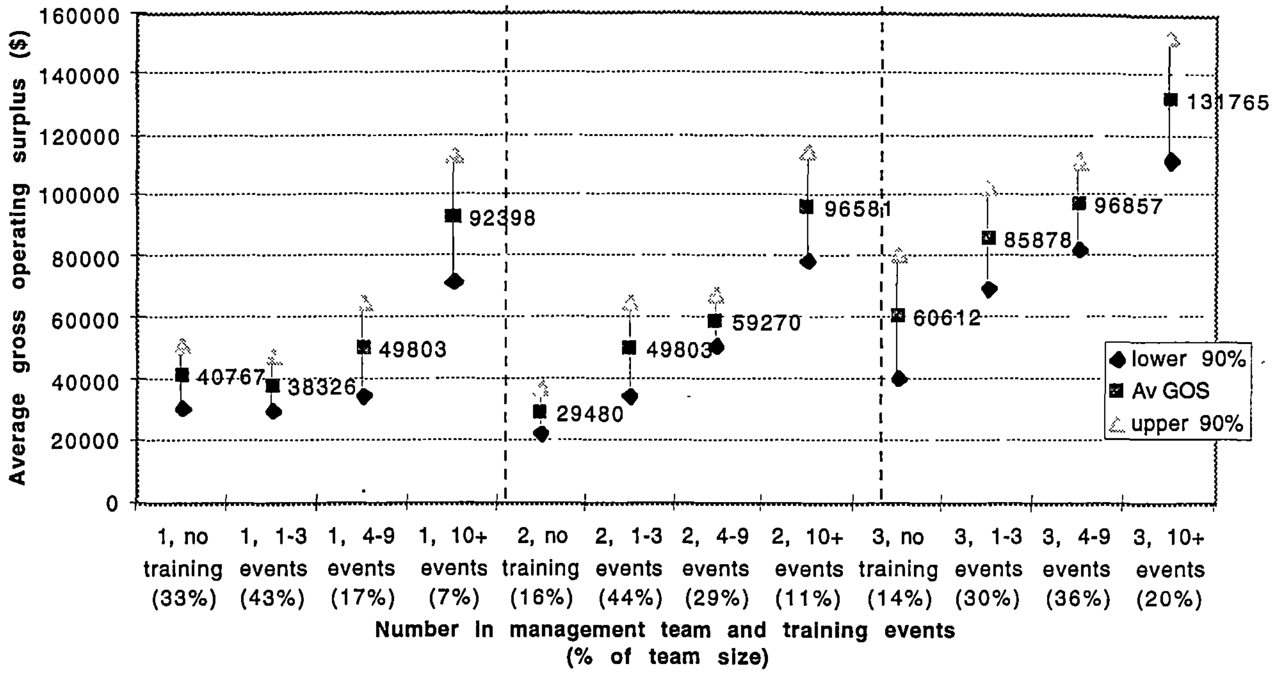
*Value of assets: low less than $500 000, mid $500 000-$999 999, high $1 million or more.

1.3.1 Size of management team, training and profit

Participation in training increases with the number in the farm business management team, as can be seen from Figure 9, which shows that whilst 33% of farm businesses with a single manager attend no training in a twelve month period, only 14% of those farm businesses with three or more managers attend no training in the same period. Figure 9 also suggests that profit increases with the number of training events attended for farm businesses with a given size of management team.

It should be noted that the average value of assets of single and dual manager farm businesses is not significantly different at the 90% confidence level, but that farm businesses with three or more managers have a significantly higher average asset value than the other two groups (Australian Bureau of Statistics, Agricultural Financial Survey, unpublished data).

Figure 24 Size of management team, training and profit (AFS)



1.3.2 Industry

Farm businesses in the fruit, vegetable, grain and grain-sheep-beef industries which attend at least one training event in twelve months have a higher gross operating surplus than those which participate in no training (see Table 4).

Table 6 Profit and training by industry (AFS)

		At least one training event			No training events		
Industry	% of farms training	Average Gross Operating Surplus	Relative Standard Error	Lower 90% confid-ence limit	Average Gross Operating Surplus	Relative Standard Error	Upper 90% confid-ence limit
Fruit*	79%	$48 839	0.1385	$37 678	$29 026	0.1641	$36 885
Vegetable*	76%	$100 080	0.1141	$81 238	$27 567	0.2933	$40 908
Grain*	88%	$92 709	0.0621	$83 210	$38 121	0.238	$53 091
Grain-sheep-beef*	83%	$71 773	0.0723	$63 211	$38 417	0.2351	$53 320
Sheep-beef	83%	$55 418	0.1139	$45 003	$55 996	0.2238	$76 674
Sheep	85%	$46 130	0.09	$39 280	$21 864	0.9041	$54 480
Beef	70%	$53 308	0.1377	$41 196	$38 773	0.2067	$51 997
Dairy	81%	$80 516	0.0896	$68 613	$53 305	0.2628	$76 419
Pigs	65%	$70 387	0.3023	$35 278	$83 792	0.2659	$120 554
Poultry	81%	$59 569	0.154	$44 433	$38 062	0.2298	$52 494
Sugar	87%	$75 645	0.1776	$53 478	$53 189	0.1814	$69 109
Cotton	94%	$322 644	0.1552	$240 021	$735 915	0.4285	$1256 225
Other	73%	$43 580	0.2319	$26 905	$16 377	0.6825	$34 820

* *Difference of means of training and non-training farm businesses is significant at 90% confidence level.*

1.3.3 State

Table 7 shows that farm businesses in all States except New South Wales and South Australia which attend at least one training event in twelve months have a higher average gross operating surplus than those which do not.

Table 7 Training and profit by State (AFS)

		At least one training event			No training events		
State	% of farms training	Average Gross Operating Surplus	Relative Standard Error	Lower 90% confidence limit	Average Gross Operating Surplus	Relative Standard Error	Upper 90% confidence limit
NSW	81%	$72 800	0.0602	$65 569	$53 903	0.1333	$65 759
Vic*	79%	$58 837	0.0726	$51 789	$23 978	0.2931	$35 574
Qld*	77%	$59 076	0.0937	$49 943	$30 165	0.1953	$39 886
SA	84%	$46 327	0.1126	$37 720	$31 484	0.2569	$44 830
WA*	85%	$124 668	0.0567	$113 005	$76 249	0.1914	$100 329
Tas*	88%	$42 638	0.0998	$35 617	$16 964	0.3534	$26 856

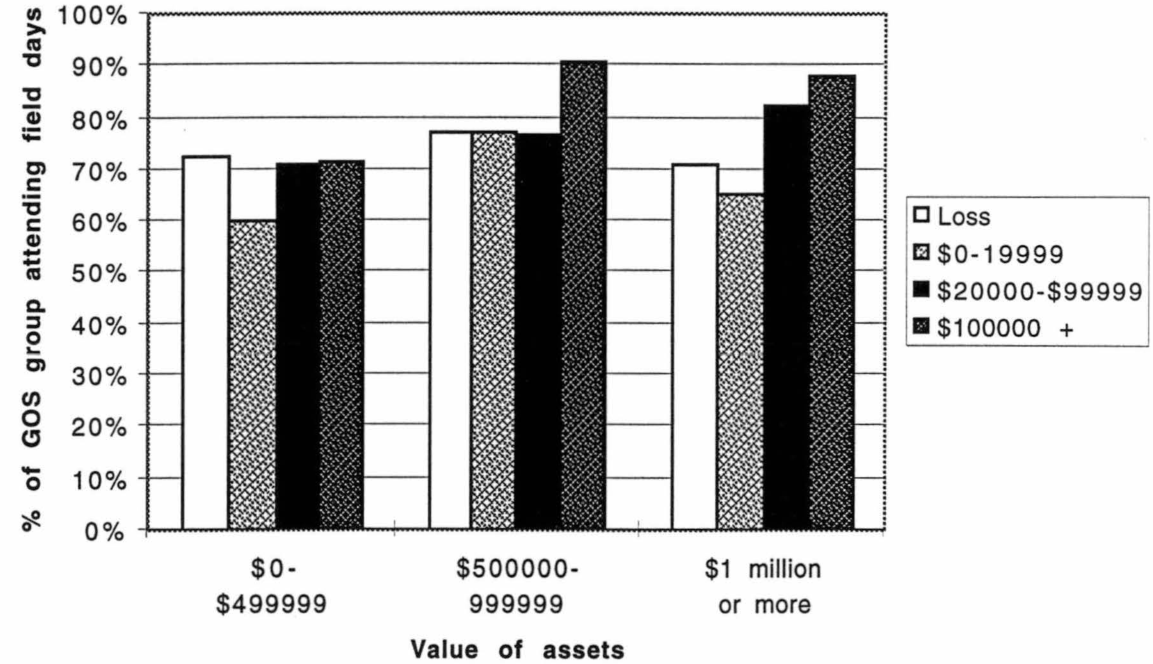
* *Difference of means of training and non-training farm businesses is significant at 90% confidence level.*

1.3.4 Field days

Farm businesses which participate in at least one field day in a twelve month period have a higher gross operating surplus than those which do not ($68 955 compared to $42 280 for 'no field day' businesses; the difference is significant at the 95% confidence level).

Field day attendance increases with the value of farm business assets. Farm businesses in the lowest asset group which earn a low, but positive gross operating surplus are the most likely not to attend field days (40% of this profit category attend no field days in twelve months). About a quarter of those large farm businesses which make a loss attend no field days. The proportion of those making $100 000 or more who attend no field days was only around 10% for the two larger asset categories (Figure 10).

Figure 25 Profit group and field day attendance by asset group (AFS)

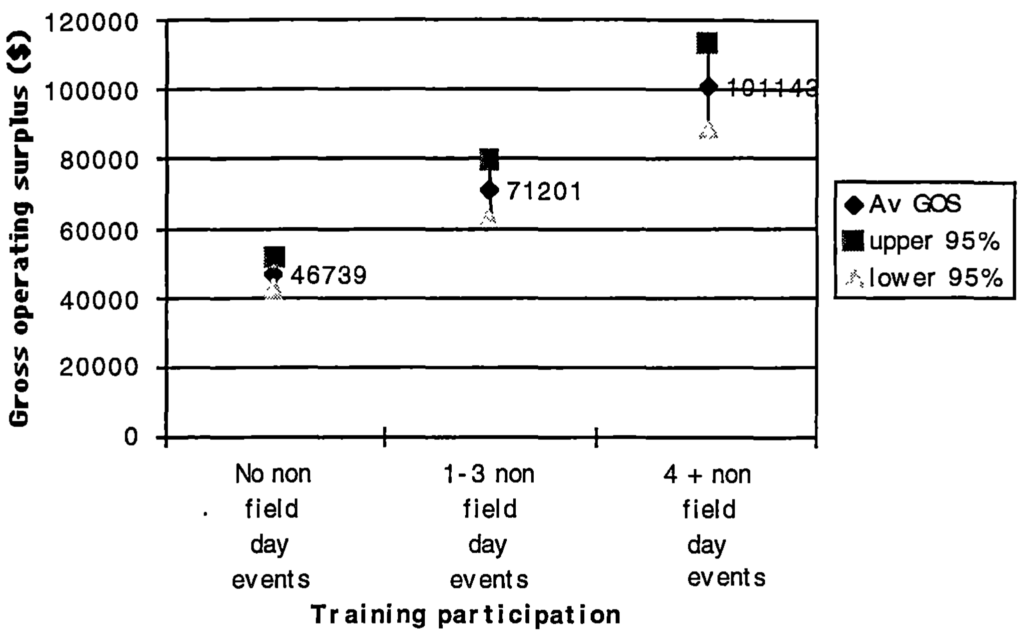


Note: Only 3% of those with assets $0-$499 999 are in the highest profit category. Only 7% of those with assets $1 million or more are in profit category $0-$19 999. All other profit categories make up more than 11% of their asset group.

1.3.5 Non-field day training

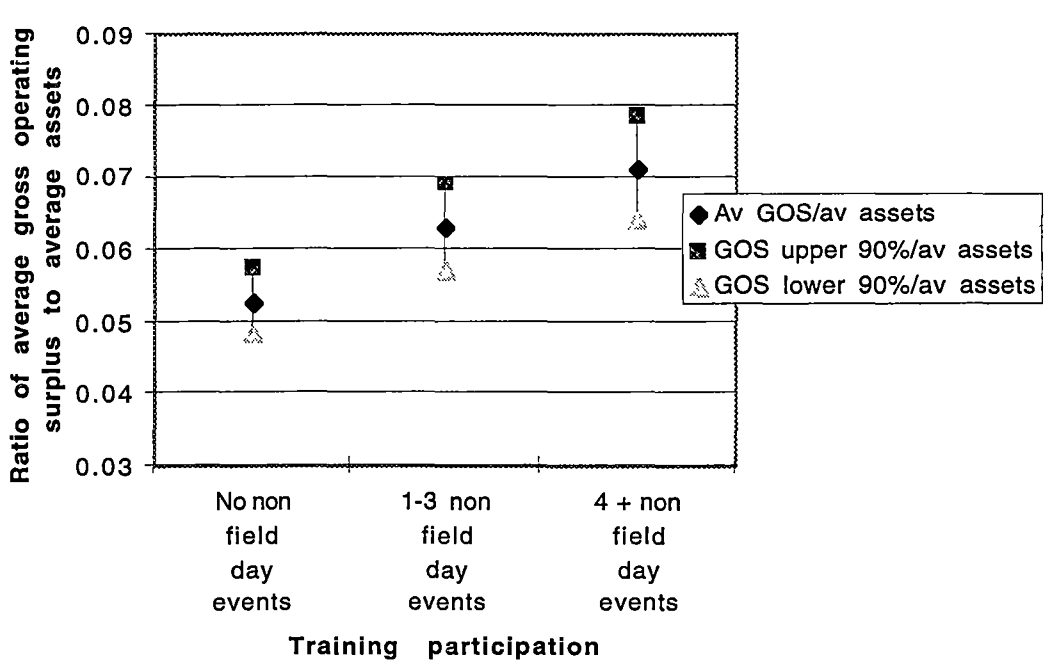
Farm businesses which participate in training other than field days; that is, courses, seminars, workshops and industry meetings, are more profitable than those which do not. The 'other than field day' training group have an average gross operating surplus of $80 993, compared to $46 739 for those who do not train or attend only field days. Average gross operating surplus increases significantly with the number of training 'events' other than field days attended (see Figure 11).

Figure 26 Profit and participation in training other than field days (AFS)



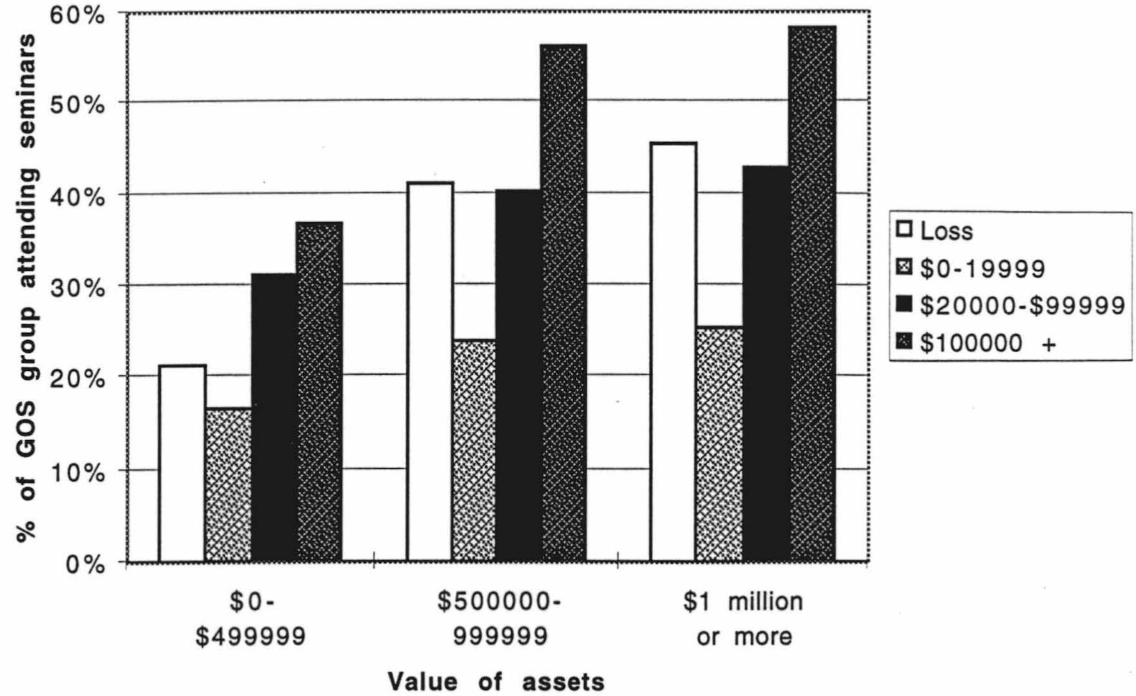
Farm businesses which attend four or more training events (field days excluded) have a significantly higher return on assets than those which attend no training, or only participate in field days (see Figure 12).

Figure 27 Return on assets and participation in training (AFS)



More profitable farm businesses in each asset group are more likely to attend seminars and workshops (Figure 13). Those making a gross operating surplus between $0 and $19 999 are least likely to attend seminars and workshops.

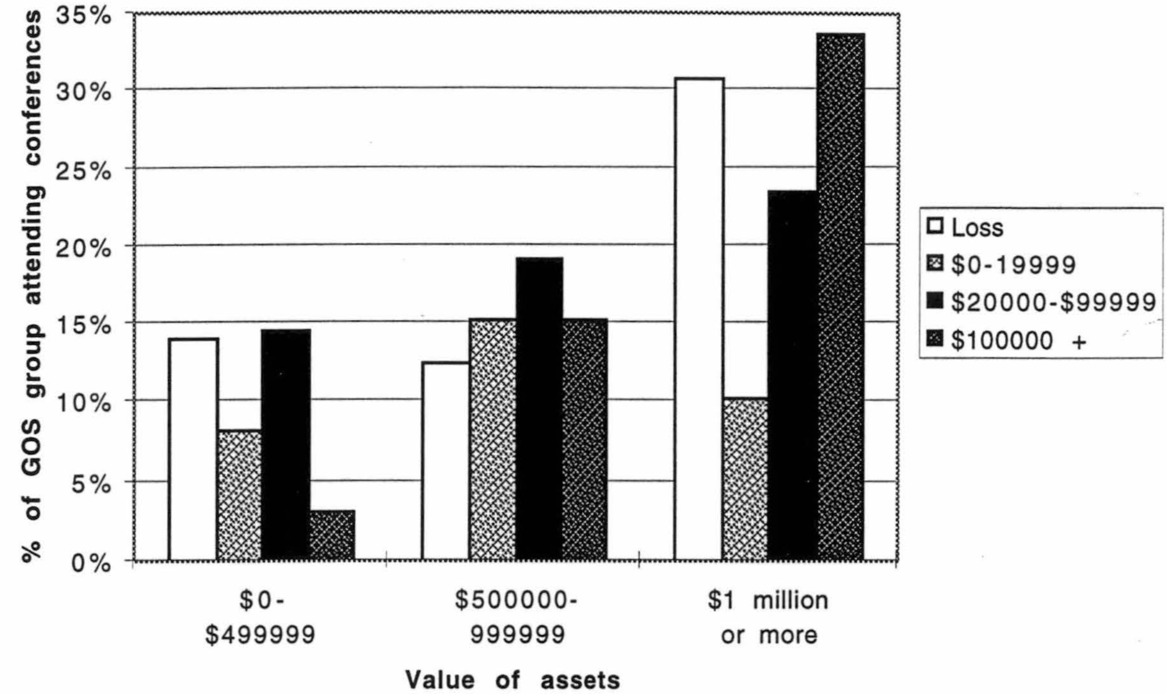
Figure 28 Profit group and seminars and workshops by asset group (AFS)



Note: Only 3% of those with assets $0-$499 999 are in the highest profit category. Only 7% of those with assets $1 million or more are in profit category $0-$19 999. All other profit categories make up more than 11% of their asset group.

The less profitable farm businesses in the lowest and highest asset groups are least likely to attend conferences and industry meetings (Figure 14).

Figure 29 Profit group and conferences and industry meetings by assets (AFS)



Note: Only 3% of those with assets $0-$499 999 are in the highest profit category. Only 7% of those with assets $1 million or more are in profit category $0-$19 999. All other profit categories make up more than 11% of their asset group.

Training events are a significant determinant of gross operating surplus in multiple regressions with independent variables; value of assets, industry, state, number of training events (categorised as none, one to three, four to nine and ten or more) and a event-state interaction variable for both all farm businesses and profit makers only. Refer to Appendix F for more information on the multiple regressions.

1.4. Training and profit - Tasmanian survey

The Tasmanian survey asked about training behaviour over the past three years, instead of a one year period as in the Agricultural Financial Survey. This allows examination of patterns of training behaviour over time.

All but two farm businesses in the sample participated in at least one training event in the past three years. Ninety-one percent of those surveyed agreed that education and/or training is important to the profitability, productivity and/or long term viability of their farm. Eighty percent believed that training or expert advice received in the last three years have improved the profitability, productivity and/or long term viability of their farm.

1.4.1 Number of training events

Training events for the Tasmanian survey include all those events attended by the farm business in the previous three years. Farm businesses which attend more than two training 'events' per year, and those that attend two or more events other than field days have a higher average gross operating surplus than those which attend fewer training events (Table 6). This result is consistent with the AFS Australia wide result that gross operating surplus and participation in training events are positively correlated (Figure 26).

Table 8 Number of training events in three years and profit (Tas survey)

Training	Number of farms (%)	Average gross operating surplus	t test probability (compared to lowest number of events category)	Number with financial data
Non field day events				
0, 1	14 (22%)	$11 771		11
2 to 5	33 (51%)	$70 952*	0.00115497	23
6 or more	18 (28%)	$50 906*	0.04591511	16
All events				
0 to 6	17 (26%)	$9 378		8
7 to 15	29 (45%)	$49 366*	0.00657308	25
16 or more	19 (29%)	$74 511*	0.00444464	17

Number sampled =65, financial data sample=50
** Difference in mean compared to lowest event category significant at 95% confidence level.*

There are too few farm businesses in each industry group which attended very few training events to allow statistical analysis of profit and training on an industry basis. For the same reason multiple regressions including various training event variables yield no significant results.

1.4.2 Seminars, field days and discussion groups

Almost half of farms surveyed participate in discussion groups, and almost half attended agricultural or technical seminars, workshops or conferences (of up to one day's duration). Table 7 shows participation in one day training via seminars, workshops and conferences, and participation in discussion groups which are on-going, regular informal training sessions. A similar proportion of the Tasmanian sample attended one day training sessions (55%) as the AFS result for Australia as a whole. From the AFS data, 55% of farm businesses participate in non field day training, which includes the 3% attending courses (see Figure 19 Distribution of farm business training behaviour (AFS) above).

Table 9 Seminars and discussion groups in the last three years (Tas survey)

Number of type of event attended / Training mode	One	2 to 5	More than 5	Total farm businesses	% of sample
Agriculture and technical seminars, workshops and conferences	15	13	3	31	48%
Business management seminars	3	3	0	6	9%
Any seminars, workshops and conferences				36	55%
Discussion groups	28	3	0	31	48%

Number sampled = 65

The content area of seminars, workshops and conferences vary widely. Examples of business management seminars include Australian Farm Management Society meetings, livestock marketing sessions and a time management seminar. Agricultural and technical seminars and workshops include; herd health, irrigation and hop farming. A full list appears in Appendix G.

Field days are defined to include Agfest (a Tasmanian agricultural industry exhibition) and agricultural shows (if the respondent volunteered agricultural shows under the category). Two thirds of farm businesses attend more than one field day per year on average and 20% attend more than five field days per year, as Table 8 shows. Eighty-three percent attend field days, slightly more than the AFS survey result of 76% (Figure 19 above).

Most dairy farmers went to 'dairy farmer of the year' and/or 'share dairy farmer of the year' field days. There was no other discernible pattern of field day attendance by industry. The topics of field days attended varied from fencing to turnips. Agfest was popular in all industries.

Table 10 Field days in the past three years (Tas survey)

Field days in Tasmania	Number of farm businesses	Percentage of survey
0	11	17%
1 to 3	10	15%
4 to 6	19	29%
7 to 15	12	18%
16 to 28	7	11%
30 or more	6	9%
Tours and field days outside Tasmania	3	5%

Number in sample = 65

Average profit (measured by either gross or cash operating surplus) for those attending/not attending individual types of events, i.e., seminars or field days or discussion groups, is not statistically significantly different.

Because of the small numbers who attended any one seminar (there is a maximum of four for any one seminar) it is not statistically appropriate to consider the possible effect of any one seminar, workshop or conference on the profit measures.

1.4.3 *Courses*

Seventy-seven percent of farm businesses had taken at least one business management, agriculture or technical course (consisting of several sessions held over more than one day) in the last three years. This percentage is high because 43 of the 65 farms surveyed were included because they had participated in the Farm Chemical Accreditation, Dairy Farm Management or Intensive Pasture Management course. Thirty-six farm businesses, or 55% of all those surveyed, had taken more than one course.

Of the other farms surveyed, only five of the TFGA sample, plus the two farms selected for the TFGA sample but later found to have taken the Intensive Pasture Management and Farm Chemical Accreditation courses, or 32%, had taken a course over the three year period. This figure is likely to understate the percentage of farms where courses are studied because those identified on one of the three course participant lists were excluded when the survey sample was drawn from the TFGA membership list.

Other courses include; Tasmanian Rural Industries Training Board financial management modules, feeding for profit, artificial insemination, advanced pasture management, a private agricultural consulting company's marketing course and grazing for profit. A list of courses designated 'Other' in Table 9 appears in Appendix G.

Table 11 Farm businesses taking courses in the last three years (Tas survey)

Number of courses	One	2 to 5	More than 5	Total farms	% of sample
TAFE or university agriculture *	20	11	1	32	49%
Other agriculture **	17	12	2	31	48%
Whole farm planning	8	0	0	8	12%
Computer or record course	7	3	1	11	17%
Other business management	4	0	0	4	6%
All courses	**15**	**27**	**8**	**50**	**77%**

* *Includes Dairy Farm Management and Farm Chemical Accreditation courses.*
** *Includes Intensive Pasture Management course.*
Number sampled = 65

When seminars are included, 38% of farm businesses undertook some business management training, including 17% of farm businesses which had someone take a computer or record management course.

There is no significant difference between the average gross operating surpluses of those farm businesses taking courses and those taking no courses. Neither is there a significant difference between the average gross operating surpluses of those taking business management training (including whole farm planning and computer courses) and farm businesses taking no management training. The small number of farm businesses in each category makes it less likely that differences will be statistically significant.

The relationship between the three survey courses and profit is considered in section 1.4.4 below. The small number of those in the TFGA sample who studied courses, the diverse nature of the courses and the spread of courses across industry sub-sectors make it statistically inappropriate to analyse profit data by industry and for individual courses other than Dairy Farm Management, Intensive Pasture Management and Farm Chemical Accreditation.

1.4.4 The three survey courses

Farm businesses which have a member of the management team who has taken one of the three courses included in the survey record better profit results than farms in the same industry sub-sector which do not. Farm businesses in the course sample have a higher average profit (gross operating surplus) even when value of assets is taken into account in multiple regressions (see Appendix F).

Table 12 Profit and courses (Tas survey)

Dairy farms	**Number**	**Average gross operating surplus**
Dairy Farm Management Course	10	$57 630**
Other dairy farmers	19	$51 401**
T test *(probability < critical value)*		T 0.2198 (0.8286)
Intensive Pasture Management Course	14	$62 206**
Other dairy farmers	15	$45 469**
T test *(probability < critical value)*		T 0.6245 (0.5397)
Crop and livestock farms		
Farm Chemical Accreditation Course	13	$81 670**
Other crop and livestock farms	25	$31 660**
T test *(probability < critical value)*		T 2.1488 (0.0448)

***Difference is significant in multiple regressions.*

The Dairy Farm Management course is positive and significant in explaining both gross and cash operating surplus for dairy farms in the multiple regressions (refer to Appendix F for the multiple regressions). The Intensive Pasture Management course also is targeted at the dairy industry. This course is associated with a higher dairy gross operating surplus in the multiple regressions.

Farm businesses in the crop industry which completed the Farm Chemical Accreditation course have a higher average gross operating surplus, and the course is positively associated with gross and cash operating surplus in the multiple regressions. Multiple regressions which also include making a change to chemical use reveal that the change to chemical use is more significant than having done the course; nine of the eleven crop farms which took the course also made a change to chemical use.

1.5. Training participation over time

As stated at the start of section 1.4, the Tasmanian interview survey data allow examination of farm business training patterns over time. Recent training participation and past training participation are correlated strongly. Table 11 shows that farm businesses which attended nil or very few training events in the period one to three years ago also attended no or very few events in the last year. Similarly, farm businesses which attended more than five events in the last year, tend to have participated in a large number of training events in the previous two years.

Table 13 Training participation over time (Tas survey)

	Training events 1 -3 years ago					
Number of training events in the last year	**Nil**	**1 or 2**	**3 to 5**	**6 to 15**	**More than 15**	**Number of farms**
Nil	2	4	1	0	0	7
1 or 2	0	7	6	5	1	19
3 to 5	0	0	6	14	0	20
More than 5	0	0	0	12	7	19
Number of farms	2	11	13	31	8	65

Correlation coefficient r=0.913255

2. What 'triggers' farm managers to make major changes to their farming practices?

This section, first, reviews the number and types of changes made to farm management practice. It then examines the characteristics of those making changes, starting with the relationship between change and education and training, and moving on to financial and other characteristics. Third, results about influences reported by respondents on the change process are presented, and, finally, the section concludes with findings relating to the relationship between change, training and profit.

2.1. Agricultural Financial Survey

Only 62% of all farm businesses made one or more changes to practice in the last three years designed to improve farm profitability. Table 12 shows that a change to agricultural practice is the most common type of change made by farm businesses, being made by just under half of all farm businesses. A change to agricultural practice is identified as the most important change in the last three years for 38% of all farm businesses. Whilst 14% of businesses made a change to financial management, only 5% rated this change to practice as the most important one made.

Table 14 Changes to practice by type (AFS)

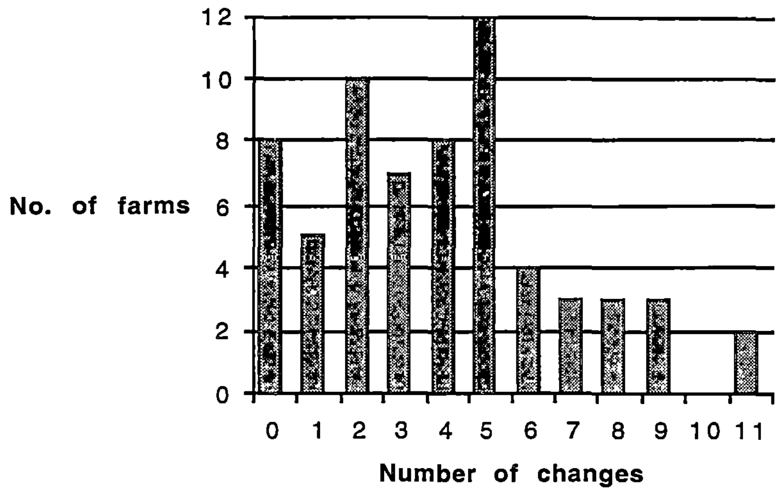
Type of change	Made a change	Was most important change
Financial	14%	5%
Marketing	11%	5%
Agricultural	48%	38%
Land management	25%	13%
Other	5%	1%
Nil		38%

Number sampled = 104 766

2.2. Tasmanian survey

The Tasmanian survey permits examination of *all* changes in the last three years which are considered to improve the profitability or long term viability of the farm business. Compared to the Agricultural Financial Survey results, a larger proportion of the Tasmanian survey made at least one change. All but 12% of these farm businesses have made at least one change to their farming practice over the past three years which they consider has improved or maintained the long term profitability or viability of their farm. Individual farm businesses report up to eleven changes, the average being 3.9 changes (see Figure 15). Over half (57%) made between two and five changes.

Figure 30 Number of changes per farm business (Tas survey)



Most changes are to pasture planning (51% of farms) and land management (49% of farms), which is not unexpected given that 29% of those surveyed had attended the Intensive Pasture Management or Dairy Farm Management courses. One third made changes to chemical use, again the presence in the survey of 16 farm businesses which had someone take the Farm Chemical Accreditation course may be an explanation for the relatively large number of farms reporting a change to this practice. The chemical use category includes; changes to fertiliser use and veterinary drugs and drenches. The number reporting a change to skills which has improved or maintained the long term profitability or viability of the farm (28% of farms) is influenced also by the number of course participants in the survey. Forty-two percent used 'new' equipment or technology, which includes tractors, dairies, soil testing, computers, harvesters and hoes (see Table 13).

Table 15 Changes to farm practice over past three years (Tas survey)

Type of change	% of changes	% making this change
Pasture planning	14%	51%
Land management	16%	49%
New equipment or technology	12%	42%
Production mix or level	10%	35%
Chemical use	9%	34%
Skills	7%	28%
Record keeping	6%	25%
Workforce	6%	22%
Increase farm size	5%	22%
Animal management	5%	20%
Other management	4%	12%
Financial management	3%	12%
Marketing	2%	9%
Reduce farm size	1%	3%
Total changes	100%	88%

Number sampled = 65

Pasture planning and land management changes are also most numerous when farmer managers rank changes made in order of importance to profitability and long term viability (Table 14). Changes to record keeping and increased farm size rank low in terms of the importance of the change, considering the number of farm businesses making these changes.

Table 16 Changes nominated by farmers as two most important made (Tas survey)

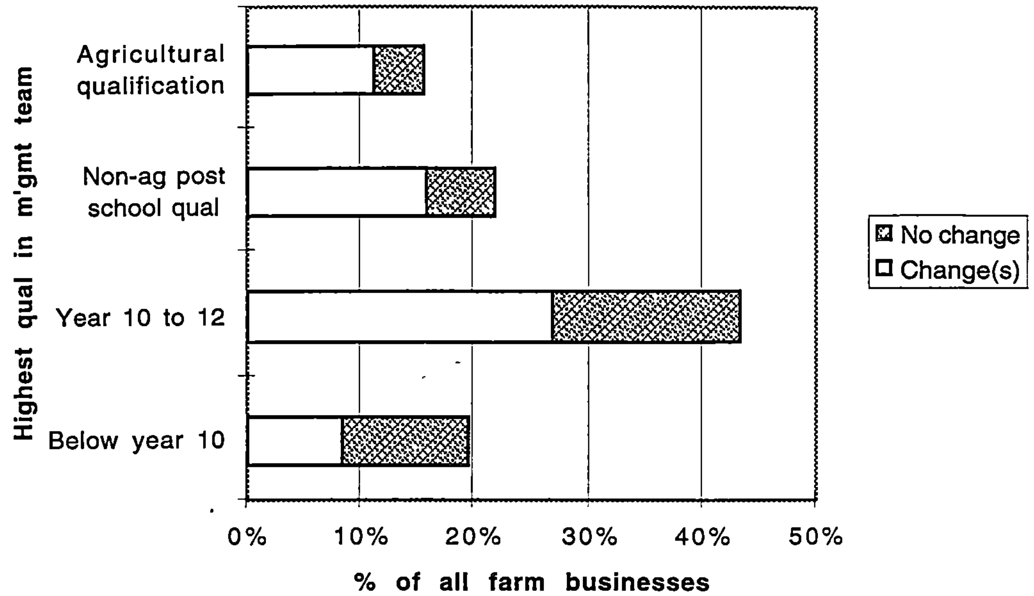
Type of change	% of changes	% of farms
Pasture planning	20%	34%
Land management	20%	34%
Production mix or level	15%	25%
New equipment or technology	12%	20%
Chemical use	9%	15%
Animal management	7%	11%
Skills	6%	9%
Other management	5%	8%
Increase farm size	3%	5%
Workforce	2%	3%
Financial management	2%	3%
Record keeping	1%	2%
Total changes	100%	88%

Number sampled = 65 (some farms made only one change)

2.3. Education and change

From the Agricultural Financial Survey, farm businesses with no one in the management 'team' having education to year 10 level are the least likely to make a change to their practice (56% made no change to improve profitability in the last three years). Only 28% of farm businesses with someone with agricultural qualifications made no change. Figure 16 shows that the likelihood of making no change to practice is greater for those without post school qualifications than for those with post school qualifications. Farm businesses with a highest education level of year 10 to 12 comprise 43% of all farm businesses. This group makes changes at the average rate for the farm business population (62% make a change).

Figure 31 Change to practice and educational qualifications (AFS)



χ^2 probability for distribution of change/no change at each education level compared to Year 10 to 12 is less than 0.000001%

Farm businesses with better educated managers are more likely to make all types of change (Table 15). Table 15 also shows that, while those with below year 10 education are less likely to make any change to practice, the difference is less marked for agricultural change than for the other types of change. This suggests that education level impacts less on the likelihood of making technical changes than it does on the likelihood of making other changes.

Table 17 Education and percentage making a change by category of change (AFS)

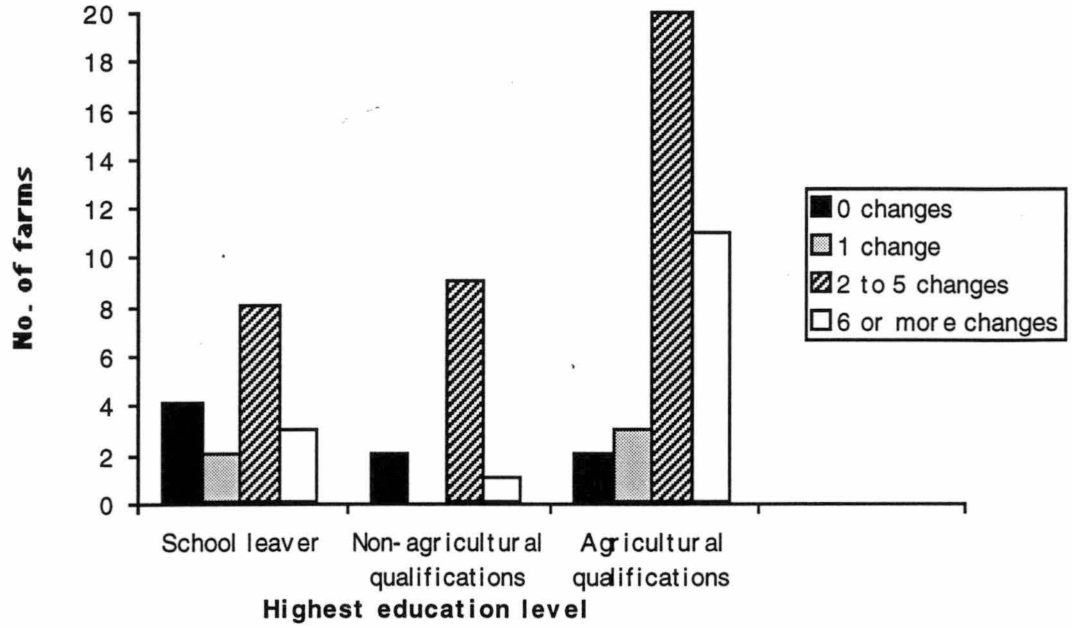
Education level	Financial	Marketing	Agricultural	Land management
Below year 10	5%	6%	32%	12%
Year 10 to 12	13%	10%	48%	24%
Non-agricultural post-school qualification	16%	12%	57%	29%
Agricultural qualification	25%	19%	56%	35%
All	14%	11%	48%	25%

χ^2 probability for distribution of change/no change at each education level compared to Year 10 to 12 is less than 0.000001% for all four types of change.

Taking only businesses which do make changes, farm businesses with agricultural qualifications make more types of change (an average of 1.86 categories), while farm businesses with the lowest educational qualifications make fewer types of change (an average of 1.28 categories). The average for all education levels is 1.57 change categories.

Tasmanian data also show that farm businesses with agricultural qualifications in the management team are more likely to make changes, and are more likely to make two or more changes (Figure 17). Highest education level below year 10 is not shown separately as only four farm businesses are in this category. Rather, they are included in the category 'school leaver'.

Figure 32 Number of changes and education level (Tas survey)



χ^2 probabilities for distribution of education levels compared to agricultural education: school leaver 0.00153961%, non-agricultural post school qualifications 0.00041137%.

2.4. Recent training and change

Those farm businesses which participate in training are more likely to have made a change; 68% of those farm businesses which train also make changes to their practice, compared to only 39% of those who do not train (Table 16).

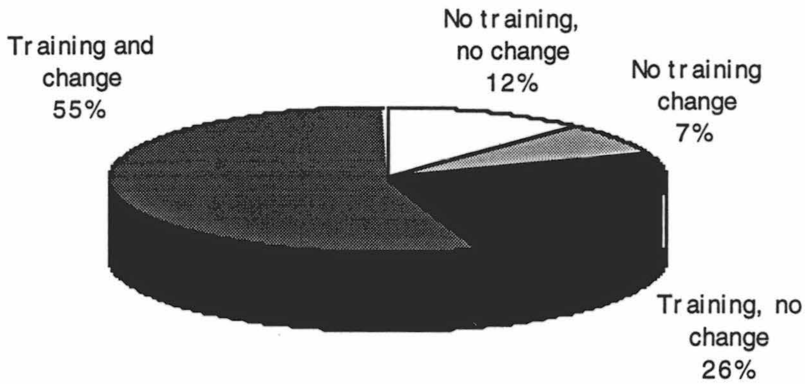
Table 18 Training participation and changes to practice (AFS)

	% making a change
Farms which train	68%
Farms which do not train	39%

χ^2 probabilities for distribution of change/no change being the same is less than 0.00001%.

Figure 18 provides a breakdown of recent training (over the past 12 months) and change behaviour over the past three years. Twenty-six percent of all Australian farm businesses have attended at least one training event in the past twelve months, but made no change to their practice in the three year period. Only 7% of Australian farm businesses both make a change to practice and have done no training in the past twelve months.

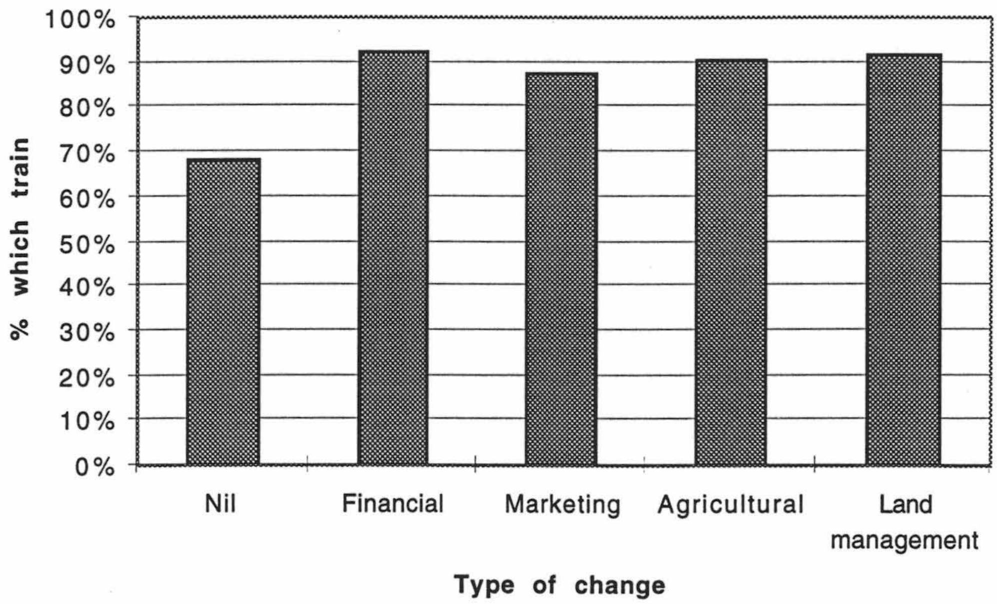
Figure 33 Training and changes to practice (AFS)



2.4.1 Types of change and training

Farm businesses which make each type of change to practice are likely to train. Between 87% and 92% of those farm businesses which make each of the four types of change to practice attend some training, compared to less than 70% of those which do not make changes (Figure 34).

Figure 34 Proportion of those making a change by type which train (AFS)

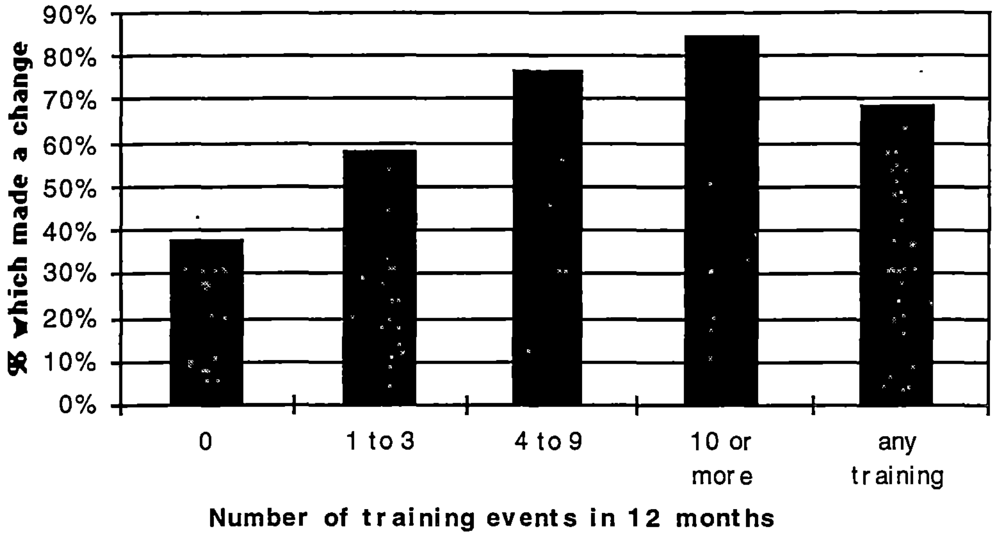


It is possible that some of the 26% surveyed which trained, but made no change to practice (Figure 33) may make a change in the future which is influenced by that training. The interview survey of Tasmanian farmers found that 62% of those who attended a course made a change which was influenced by the course (see section 2.4.4 below).

2.4.2 Number of training events and change

The more events attended, the greater the chance that there has been a change to practice. Figure 35 shows that 84% of those Australian farm businesses which participate in ten or more training events make some change to practice, compared to 58% of those attending between one and three events and only 37% of those which do not train. The increase in the proportion making changes to practice as training attendance increases provides limited support for there being a threshold level of training participation before benefits are derived.

Figure 35 Proportion of those attending training which made a change (AFS)



2.4.3 Training methods and change

When each training method is considered separately, the proportion of participants who make a change is larger than the proportion of those who do not participate in that type of training but make a change (Table 17). Those training methods which attract larger farm businesses, such as conferences and seminars, have a greater proportion of participants who make changes. This is consistent also with larger farm businesses' greater propensity to make a change.

Table 19 Training method and farm businesses which make a change (AFS)

Training method	% which make a change
Field day	68%
No field day	*44%*
Seminar	78%
No seminar	*53%*
Conference	80%
No conference	*58%*
Agricultural course	75%
No agricultural course	*62%*
Non field day training	76%
No non field day training	*50%*
All training	**68%**

2.4.4 Tasmanian courses and changes to practice

Almost two-thirds of participants in the three survey courses made at least one change to their farming practice as a result of attending one of the courses. Changes are planned on two other farms. All but two of the farmers believe that these changes have or will improve the profitability or long term viability of the farm. (One of these two made a change for safety reasons, the other for legal reasons.)

Twenty percent of all the farmers who attended one of the courses became aware of a new practice or management strategy at the course and subsequently implemented that practice or management strategy. One of the courses was the 'trigger', or critical factor, in the decision to make the change in almost half of cases. One quarter of the course-influenced changes were rated the most or second most important change made on the farm over the past three years (Table 18).

Table 20 Changes to practice influenced by courses (Tas survey)

Impact of course on change	Dairy course participants	Pasture course participants	Chemical course participants	Proportion of all course participants
Made a change influenced in any way by course	8	12	9	64%
Became aware of the change at course	2	5	2	20%
Course was trigger for change	4	5	3	27%
Change was one of two most important made on farm in last 3 years	3	3	1	16%
Total participants	13	16	16	

Number sampled=45

The types of change referred to in Table 20, and made as a result of the Dairy Farm Management and Intensive Pasture Management courses, are largely changes to pasture planning or land management (these two changes comprise 85% of all changes from the two courses). Not surprisingly most of the changes as a result of the Farm Chemical Accreditation course are to chemical usage (56%).

The most frequently reported reason for not making a change related to the course is that the course reinforced the appropriateness of existing practices (especially the Farm Chemical Accreditation course). Only three people gave reasons related to the way the course was delivered for not implementing a change to practice following the course (see Table 19).

Table 21 Reason for making no change as a result of a course (Tas survey)

Course Reason	Chemical participants	Dairy participants	Pasture participants	% of non changers
Reinforced existing knowledge	4	2	1	44%
Didn't apply to my farm	2	1	0	19%
Course too theoretical	0	1	1	13%
Prefer existing way of doing things	0	0	2	13%
Not enough capital to implement changes	0	1	1	13%
Too soon, changes planned	0	1	1	13%
Course delivery problems	0	1	0	6%

Number sampled = 16, some gave more than one reason.

2.5. Other characteristics and change

2.5.1 Industry

From the Agricultural Financial Survey data, the proportion making a change on an industry by industry basis varies from 40% for sheep to 74% for poultry. The only industry which is statistically significantly different from the average, however, is the sheep industry (Table 20).

Table 22 Percentage making a change by industry (AFS)

Industry	% change
Fruit	65%
Vegetable	72%
Grain	68%
Grain-sheep-beef	64%
Sheep-beef	61%
Sheep	40%*
Beef	62%
Dairy	67%
Pigs	68%
Poultry	74%
Sugar	68%
Cotton	71%
Other	58%
Total	**62%**

**Significantly different from total at 90% confidence level.*

2.5.2 State

Farm businesses in New South Wales make changes at a significantly lower rate than the national average, while those in Western Australia are significantly more likely to make changes (see Table 21).

Table 23 Percentage making a change by state (AFS)

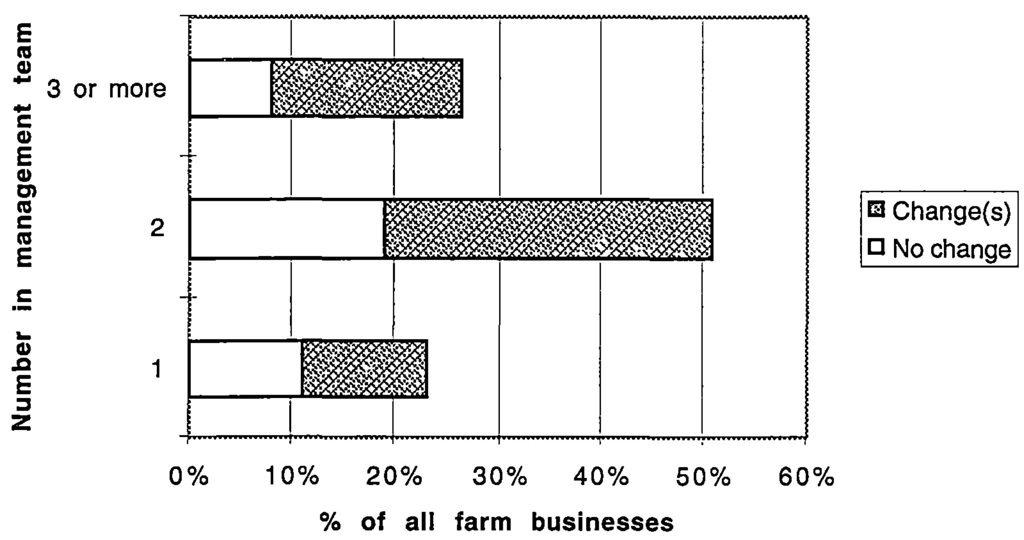
State	% change
NSW	52%*
Vic	64%
Qld	61%
SA	66%
WA	71%**
Tas survey	70%
All states	**62%**

**Significantly lower than total at 90% confidence level.*
***Significantly higher than total at 90% confidence level.*

2.5.3 Size of management team

Australian farm businesses with a single manager are least likely to make a change to practice, and farms with two managers are less likely to make a change than those with larger management teams (Figure 21). This pattern also applies for each type of change (see Table 22).

Figure 36 Number in management team and changes to practice (AFS)



χ^2probability for distribution of change/no change for 1 and 3 or more managers compared to 2 managers is less than 0.000001%.

Table 24 Size of management team and percentage making a change by category of change (AFS)

Number in management team	Financial change	Marketing change	Agricultural change	Land management change
One	8%	9%	43%	19%
Two	13%	10%	47%	25%
Three or more	22%	15%	55%	29%
All	14%	11%	48%	25%

χ^2probability for distribution of change/no change for 1 and 3 or more managers compared to 2 managers is less than 0.000001% for all four types of change.

2.5.4 Value of assets

From AFS data, larger farm businesses (by value of assets) are more likely to make a change to practice in all change categories, except marketing where only those with assets of $1 million or more are more likely to make a change (Table 23). Farm businesses with assets of less than $500 000 comprise less than 30% of all farm businesses yet are the largest group of those which make no change to practice; these low asset farm businesses comprise 36% of all farm businesses which make no change to practice.

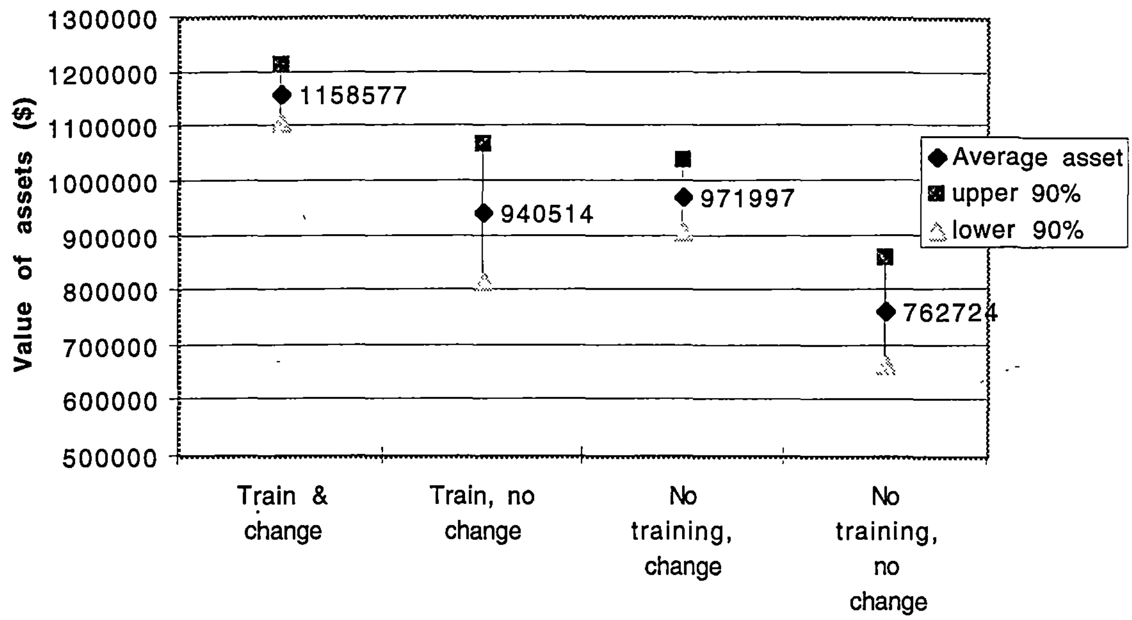
Table 25 Value of assets and type of change to practice (AFS)

Type of change / Assets	All changes	Financial	Marketing	Agricultural	Land management
less than $500 000	53%	10%	10%	37%	17%
$500 000 to $999 000	63%	11%	9%	50%	27%
$1 million or more	69%	20%	14%	55%	28%
All	62%	14%	11%	48%	25%

χ^2 probability for distribution of change/no change at asset levels less than $500 000 and $1m or more compared to $500 000 to $999 999 is less than 0.000001% for all changes and for each type of change.

The average value of the assets of farm businesses which both train and make changes to practice is higher than the average of other farm businesses. Those which neither train nor make changes have a significantly lower average value of assets than those which make changes (Figure 22).

Figure 37 Average value of assets and training and change (AFS)



2.5.5 Indebtedness

Farm businesses with no debt are less likely to make any type of change than farm businesses with equity between 76% and 99% (Table 24). Farms with equity of more than 50% and up to 75% are more likely to make all types of change. The small proportion of farm businesses with equity of 50% or less have a likelihood of making a change that bears more resemblance to the 76% to 99% equity group than the next lowest equity group. If this group is excluded, the probability of making a change falls as equity rises.

Approximately one quarter of Australian farm businesses are debt free. Almost half of these have made no change to their practice to improve profitability in the last three years (Table 24).

Table 26 Equity and type of change to practice (AFS)

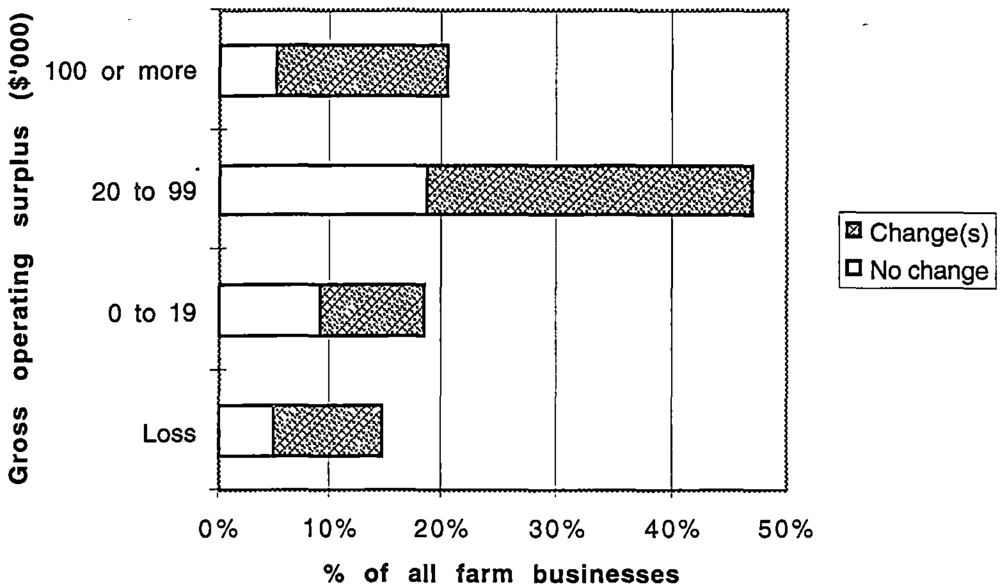
Type of change / Equity	Financial change	Marketing change	Agricultural change	Land management change	No change	% of all farms
50% or less	19%	15%	49%	21%	36%	6%
51-75%	22%	20%	60%	32%	25%	14%
76-99%	14%	11%	48%	26%	37%	56%
100%	7%	6%	41%	17%	47%	24%
All	14%	11%	48%	25%	38%	

χ^2probability for distribution of change/no change for equity categories compared to 76-99% is less than 0.000001% in aggregate and for all four types of change.

2.5.6 Profit

Australian farm businesses which make a small, but positive, profit are less likely to make a change than more profitable farms, and those making a loss. Half of farm businesses with a positive gross operating surplus of less than $20 000 have made no change to practice to improve profitability in the last three years. In contrast, only one quarter of farm businesses with a gross operating surplus over $100 000 have made no change to practice (Figure 23).

Figure 38 Profit and changes to practice (AFS)



χ^2probability for distribution of 'change/no change' for other profit categories compared to $20 000 to $99000 is less than 0.000001%.

The average gross operating surplus for those farm businesses which made at least one change to practice is $70 621, which is statistically significantly higher than the average of $49 240 for those which have made no change in the last three years (AFS data, see Table 25). The Tasmanian data confirms that businesses which make a change have a higher profit.

Table 27 Gross operating surplus and changes (AFS and Tas survey)

	Agricultural Financial Survey	%	Tasmanian survey	% #
Change	$70 621*	62%	$60 390*	82%
No change	$49 240*	38%	$11 096*	18%

Difference significant at the 90% level.
#Number sampled=50

Farm businesses making a loss make changes to practice at a rate between that of the two highest profit categories. For farm businesses with a positive gross operating surplus, the likelihood of making a change increases as profit increases for all four change types, see Table 26.

Table 28 Profit and changes to practice (AFS)

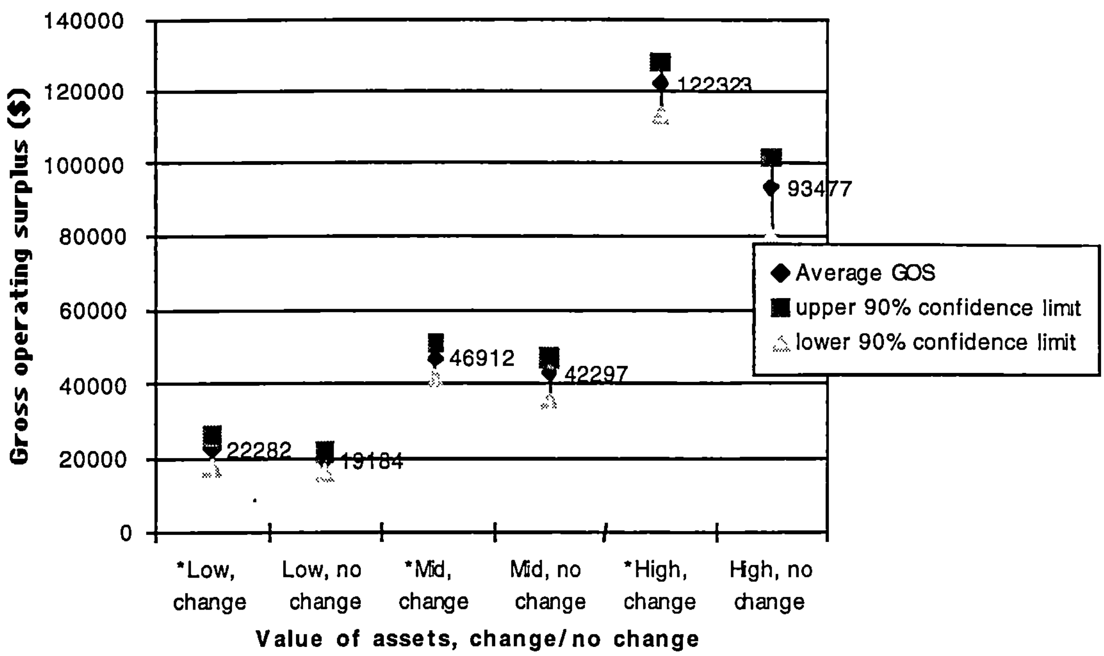
Type of change / Gross operating surplus ($'000)	All changes	Financial change	Marketing change	Agricultural change	Land management change
Loss	66%	14%	9%	50%	29%
0 to 19	50%	9%	8%	36%	16%
20 to 99	61%	12%	10%	46%	24%
100 or more	75%	24%	17%	62%	30%
All	62%	14%	11%	48%	25%

χ^2 probability for distribution of change/no change at each profit category compared to $20 000 to $99 000 is less than 0.000001% for all changes and for each type of change.

As noted in section 2.5.4 above, farm businesses with a higher value of assets are more likely to make changes to practice. Value of assets and profit can be expected to be positively correlated - the larger the business and the more capital improvements the larger the expected profit. The highly significant positive coefficients on value of assets in the multiple regressions discussed in section 1. and in Appendix G confirm this relationship. It may be, then, that the relationship between profit and change is merely a reflection of the relationship between assets and profit. An examination of the relationship between changes to practice and profit within groups of farm businesses of similar asset value will determine if the higher profits earned by those farm businesses which do make changes to practice are solely due to the fact that these farm businesses also tend to be larger, as measured by value of assets.

The average gross operating surplus is greater for those farm businesses which make a change than for those which do not for each of the three asset categories, but the difference is statistically significant only for farm businesses with assets value at $1 million or more (see Figure 24).

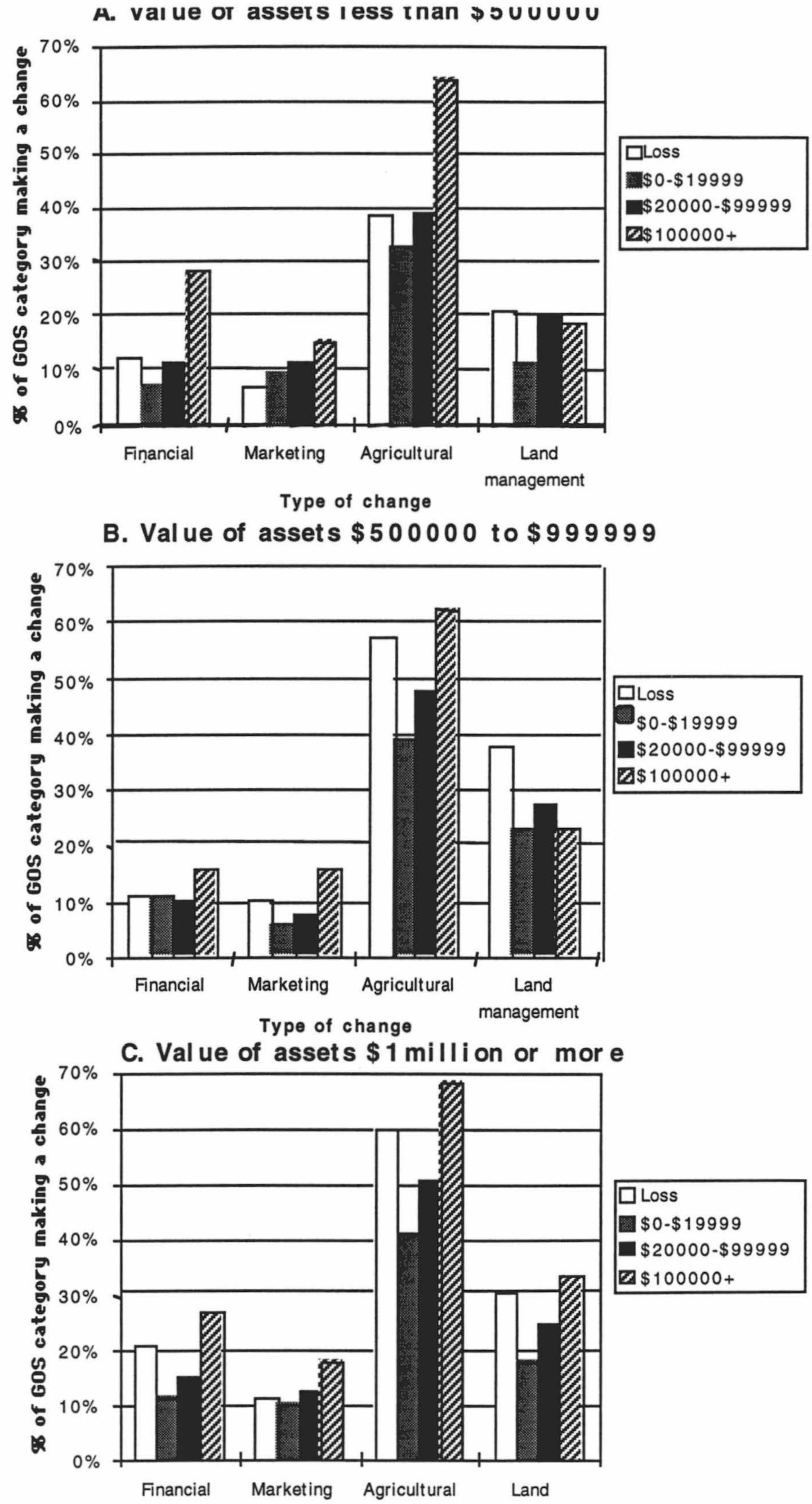
Figure 39 Change, value of assets and average profit (GOS) (AFS)



**Low value of assets: less than $500 000, mid value of assets: $500 000 to $999 999, high value of assets: $1 million or more.*

When farm businesses are compared to others with similar value of assets, more farm businesses earning a gross operating surplus of $100 000 or more make financial, marketing, agricultural and land management changes than those with lower gross operating surpluses. Farm businesses which make a loss tend to make each type of change at a rate similar to businesses with larger gross operating surpluses, rather than the rate of change of those making a small positive profit (see Figure 25 A, B and C). Farm businesses which make a small, but positive, gross operating surplus appear to behave in a way which is different from other farm businesses. There is no obvious reason for their different behaviour, although it could be speculated that these farm businesses are more risk averse than other businesses. That is, they are less likely to make a change which could result either in a larger profit, or in a loss.

Figure 40 Type of change and profit by value of assets (AFS)



χ^2probability for distribution of change/no change is less than 0.0001% for each type of change.

2.5.7 Contribution to Australian farm profit

The 29% of Australian farm businesses with assets of less than $500 000 contribute only 10% of total farm profit as measured by gross operating surplus (GOS), while the 36% of farm businesses with assets of $1 million or more contribute 65% of the total (see Table 27). Whilst small asset value farms which make no changes to practice make up 14% of all farm businesses, they represent only 4% of total farm profit. The pattern of contribution to gross operating surplus is similar to the pattern of contribution to total turnover and to the value of farm production (see Australian Bureau of Statistics, 1995).

Table 29 Contribution to Australian farm profit by assets and change (AFS)

Value of assets Change status	Low (less than $500 000)	Mid ($500 000 to $999 999)	High ($1 million or more)	All farm businesses
Change				
% of GOS	6%	16%	48%	70%
% of farms	*16%*	*22%*	*25%*	*62%*
No change				
% of GOS	4%	9%	17%	30%
% of farms	*14%*	*13%*	*11%*	*38%*
All				
% of GOS	10%	25%	65%	
% of farms	*29%*	*35%*	*36%*	

Note: totals may not tally due to rounding.

2.5.8 Number of changes and profit

The Tasmanian survey allows consideration of the number of changes to practice in a three year period. Making less than two changes or making more than five changes are both associated with lower profitability. Those farm businesses that made between two and five changes over three years to their farming practice have a significantly higher gross and cash operating surpluses.

Those making one or no change to farming practice are less likely to have an increasing or stable cash operating surplus over the three year period than those making two or more changes (this result is highly statistically significant at the 0.001% level).

Making between two and five changes to practice is significant in increasing profit in multiple regressions (see Appendix G). Whilst making between two and five changes has a significant, positive impact on both profit measures for the sample as a whole. The only industry in which the number of changes is significant is the crop industry (Table 28).

Table 30 Changes to practice and profit (Tas survey)

A.

Number of changes to practice over 3 years	Number of farms	Average gross operating surplus	*90% upper confidence limit*	*90% lower confidence limit*
Less than 2	11	$10 794*	*$21 082*	*$507*
2 to 5	31	$63 591* **	*$87 927*	*$39 256*
More than 5	12	$33 756	*$52 783*	*$14 730*

B.

Number of changes	Cash operating surplus	Number
All industries		
0 to 1	$ 4 548	11
2 to 5	$39 357**	31
More than 5	$19 439	12
Crop		
0 to 1	$-4 179	4
2 to 5	$47 995* **	13
More than 5	$ 9 603	7

* *Difference is significant at the 90% confidence level.*
** *Difference is significant in multiple regressions.*

2.6. Prompts for change

2.6.1 Triggers - Agricultural Financial Survey

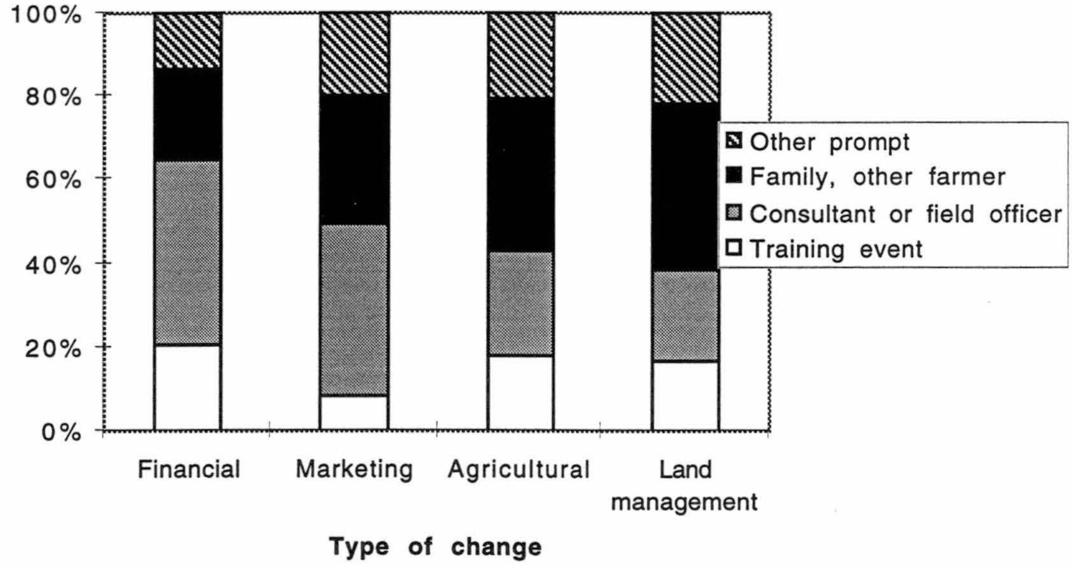
Farm businesses were asked what prompted the change rated as most important to improve the profitability of the farm. Table 29 shows that other farmers are the most frequently cited prompt, followed by 'training event', (including field days) family and staff and various classes of expert advisers. A large number of the 'other' prompts are specified as 'self', 'own idea' or 'no one'. External events such as drought, flood, hail and fire and other reasons including worn out equipment and retirement of a share farmer make up the 'other' category.

Table 31 Prompts for change to practice (AFS)

Prompt	% of changes
Other farmers	18%
Training event	17%
Family or staff	13%
Agricultural companies	7%
Consultants (inc financial)	8%
Government agencies	6%
Industry organisations	7%
Land management groups	2%
Media	2%
Financial reasons	3%
Other	18%

Financial and marketing changes are most likely to be prompted by consultants, field officers, bank personnel or other expert advisers. Agricultural and land management changes are most likely to be prompted by other farmers or family. Training, including informal learning events such as field days, prompt 20% of financial changes, 18% of agricultural changes and 17% of land management changes (see Figure 26).

Figure 41 Prompts for change by type of change (AFS)

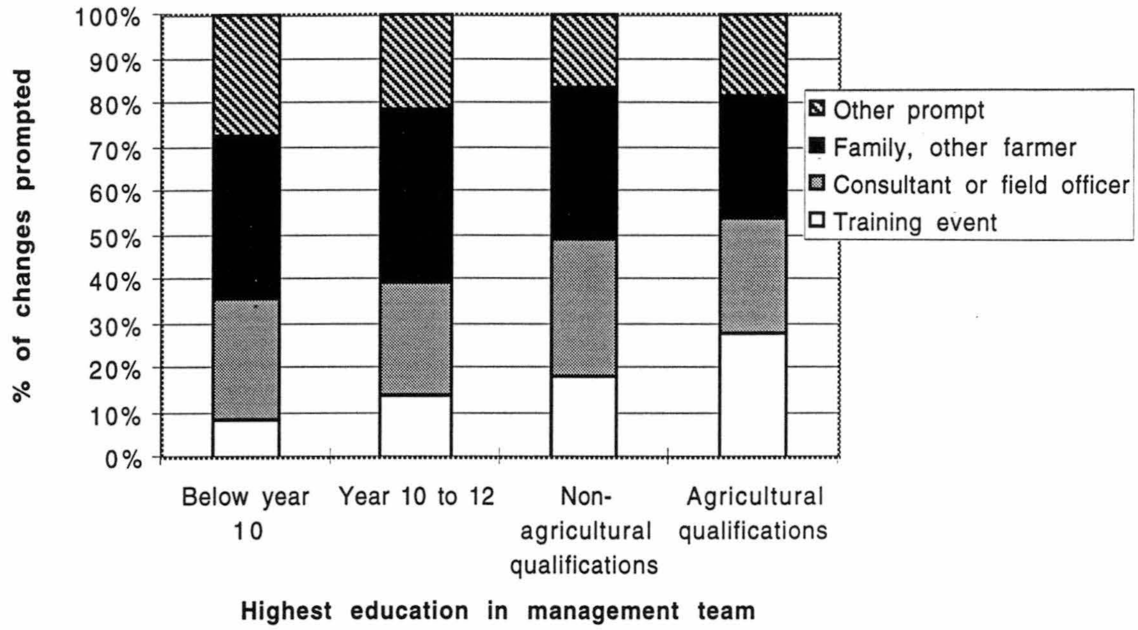


χ^2 distribution of prompts within each type of change compared to each other type of change is less than 0.00001%.

2.6.2 Prompts and education

Family, staff and other farmers are relatively more important in prompting change for farm businesses with no post-school educational qualifications in the management team. Those with only below year 10 qualifications are the most likely to have 'other' prompts for change, many of which are 'self' or 'none'; others are external events such as drought. Training events prompt relatively more changes for those with post-school qualifications, while experts (consultants and field officers) prompt the smallest proportion of changes for farm businesses with agricultural qualifications (see Figure 27).

Figure 42 Highest education level in management team and prompt for change (AFS)



χ^2 probability for distribution of prompt categories compared to Year 10 to 12 is less than 0.000001% for each education level.

2.6.3 Prompts, assets, managers and equity

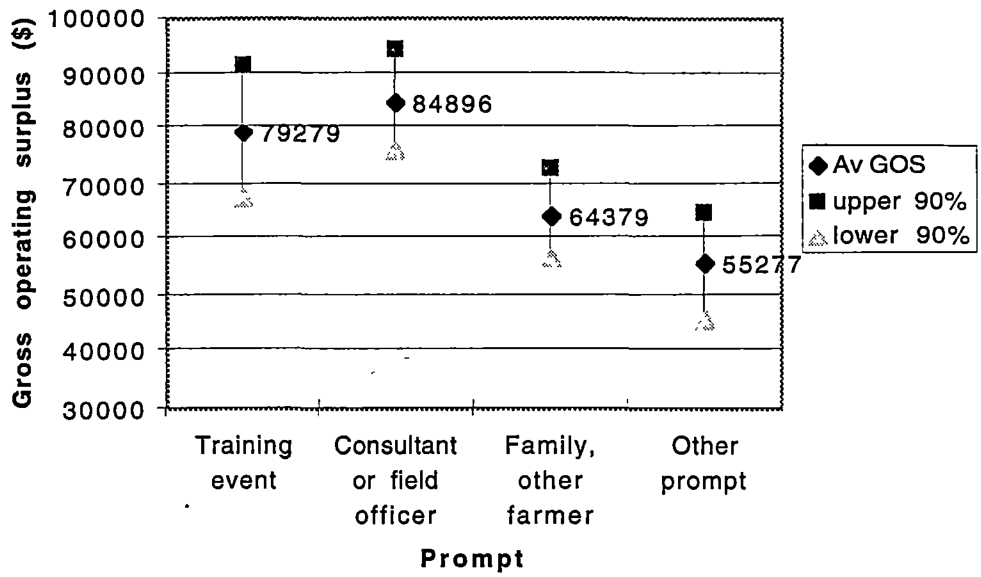
Farm businesses with assets of $1 million or more are less likely to make changes prompted by family or other farmers than smaller farm businesses, and more likely to be prompted to change by training events (Table 30). Single manager farm businesses are more likely to be prompted by 'other' prompts than those with larger management teams, as are farm businesses with no debt. Dual manager farms are least likely to be prompted to change by a training event. The proportion of changes prompted by expert advisers (such as consultants) declines as equity rises.

Table 32 Prompts, assets, managers and equity (AFS)

Prompt / Assets	Less than $500 000	$500 000 - $999 999	$1million or more
Training event	16%	15%	19%
Consultant or field officer	25%	26%	29%
Family, staff, other farmer	38%	41%	30%
Other prompt	20%	18%	22%
χ^2 probability compared to $500000-$999999 to 4 decimal places	*0.0000%*	-	*0.0000%*
Prompt / Number of managers	**One**	**Two**	**Three or more**
Training event	19%	14%	21%
Consultant or field officer	24%	27%	30%
Family, staff, other farmer	25%	39%	37%
Other prompt	31%	20%	12%
χ^2 probability compared to 2 managers to 4 decimal places	*0.0000%*	-	*0.0000%*
Prompt / Equity	**75% or less**	**76% to 99%**	**100%**
Training event	15%	18%	16%
Consultant or field officer	35%	26%	22%
Family, staff, other farmer	35%	35%	38%
Other prompt	16%	21%	24%
χ^2 probability compared to 76-99% to 4 decimal places	*0.0000%*	-	*0.0000%*

Farm businesses whose most important change is prompted by expert advisers such as consultants have a significantly higher average gross operating surplus ($84 896) than those whose most important change is prompted by family, other farmers ($64 379) or 'other' prompts ($55 277) (which includes 'self', etc.). Farm businesses making a change prompted by training events also have a higher average gross operating surplus ($79 279) than those whose main change has 'other' prompts (see Figure 28).

Figure 43 Average gross operating surplus and prompt (AFS)



2.6.4 Source of awareness for change (Tasmanian survey)

The Tasmanian survey provides more information about influences on the decision-to-change process for the changes identified by the farmers as the two most important changes made in the farm business in the past three years. Farmers were asked how they became aware of the strategy, action or technology, what other factors influenced them to change, and the critical factor or trigger, in making the decision to change.

'Other farmers' are the most common source of initial information about a new strategy, action or technology. They are the channel via which one quarter of farmers become aware of strategies, actions and new technologies subsequently become changes. Training events are the source of awareness for 19% of changes and 'expert advisers' (including government agencies, private consultants and field officers of output purchasers and input suppliers) the source of awareness for 22% (see Table 31).

Table 33 How farmers become aware of important changes (Tas survey)

Source of awareness	Number of changes	% of changes
Other farmers	28	26%
Experts*	26	24%
Always known it was possible**	17	16%
Field day	11	10%
A course	10	9%
The media	9	8%
Family member	8	7%
Total	**109**	**100%**

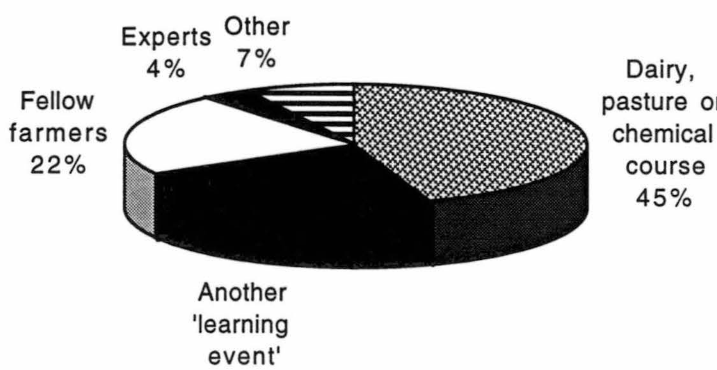
*Experts include Government agency, Input supplier, Output purchaser's field officer, Private consultant and Industry organisation.

**Examples of "always known it was possible" are:

- We had decided to go into dairying, so we needed a dairy (change was building a dairy).
- The old tractor kept breaking down and was expensive to repair - I've always known it was possible to buy a new one!
- We've always known the farm was suitable for Jerseys and that people wanted them for house cows.

Changes influenced by 'courses' are analysed separately (course-influenced changes ranked the two most important are included in both groups). Section 2.4.4 above reports the role of the three courses in the change decision process. The most common sources of awareness for the course-influenced changes apart from the courses are peers (other farmers) and other learning events. Figure 29 summarises sources of awareness for course related changes.

Figure 44 Sources of awareness for changes influenced by courses (Tas survey)



Number sampled=27

2.6.5 Other influences on the decision to change (Tasmanian survey)

Other farmers are the most often reported influence in making the decision to change practice (37% of changes). The next most reported influences (24%) are government agencies (for example, the Department of Primary Industries and Fisheries and Tasmania Development and Resources) and the media (23%). The need for extra income and higher production which leads to extra income are influences for 35% of changes. Income and production were not listed as categories on the questionnaire, so were reported under the category "other". 'Income' and 'production' responses are not to be confused with higher costs or lower product prices, both of which were listed as possible responses on the questionnaire.

The ranking of other reported influences (Table 32) is similar to the ranking of sources of awareness, presented above in Table 33.

Table 34 Other influences for two most important changes (Tas survey)

Influence	Number of changes	% of changes influenced
Other farmers	40	37%
Government agency	26	24%
More income or financial survival	25	23%
The media	25	23%
Field day	23	21%
Input supplier	21	19%
Other external factors	18	17%
Low product price	18	17%
Course	18	17%
Output purchaser's field officer	14	13%
Increase production	13	12%
Reduce workload	13	12%
High costs	13	12%
Family	13	12%
Climate	12	11%
Land degradation or run down land	9	8%
Industry organisation	8	7%
Private consultants	6	6%
Another change made	8	7%
Employees	4	4%
Other	7	6%
Total number of influences	**334**	

Note: For some farmers a factor category occurs in both the 'aware' and the other influences fields. An example is where the farmer became aware of the strategy from other farmers, and either different farmers influenced the decision to change or the same farmer(s) influenced the decision to change in other ways.

The other influences for course-influenced changes are similar, with experts, fellow farmers and other training events ranking highest.

2.6.6 Triggers (Tasmanian survey)

For many of those surveyed identifying the critical factor in going ahead with a change, or the trigger to change, required some considerable thought. However, after some time for reflection, all were able to name one critical factor.

The most frequent triggers to change are the need or desire for extra income and higher production which generates extra income (32% of changes). This is consistent with either a traditional economic profit maximisation goal or with a lifestyle goal, given that achieving many lifestyle goals, such as holidays or better education for children, requires money. Reducing workload, which is also related to lifestyle goals, is the critical factor in 8% of changes.

Land degradation or improving a run down farm is the third most frequent trigger, but is the critical factor for only 9% of changes (Table 33).

Table 35 Triggers for the two most important changes (Tas survey)

Trigger	Number of changes	% of changes triggered
More income or financial survival	23	21%
Increase production	12	11%
Land degradation or run down land	10	9%
Reduce workload	9	8%
External factors	9	8%
High costs	8	7%
Family or staff	6	6%
Another change made	5	5%
Low prices	5	5%
Climate	4	4%
Other farmers	4	4%
Input supplier	4	4%
Government agency	2	2%
Course	2	2%
Field day	2	2%
Output purchaser's field officer	2	2%
The media	1	1%
Private consultants	1	1%
Total changes	**109**	

The distribution of responses in Table 35 differs from Table 31 Prompts for change to practice (AFS). This is particularly in the proportion giving financial reasons, which is only 3% for the AFS data, but 33% for the Tasmanian data if 'more income or financial survival', 'high costs' and 'low prices' are combined, and 44% if 'increase production' is assumed to be ultimately for financial reasons.

The AFS question asked "Which of the following prompted you to make that change?" and provided a list of possible responses (not including financial reasons) and an 'other' option. The possible responses are those appearing in Table 31, except that 'training event' was divided into formal courses, other courses and other training including field days. This question followed immediately after one asking for the most important change made.

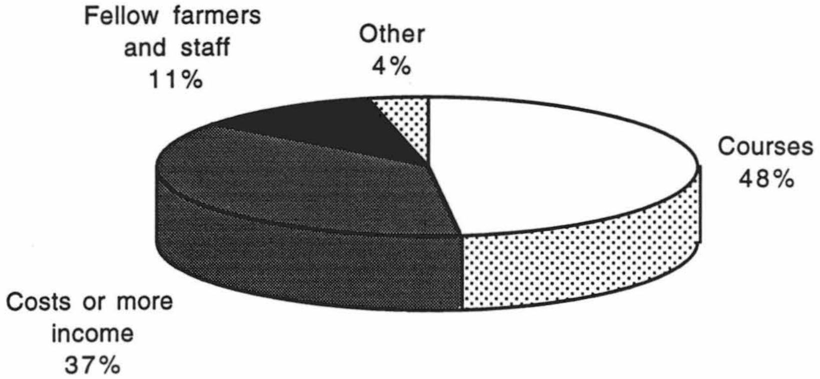
The Tasmanian semi-structured interview asked "What was the factor which was the most critical in making your decision to go ahead with the change?", after questions relating to how the respondent first became aware of the strategy/action/new technology?, and what were the other factors which influenced them to make the change?

The questions are thus not identical. The AFS question suggests possible responses, which do not include financial reasons. The Tasmanian survey respondents were encouraged to think about the whole decision process before giving the critical factor. The Tasmanian results may thus be more accurate in identifying 'the critical factor', while the AFS results give information about the most important of the listed possible prompts for change. These prompts could be described as sources of information or advice, as distinct from the critical factors in making a change which come from the Tasmanian interview survey.

2.6.7 Triggers for course-influenced changes

A 'course' was the trigger, or the critical factor in the decision to make the change in almost half of the course-influenced changes, followed in frequency by income and cost reasons (see Figure 30).

Figure 45 Triggers for course-influenced changes (Tas survey)



Number sampled=27

2.7. Training, change and profit

Farm businesses which both train and make changes to practice have a higher average gross operating surplus ($73 170) than other farm businesses ($55 335). Those which attend training other than field days have an even higher average gross operating surplus ($83 651). Farm businesses which neither train nor make any changes to practice have a significantly lower average gross operating surplus ($31 580) than other farm businesses. Figure 31 shows the average gross operating surplus and 90% confidence limits for various combinations of training and change behaviour. Table 34 gives the proportion of farm businesses in each category.

Figure 46 Profit and training and change (AFS)

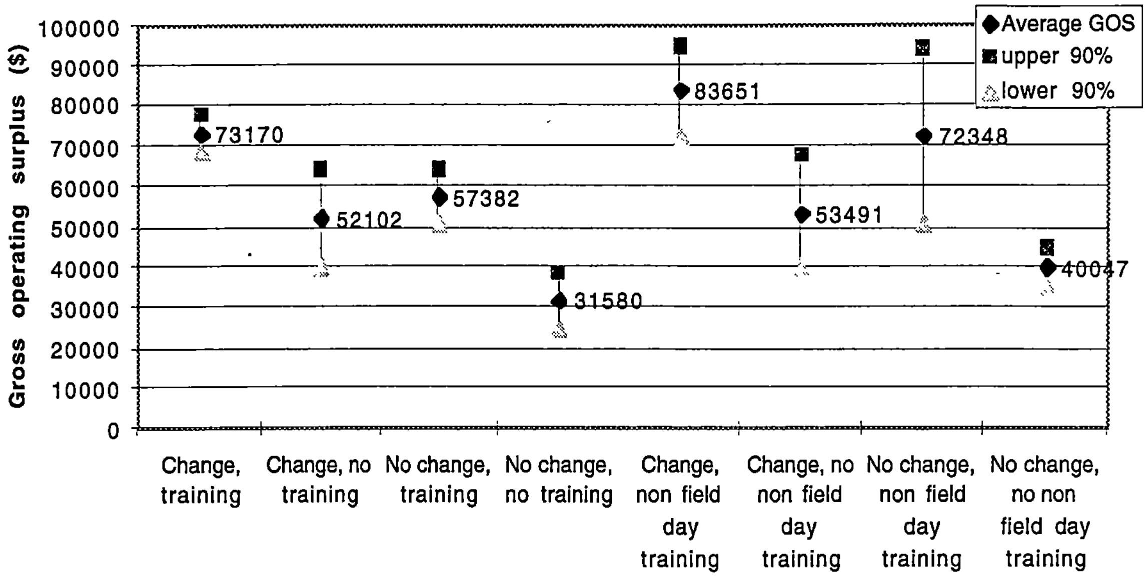


Table 36 Proportions of farm businesses by training and change (AFS)

Change and training	55%
Change, no training	8%
No change, training	26%
No change, no training	12%
Change and non field day training	35%
Change, no non field day training	27%
No change, non field day training	11%
No change, no non field day training	27%

2.7.1 Contribution to total farm profit

Farm businesses which both train and make changes to practice represent 55% of all farm businesses (Table 36), but contribute 64% of total farm profit (gross operating surplus), see Table 35. The 12% of farm businesses which neither train nor make changes to practice contribute only 6% to farm profit.

Table 37 Contribution to total farm profit by training and change behaviour (AFS)

Training and/or change	Contribution to total farm profit
Training and change	64%
Training, no change	24%
No training, change	6%
No training and no change	6%

An alternative breakdown of the data shows that those farm businesses which attend training events other than field days, and also make changes to their practice contribute 47% of total farm profit.

2.7.2 Tasmanian courses, changes and profit

The profit, measured by the gross operating surplus for the full financial year before the survey, of the farm business which attended one of the survey three courses, is significantly higher for those which make a course-influenced change to practice (Table 36, and see also section 2.4.4 Tasmanian courses and changes to practice).

Table 38 Course participants, course influenced change and profit (Tas survey)

	Made course-influenced change	Remainder of course sample	Non-course sample
Average gross operating surplus	$ 76 697	$ 34 541*	$ 26 993*
T test probability compared to course influenced change group		0.07488	0.0195
Number with financial data	23	11	16

* *Difference compared to average GOS of course-influenced change group is significant at 90% level.*

3. What are the support mechanisms or who are the people who mentor farmers as change is undertaken?

3.1. Agricultural Financial Survey

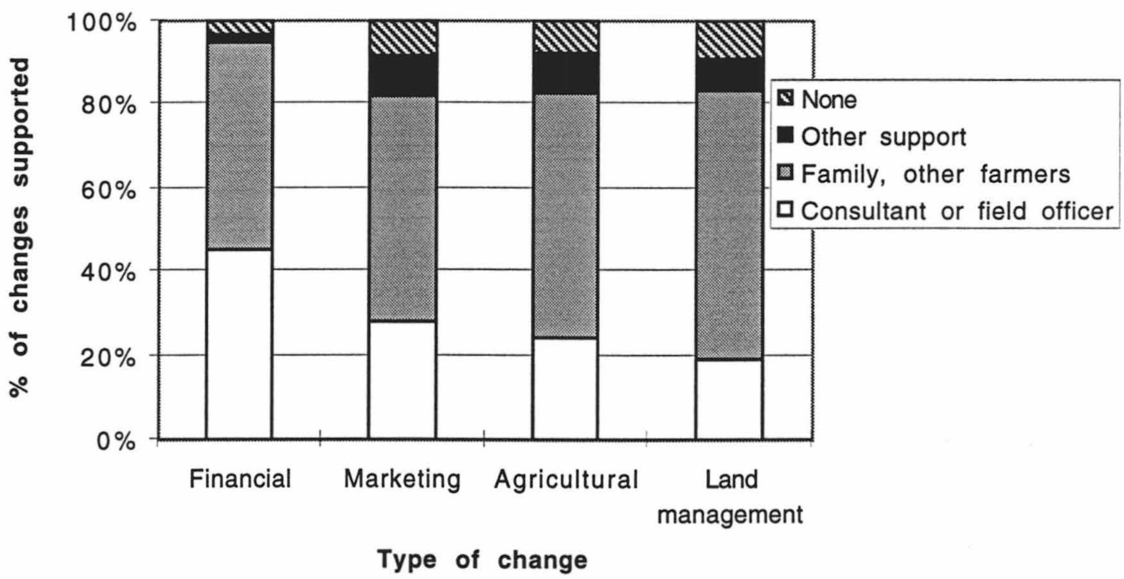
Respondents were asked "who has provided you with the most support in implementing the change identified as the most important for improving the profitability of the farm made in the last three years?" Those close to the management team or decision maker(s) are most likely to fill this role. Family or staff are the most common providers of the most support in making a change to practice (41% of farm business changes), followed by other farmers (18%). Expert advisers of various types provide the most support for making the change for 26% of farm businesses (see Table 37). Only 8% could not identify any source of support.

Table 39 Sources of support for most important change (AFS)

Source of support	% of changes
Family or staff	41%
Other farmers	18%
Consultants (inc financial)	10%
Government agency	8%
Industry organisations	8%
Land management groups	3%
Other	4%
None	8%

Family and other farmers are the most frequently cited source of support for all types of change. Consultants (including financial consultants) are more likely to be the main source of support for financial change than any other type of change (Figure 32).

Figure 47 Sources of support when making a change (AFS)



χ^2probability for distribution of sources of support within each type of change is less than 0.00001% for each type of change compared to each other type of change.

3.1.1 Support, financial and other characteristics

Larger farm businesses with assets of $1 million or more and those with gross operating surplus of $100 000 or more are more likely to be supported in making a change by experts such as consultants or field officers than other farm businesses. Single manager farm businesses are more likely to make changes with no support than other farm businesses. Farm businesses with 75% or lower equity are more likely than other farm businesses to cite expert advisers such as consultants as the main source of support (see Table 38 to Table 41).

Table 40 Source of support and profit (AFS)

Gross operating surplus / Support source	Loss	\$0-\$19999	\$20000-\$49999	\$100000 or more
Consultant or field officer	23%	21%	23%	32%
Family, other farmers	56%	58%	60%	58%
Other support	15%	6%	9%	6%
None	6%	14%	7%	4%
All farm businesses	15%	18%	47%	20%
χ^2 compared to \$20000 to \$99999 to 4 decimal places	*0.0000%*	*0.0000%*	-	*0.0000%*

Table 41 Source of support and assets (AFS)

Value of assets / Support source	Less than \$500000	\$500000 to \$999999	\$1million or more
Consultant or field officer	21%	22%	30%
Family, other farmers	65%	58%	56%
Other support	8%	12%	7%
None	7%	8%	7%
All farm businesses	29%	34%	37%
χ^2 compared to \$500000-\$999999	*3.715E-190%*	-	*3.904E-211%*

Table 42 Source of support and managers (AFS)

Number of managers / Support source	One	Two	Three or more
Consultant or field officer	22%	28%	23%
Family, other farmers	51%	56%	68%
Other support	11%	9%	7%
None	17%	7%	2%
All farm businesses	23%	51%	26%
χ^2 compared to 2 managers to 4 decimal places	*0.0000%*	-	*0.0000%*

Table 43 Source of support and equity (AFS)

Equity / Support source	75% or less	76 to 99%	100%
Consultant or field officer	30%	24%	24%
Family, other farmers	61%	57%	59%
Other support	4%	10%	10%
None	5%	9%	7%
All farm businesses	20%	56%	24%
χ^2 compared to 76-99% to 4 decimal places	*0.0000%*	-	*0.0000%*

3.2. Tasmanian survey

Support from others in making a decision to change was reported for 81% of changes. The Tasmanian survey asked respondents to nominate all sources of support in making a change, and to give the chronological sequence in which those sources were used, not a ranking of sources of support. The chronological sequence in which the sources are used varied widely and with no apparent pattern. More than one source of support was used in implementing over half of the changes (Table 42).

Table 44 Frequency of use of nil, one, and multiple sources of support (Tas survey)

Number of sources of support	Number of changes	% of changes
0	21	19%
1	26	24%
2	31	28%
3 or more sources	31	28%
Total changes	109	

Sources of support are classified into two categories; emotional and social support from those close to the farmer, for example family members and other farmers, and technical or economic support from 'expert' sources. Each category was used in 61% of changes (see Table 43).

Table 45 Sources of support for the two most important changes (Tas survey)

Support source	Number of changes	% of changes
Family	43	39%
Other farmers	37	34%
Farm owner	5	5%
Employee	4	4%
Emotional and social support	**66**	**61%**
Private consultant	31	28%
Government agency	26	24%
Input supplier	23	21%
Output purchaser's field officer	21	19%
Industry organisation	6	6%
Course	3	3%
'Expert' support	**66**	**61%**
No source of support	**22**	**20%**
Total changes made	109	

n=57 farm businesses
More than one source of support could be nominated.

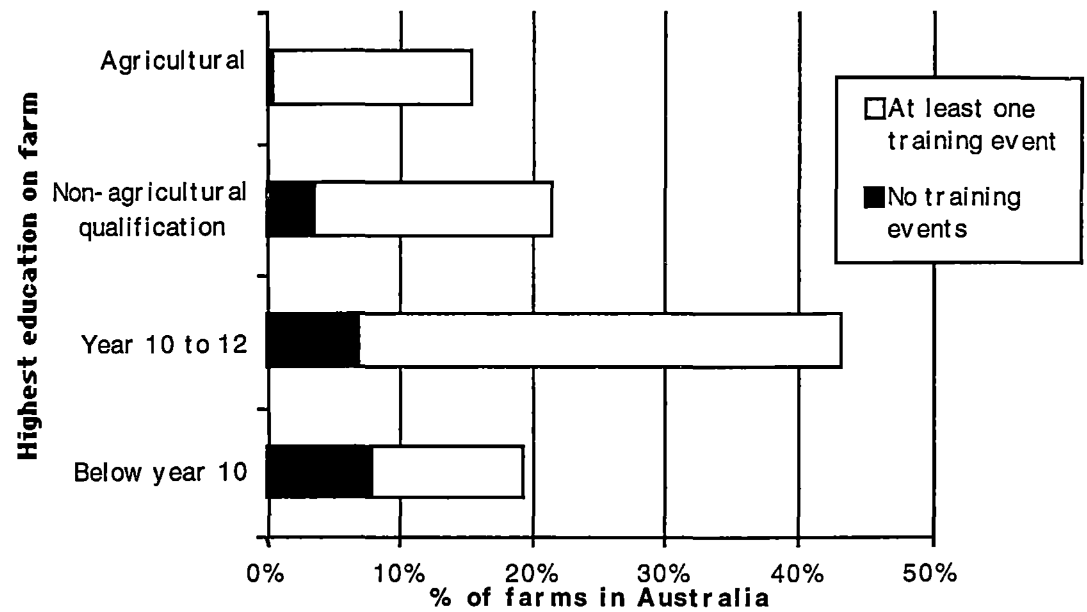
4. What are the reasons which foster farmer, and their workforce, participation in training?

4.1. Education as a barrier to training

From the Australian Bureau of Statistics' Agricultural Financial Survey data, farm businesses with no manager who had completed year 10 schooling are least likely to participate in training, followed by others with no post school qualifications.

Figure 33 shows that the those with less than year 10 education form the largest group of non-trainers, followed by those without post school qualifications. The below year 10 group are 42% of all non trainers, yet make up only 19% of all farm business.

Figure 48 Education and participation in training (AFS)



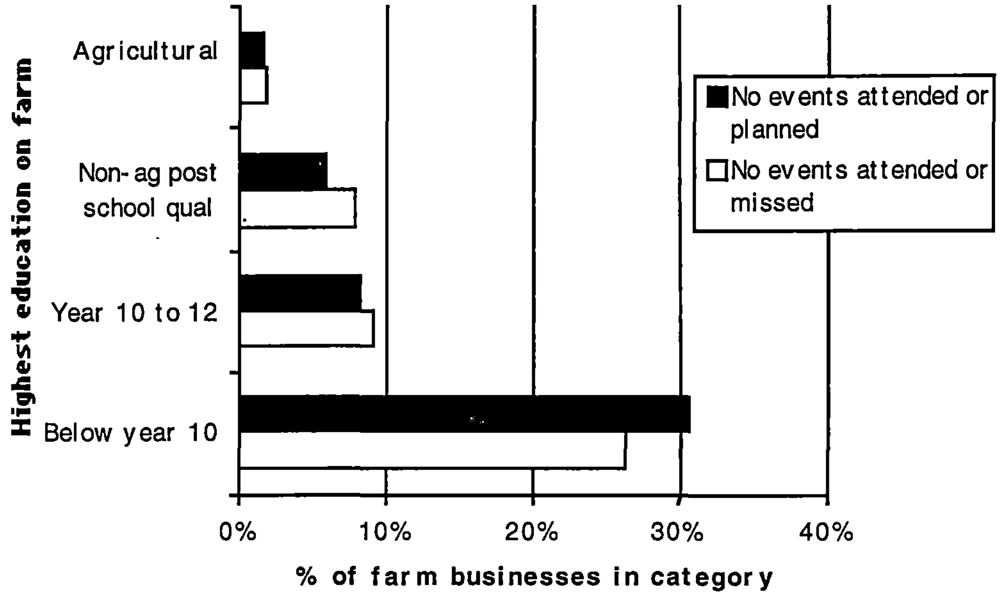
χ^2 distribution probabilities that the proportion of each education group attending training is the same as for the year 10 to 12 group is less than 0.00001% in each case.

4.1.1 Does education foster further training?

Forty-one percent of all farm businesses identified at least one training event they would have liked to attend, but did not. These farm businesses tended to have more educated management teams than farm businesses which could not identify any worthwhile, but 'missed' training events. More than one quarter (27%) of those who missed no events also attended no events in the past 12 months. These farm businesses are 11% of all farm businesses. Those with a low level of education are over represented in this group which identified no training events as worth attending. Twenty-seven percent of farm businesses with no one with year 10 education or beyond fail to identify or attend any desirable training events, compared to less than ten percent of farm business with education beyond year 10.

As well, 31% of farm businesses in the lowest education category attend no training events, and plan no training in the next three years, again compared to less than ten percent of farm businesses with higher education. Figure 34 illustrates these points.

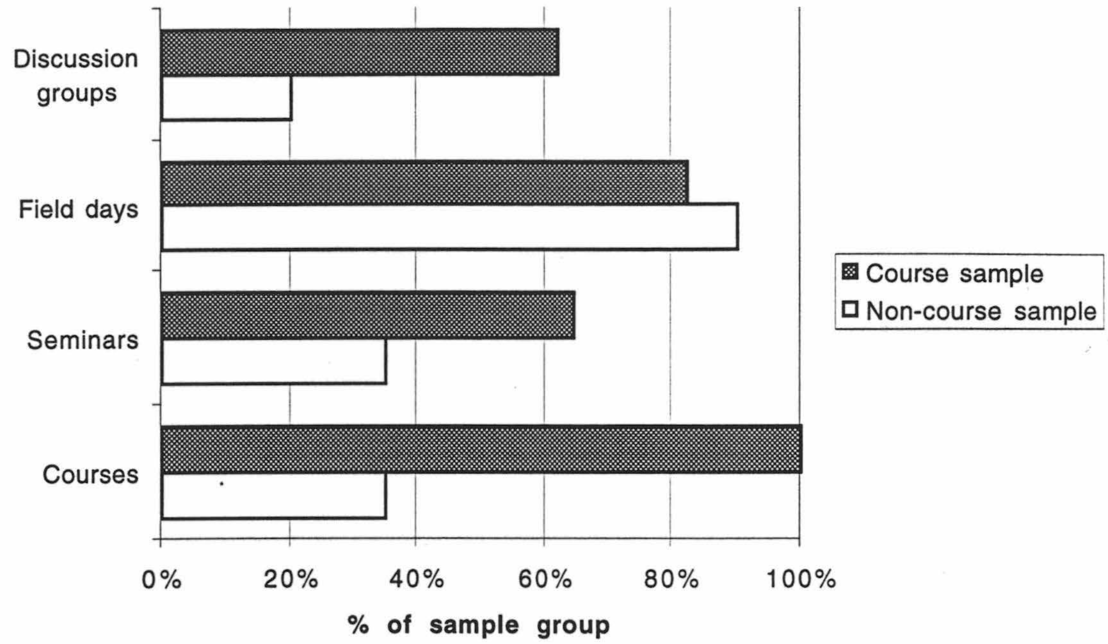
Figure 49 Education, identification of training and training plans (AFS)



χ^2 probabilities that the proportion of each education group not attending or planning training and the proportion not identifying training is the same as for the year 10 to 12 group is less than 0.00001% in each case.

Those farm businesses which attended one of the three Tasmanian courses are more likely to participate in discussion groups and seminars than the non-course sample. The non-course sample is more likely to participate in field days. This result applies to the sample as a whole, to the dairy industry, and to those in other industries. Training 'methods' chosen by the Tasmanian sample are shown in Figure 35.

Figure 50 Course attendance and other training (Tas survey)



χ^2 probabilities for participation/non participation rates of the two sample groups being the same are less than 0.00001% for all types of training,. This is also true when the whole is split into dairy industry and other industries.

4.2. Industry

Grain farm businesses are more likely to have someone attend at least one training event than the average for all industries. Beef farm businesses are less likely to have someone attend (Table 44).

Table 46 Training attendance by industry (AFS)

Industry	% attending no training
Fruit	21%
Vegetable	24%
Grain*	12%
Grain-sheep-beef	17%
Sheep-beef	17%
Sheep	15%
Beef**	30%
Dairy	19%
Pigs	35%
Poultry	19%
Sugar	13%
Cotton	6%
Other	27%
All industries	**20%**

* *Significantly fewer attend no training than the total.*
** *Significantly more attend no training than the total.*
Large standard errors apply to the data from many other industries.

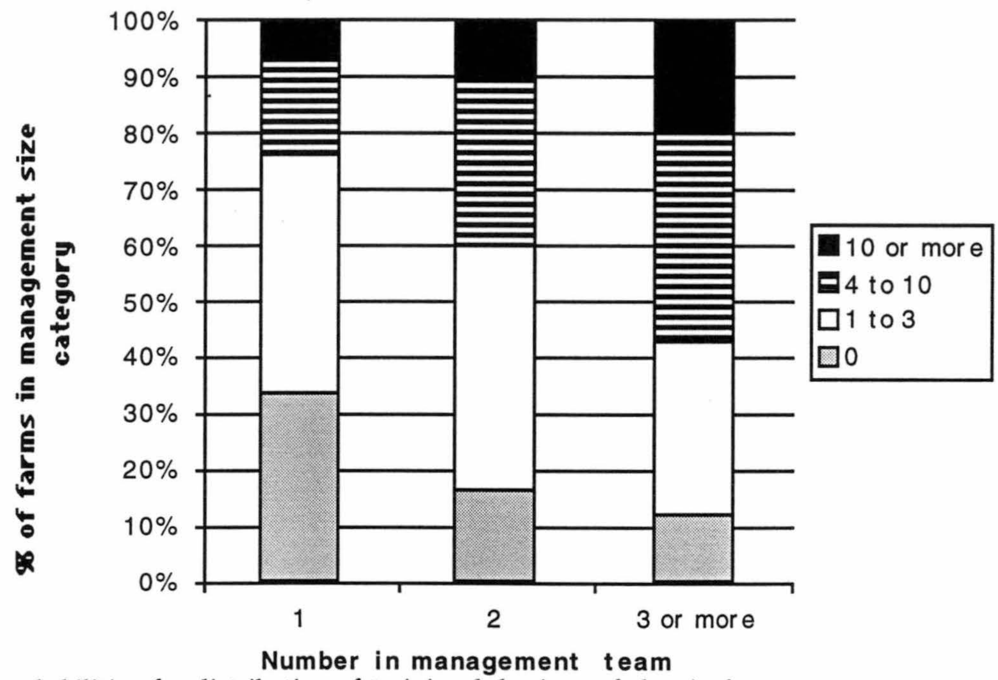
4.3. State

There is no statistically significant difference in the percentage of farm businesses participating in training on a state by state basis.

4.4. Size of management team

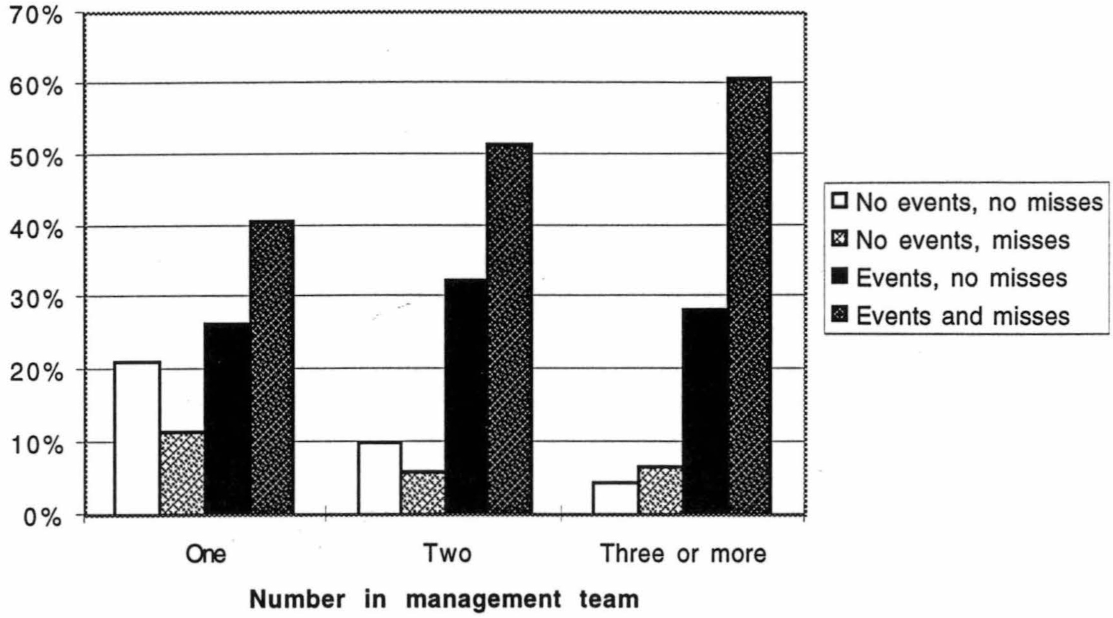
Single manager farms attend less training events than farm businesses with larger management teams (Figure 36). Thirty-three percent of single manager farms attended no training, compared to 12% of farms with 3 or more in the management team. Single manager farms are also less likely to identify training worth attending (Figure 37).

Figure 51 Size of management team and number of training events (AFS)



χ^2 probabilities for distribution of training behaviour of the single manager group compared to the dual manager group and of the 3 or more manager group compared to the dual manager group are both less than 0.00001%.

Figure 52 Size of management team and training identified and attended (AFS)

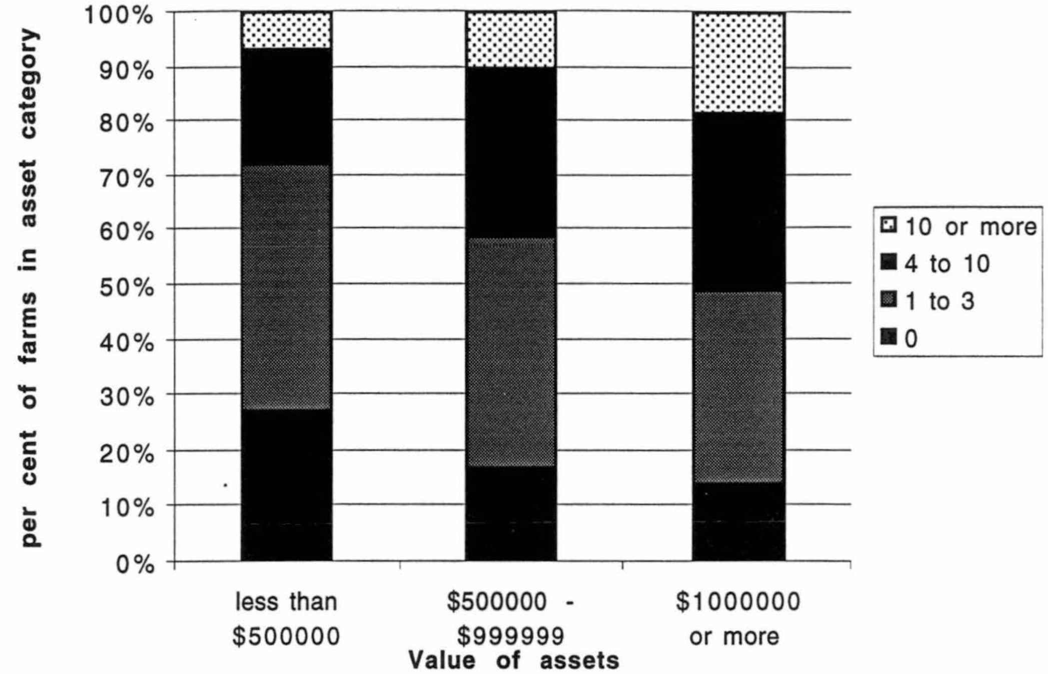


χ^2 probabilities for distribution of training behaviour of the single manager group compared to the dual manager group and of the 3 or more manager group compared to the dual manager group are both less than 0.00001%.

4.5. Value of assets

The higher the value of farm assets, the more courses, seminars, field days and other training events attended by those working in the farm business (see Figure 38). Twenty-seven percent of businesses with assets of less than $500 000 attended no training, compared to only 14% of those with assets of $1 million or more.

Figure 53 Value of assets and number of training events attended (AFS)



χ^2 probabilities for distribution of training behaviour of the low asset group compared to the mid asset group and of the high asset group compared to the mid asset group are both less than 0.00001%.

4.5.1 Assets and training methods

Farm businesses with a higher value of assets are more likely to employ each training method (see Table 45). Field days are the most widely attended type of training for each group, followed by seminars and workshops, conferences and industry meetings and agricultural courses.

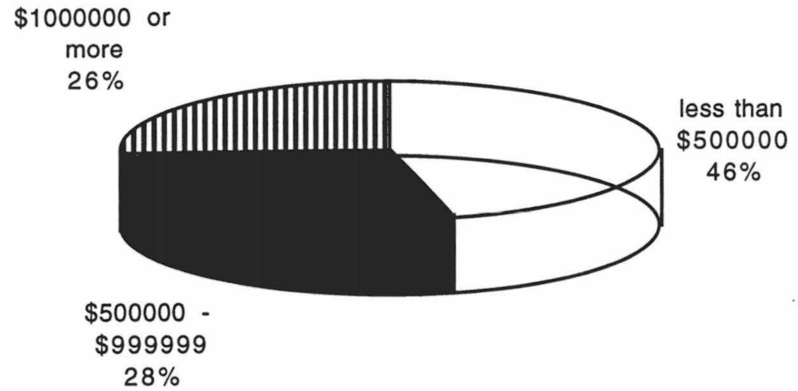
Table 47 Training methods by value of assets (AFS)

Value of assets / Type of training	\$0-\$499999	\$500000-\$999999	\$1 million or more
Field days	68%	79%	82%
Seminars, workshops	25%	40%	48%
Conferences, industry meetings	12%	18%	27%
Agricultural courses	2%	3%	4%
Any training	**73%**	**83%**	**86%**

Probability distribution of training is the same for low and high asset groups compared to the mid group is less than 0.0001%.

Almost half of farms which fail to identify suitable training events are those with assets of less than \$500 000, yet this group represents only 20% of all farms (see Figure 39).

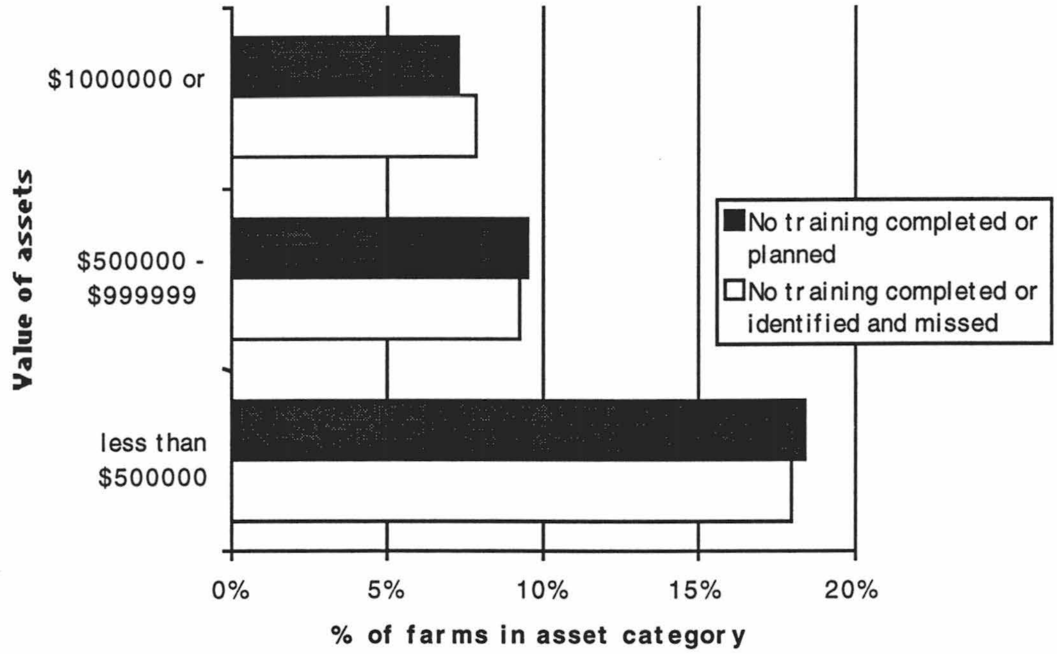
Figure 54 No training events attended or identified, by value of assets (AFS)



χ^2 probability that the proportions are equal is less than 0.00001%

Eighteen percent of low asset farm businesses fail to identify any suitable training opportunities in a 12 month period. The same proportion do not participate in any training events over the year and also plan no training in the next three years. In both cases this compares with less than ten percent of larger farm businesses (Figure 40).

Figure 55 Value of assets, training undertaken, identified and planned (AFS)

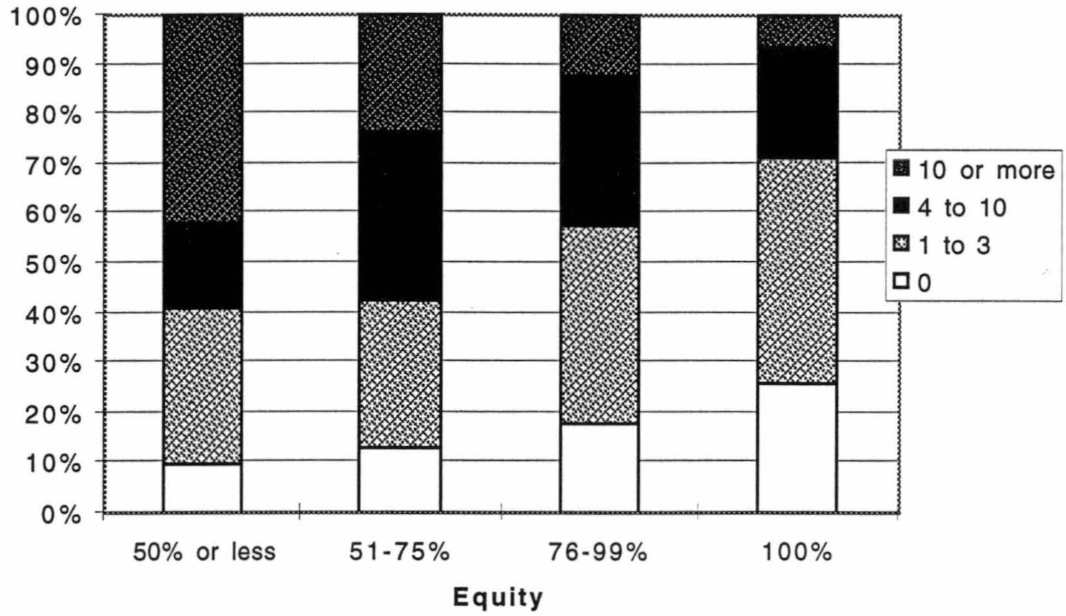


χ^2 probabilities for distribution of training behaviours of the low asset group compared to the mid asset group and of the high asset group compared to the mid asset group are both less than 0.00001%.

4.6. Indebtedness

Farm businesses with no debt attend fewer training events; 71% attend fewer than four in one year compared to 43% of those with equity between 50% and 75% (see Figure 41). Newer entrants to farming are more likely to have debt than those with longer experience.

Figure 56 Equity and number of training events (AFS)

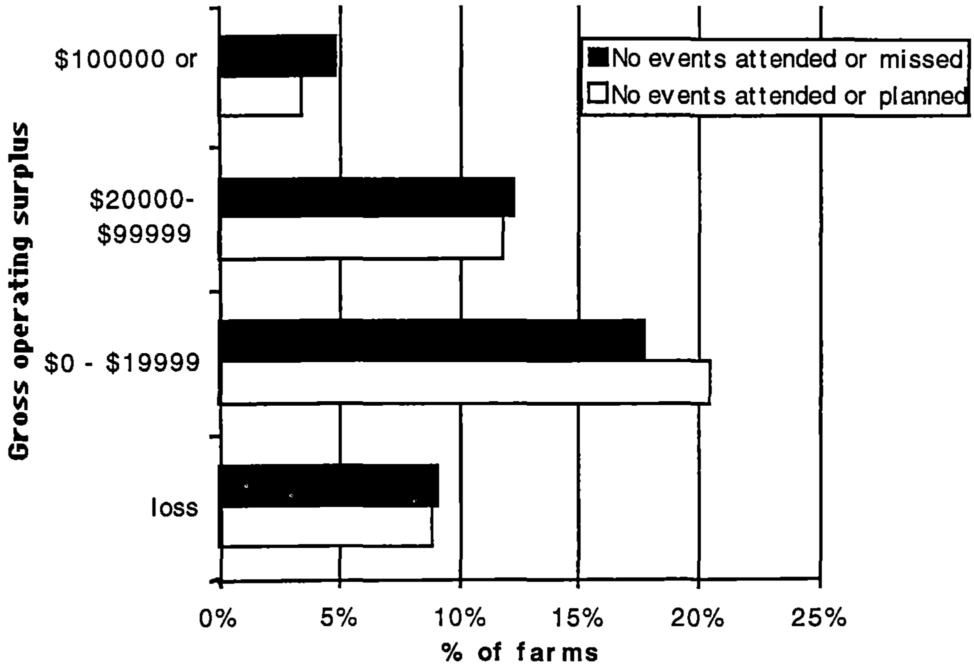


χ^2 probabilities for distribution of training behaviour of the other equity groups compared to the 76-99% equity group are all less than 0.00001%.

4.7. Profit

Farms which are covering costs (interest payments excluded), but making less than $20 000 per year, are least likely to identify and plan training. Those making a loss train and plan training at a similar rate to farms making larger profits (see Figure 42). Agricultural Financial Survey data (Australian Bureau of Statistics, unpublished data) show that farm businesses making a loss have an asset distribution weighted toward the high end of the farm business population as a whole.

Figure 57 Profit and training events (AFS)

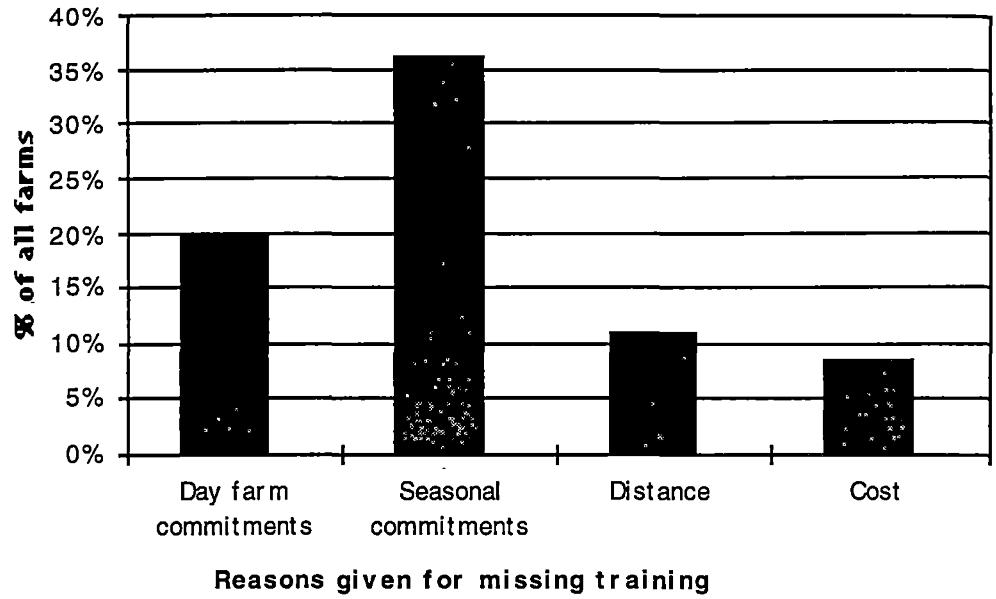


χ^2 probabilities for distribution of training behaviours of the loss, low profit and high profit groups compared to the $20 000 to $99 999 group are all less than 0.00001%.

4.8. Reasons given for not attending

Most reasons given for missing training events relate to on-farm commitments, especially seasonal commitments. Figure 43 shows that 36% of all Australian farm businesses did not attend a training event identified as desirable for the farm businesses because of seasonal on-farm commitments.

Figure 58 Reasons given for not attending events identified as desirable (AFS)



Respondents were able to give more than one reason.

The percentage of farm businesses giving each of the four reasons for missing training events increases with the size of the management team, value of assets and profit (although businesses making a loss behave more like those with a gross operating surplus over $20 000). Those with no debt are less likely to give each reason than those with debt. As an example, Table 46 shows the percentages giving seasonal commitments as a reason for missing training events identified as desirable.

Table 48 Size of management team and seasonal commitments as a reason for missing training (AFS)

Number in management team	% of all farms giving seasonal commitments as reason
One	28%
Two	36%
Three	40%
Four or more	48%

4.8.1 Tasmanian survey

Thirty-five of those surveyed (54%) recalled at least one training event which they would like to have attended, but did not. Thirteen named two events and three farms identified three events. The types of events are set out in Table 47 below and the reasons given for not attending appear in Table 48.

Table 49 Training events not attended (Tas survey)

Type of training	Number of missed events	Percentage of missed events
Technical seminar	12	23%
Field day	8	15%
Whole Farm Planning course	5	9%
TAFE agricultural course	5	9%
Farm Chemical Accreditation course	1	2%
Intensive Pasture Management course	4	8%
Other agriculture course	6	11%
Business management seminar	5	9%
Business management course	4	8%
Computer course	2	4%
TAFE business course	1	2%
Total missed training events	**53**	
No missed events	30	

n = 65

As can be seen from Table 49, over three-quarters of the 'missed' events were of a technical, agricultural nature, rather than management or business related. About half the 'missed' events were one day field days or seminars and about half were courses, for example, the whole farm planning course.

People reported they were unable to attend training events because, "they cannot get away from the farm", "'the events are held too far away" or "at a time of year when it is busy on their farm". These three reasons together account for two-thirds of all reasons for missing events (Table 48).

Table 50 Reasons for not attending (Tas survey)

Reason	Percentage of reasons given
Person needed on farm	32%
Distance	19%
Wrong time of year	15%
Cost	12%
Wrong time of day	5%
Not suited to this farm	4%
Personal reasons	5%
Event canceled	4%
Class full	1%
Not eligible to enroll	1%
Found out too late	1%

n=65

4.9. Factors which foster course participation

Responses from the Tasmanian survey course participants to the open-ended question, "what did you like most about the course?" give some indication of factors which foster course participation. These responses are summarised in Table 49.

Table 51 What people liked most about the course (Tas survey)

Course / Factor liked most	Chemical participants	Dairy participants	Pasture participants	% all course participants
Content	12	10	12	76%
Was practical	3	4	4	24%
Interaction with other farmers	4	2	5	24%
Presenter	6	10	6	49%
Location or duration of course and/or sessions	2	2	5	20%
n *	16	13	16	

**Some people gave more than one reason.*

About three-quarters of all those from each course cited the content or knowledge gained as the thing they liked most. The practical nature of the courses and the opportunity for interaction with other farmers are mentioned by those from all three courses.

The "things liked least" and suggested improvements may be factors that are keeping others away from courses. Table 50 summarises responses to the open-ended question, "what did you like least about the course?" Suggested improvements reflect the same factors. Whilst some had complaints about specific parts of the content, the amount of content to be absorbed each session time is a factor which could inhibit farmers from participating in courses.

Table 52 What people liked least about the course (Tas survey)

Course / Factor liked least	Chemical participants	Dairy participants	Pasture participants	% all course participants
Content (specific parts)	0	7	2	20%
Sessions too concentrated	1	4	2	16%
Wrong time of the year	0	3	1	9%
Not practical enough or too theoretical	1	1	3	11%
Course structure and delivery	0	3	4	16%
Too expensive	1	0	0	2%
Nil	13	2	7	49%

n=45

5. What are the future training needs in agriculture?

5.1. Agricultural Financial Survey

Eighty-three percent of all farm businesses intend to participate in some training in the next three years. Most intend to participate in training about agricultural practices (Table 51).

Table 53 Area of intended training (AFS)

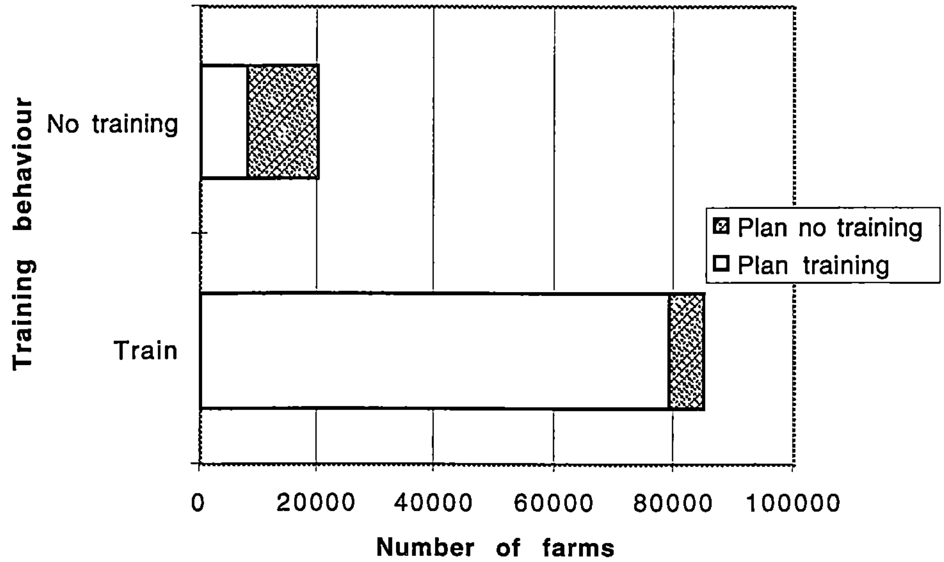
Training area	% of all farm businesses
Financial management	19%
Marketing	20%
Agricultural practices	70%
Land management	29%
Any intended training	83%

More than one training area could be nominated.

5.1.1 Training behaviour over time

Section 1.5 Training participation over time, shows that recent and past training behaviour are strongly correlated. Those who do train also plan more training in the future, while most of those who do not train do not expect to train in the next three years. Figure 44 shows training behaviour and future training plans. Ninety-three percent of those farm businesses which have participated in training in the past twelve months plan more training in the next three years compared to only 41% of those who have not participated in training in the past twelve months.

Figure 59 Training behaviour and training plans (AFS)



χ^2 probability is less than 0.0001 for training planned/not planned ratios.

Looking at the data from another perspective, 66% of those who plan no training in the next three years did not participate in any training in the last twelve months. These non-training farm businesses comprise 11% of all farm businesses.

5.1.2 Changes and training intentions

Thirty percent of those farm businesses which made no change to practice to improve profitability in the last three years have no training intentions, compared to 17% of all businesses.

5.1.3 Farm characteristics and training intentions

Farm businesses with higher asset values, larger management teams and more education are more likely to plan to train in the next three years. Those with a small, but positive profit (gross operating surplus) and those with no debt are less likely to plan training (Table 52).

Table 54 Training intentions by assets, profit, equity, managers and education (AFS)

Characteristic	% planning training
Highest education in management team	
Year 9 or below	60%
Year 10 to year 12	87%
Non-agricultural post-school qualifications	89%
Agricultural qualifications	95%
Number in management team	
One	68%
Two	85%
Three or more	93%
Value of assets	
$0 to $499 999	73%
$500 000 to $999 999	84%
$1 million or more	91%
Equity	
Up to 50%	80%
51% to 75%	92%
76% to 99%	85%
100%	76%
Gross operating surplus	
Loss	83%
$0 to $19 999	69%
$20 000 to $99 999	84%
$100 000 or more	94%
All farm businesses	**83%**

χ^2 probabilities are less than 0.0001 for all training planned/not planned ratios within each of the education, management team, asset, equity and profit categories compared to others in that category.

5.1.4 Farm business characteristics and area of intended training

Larger farm businesses are more likely to plan to train in each of the four areas. The pattern for each area of training is similar to the overall pattern of intention to train for all the characteristics listed in Table 54. Intended training area by value of assets is provided to illustrate the increasing proportion planning training in each area as the size of the farm businesses increases (Table 53).

Table 55 Intended training area by value of assets (AFS)

Training area / Value of assets	Financial	Marketing	Agricultural	Land management
Less than $500 000	13%	15%	62%	24%
$500 000 to $999 999	16%	18%	70%	27%
$1 million or more	25%	27%	77%	36%

χ^2 probabilities that the distribution of training areas for the high and low asset groups are the same as the mid assets group are both less than 0.0001%.

5.2. Tasmanian survey

The Tasmanian data provide more specific information about future training needs and plans. Three-quarters of farm businesses identified one or more future training need.

Agricultural technical courses of more than one days' duration were the most commonly identified training need, comprising 31% of all training identified, followed by business management courses (including computing courses), being 30% of identified training. One day agricultural or technical seminars are 28%. The requested topics for the one day training ranged from artificial insemination to fencing. The Whole Farm Planning course, which covers both physical and financial farm management was named by eight farm businesses, and the Farm Chemical Accreditation and Intensive Pasture Management courses by six respondents each. Computer courses were cited by twelve people. Table 54 presents these results.

Table 56 Future training needs (Tas survey)

Type of training	Percent of training identified
Agriculture/technical seminar	28%
Agriculture /field day	4%
Intensive Pasture Management	6%
Dairy Farm Management course	1%
Farm Chemical Accreditation course	6%
Other TAFE agricultural course	10%
University agricultural course	1%
Other agricultural course	8%
All agricultural courses	**31%**
Business management seminar	6%
Whole farm planning course	8%
TAFE business course	7%
Computer course	12%
Other business management course	3%
All management courses	**30%**

Number of respondents = 65, number of training needs identified =103. Respondents were able to nominate more than one future training need.

Areas of identified training needs are summarised by number of farm businesses in Table 55 to allow comparison of the course and non-course samples within the Tasmanian interview survey data. Only one farm business identified a need for training in marketing (as one aspect of a management course). Unlike the Agricultural Financial Survey, the Tasmanian question was open-ended, with no listed response categories. Both financial management and general management or record keeping were specifically mentioned by most of the farm businesses wanting training in computer skills and those wanting to study TAFE or other business courses.

Thirty-one farm businesses, or almost half the sample, reported a wish to undertake some sort of business management training in the next three years, compared to the 20% which actually completed some business management training in the past three years.

Those from the course sample (45 farm businesses) identify more future 'training events' than those from the non-course sample (20 farm businesses), and are more likely to identify training in each of the areas listed in Table 55.

Table 57 Summary of identified training needs by course/non-course samples and area (Tas survey)

Area of identified training need	Course sample		Non-course sample	
	number of farms	% of sample	number of farms	% of sample
Agricultural practices	31	69%	7	35%
Business and/or financial management	25	56%	6	30%
Land management	12	27%	2	10%
Nil*	8	18%	8	40%
Average no. of training events identified per farm business**	1.89		0.90	

** Difference between .course and non-course samples significant at 99% confidence level.*
*** Difference significant at 95% level (probability of not being different from t test is 0.00245).*
Number of respondents = 65, number of training needs identified =102.
Respondents were able to nominate more than one future training need.

5.2.1 Preferred delivery characteristics

Most respondents would like their identified training needs to be delivered in face-to-face sessions; however eight farmers would prefer a total of eleven courses to be delivered by correspondence mode. Preferred delivery modes are shown in Table 56. The number of preferences for courses of a number of sessions is related to the number of farmers who want to study particular courses (as shown in Table 56).

Those who have taken courses (and are in the course sample) are more likely to plan to undertake courses consisting of a number of sessions than are farm businesses in the non-course sample (see Table 56).

Table 58 Preferred delivery mode for identified future training (Tas survey)

Responses / Preferred delivery mode	Number of mentions	Course sample mentions	% of course sample mentioning	Non-course sample mentions	% of non-course sample mentioning
A number of face to face sessions	56	45	64%*	11	40%*
Seminar or workshop	26	23	31%	3	15%
Correspondence	11	10	16%	1	5%
Field day	8	5	13%	3	15%
No preference	2	2	2%	0	0%

**Difference significant at 90% confidence level. T test probability of proportions being the same is 0.07568.*
Respondents were able to nominate more than one future training need.

Most prefer courses held within 80 kilometres of their farm. Eighteen percent were prepared to travel within Tasmania, for a wide variety of training activities ranging from seminars to university courses.

Almost one quarter expressed a preference for evening sessions. One third wanted daytime sessions, with a large proportion of those preferring the middle of the day. The remainder had no preference, with the exception of three who preferred the existing block arrangement for TAFE agricultural courses.

Winter was the most popular time of the year for training, followed by autumn, although one third had no preference and 10% preferred spring or summer. The spring and summer preferences applied to seminars only.

About half wanted to do the training indicated within 12 months, and all but 8% would like to undertake the course/seminar within the next two years.

When asked where they would seek information about available training most mentioned the print media, especially the local country newspaper and agricultural newsletters. Some would ask 'experts' such as extensions officers or consultants. Two would ask other farmers. None suggested they would approach educational institutions.

CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter first considers each of the five research questions in turn in sections 1 to 5. Within these sections, the results of this study, as presented in Chapter 4, are discussed in relation to the literature reviewed in Chapter 2. The findings which emerge in relation to each research question are outlined at the start of each section. The final section of the chapter summarises the conclusions which emerge from the discussion in the first five sections of the chapter and suggests areas for further research.

1. Research Question 1: What impact has training had on farm profitability?

Four major findings emerge from this study in answer to the first research question. The results of this study, in summary form, suggest that:

(i) Farm businesses managed by those with formal, accredited agricultural education are more profitable than other farm businesses of similar asset value;

(ii) Large farm businesses managed by those with a low level of school education are less profitable than other farm businesses of similar asset value;

(iii) More profitable farm businesses participate in more training than other farm businesses; and

(iv) Those who make changes to practice which are influenced by a training course have more profitable farm businesses than those who do not.

This section considers each of these findings in turn and relates the findings to the literature reviewed in Chapter 2.

1.1. Agricultural qualifications and profitability

Farm businesses managed by those with formal, accredited agricultural education are more profitable than other farm businesses of similar asset value.

The literature review (Chapter 2) first, failed to find any research studies which related the presence or absence of agricultural qualifications and farm business profitability or farm productivity, second, the literature review did not find any studies which related other industry-specific qualifications to small business profitability. The results relating to agricultural qualifications in this thesis cannot therefore be compared directly to existing research results. However, the finding that farm businesses managed by those with formal, accredited agricultural education are more profitable than other farm businesses of similar asset value, is consistent with a general relationship between education and training and business success, as found by Cooper, Gimenogascon and Woo (1994) and Williams (in McMahon, 1989).

Figure 17 Education level and gross operating surplus (AFS), in Chapter 4, shows that farm businesses with agricultural qualifications present in the management team have a statistically significantly higher gross operating surplus than all other farm businesses; a gross operating surplus of $85 387 in 1993/94 for those with agricultural qualifications compared with $66 974 for those.with year 10 to 12 education.

As indicated in Chapter 3, Methodology, the data which appear in Figure 17 are from a large, stratified sample of Australian farm businesses. The sample is selected so as to be representative of Australian agricultural industries (which covers main enterprise) and state (which partially covers local environmental factors). The data (and all AFS data in Chapter 4) are weighted data. Frequency distributions of weighted and unweighted data show similar distributions of qualifications and profit. The Tasmanian data presented in Chapter 4, Table 4 Agricultural qualifications and profit measures (Tas survey), also suggest that farm businesses with agricultural qualifications present in the management team have a statistically significantly higher gross operating surplus.

However, the profit figures in Figure 17 Education level and gross operating surplus (AFS) in Chapter 4, are averages of all farm businesses and do not include the influence of variables other than education which may increase with both educational qualifications and farm business profit. By selecting a cross-sectional sample for a single period of time, variations in profit attributable to product prices, costs and many major climatic seasonal factors are reduced. Another of the difficulties of isolating the impact of education and training from the many other variables which may impact on profit is overcome by choosing gross operating surplus rather than cash operating surplus as a profit measure. This minimises any impact which the level of debt may have on profit by measuring profit before interest payment are deducted. As mentioned in Chapter 3 Methodology, other possible variables which could affect profit include farm management practices, value of assets, enterprise mix and local environmental factors.

The next subsection attempts to isolate the impact on profit of formal agricultural education from the impact of the value of the farm business assets, which can be expected to be a major influence on the absolute value of profit.

1.1.1 Value of assets, agricultural qualifications and profit

Both educational qualifications and farm business profit increase with value of farm business assets (see Table 5 Value of assets by highest education level in management team (AFS)). A correlation between educational qualifications and value of assets is consistent with the literature reviewed in Chapter 2, which suggests that participation in education will be greater for larger farm businesses. This is because the proportionate cost of education in terms of lost labour and percentage of income spent on education is less for large farm businesses than for smaller ones (Lees & Reeve, 1991; Smith & Kahler, 1982; Anderson, 1982).

The relationship between agricultural qualifications and profit as measured by gross operating surplus, taking value of farm business assets into account, is shown in Figure 19 Education, assets and gross operating surplus (AFS).

Less than a third of all farm business (29%) have assets of less than \$500 000. Only a small proportion of these (10%) have someone with agricultural qualifications in the management team. This group is more likely to earn a gross operating surplus of \$20 000 or more than are other farm businesses of similar asset value. The proportions earning more than \$20 000 are 62% of the agricultural qualifications group compared to 44% of the other low asset value farm businesses (chi squared probability less than 0.00001%).

Farm businesses with agricultural qualifications in the largest asset group (\$1 million or more) are more likely to earn a gross operating surplus of over \$100 000; 48% of the agricultural qualifications group earn more than \$100 000 compared to 38% of the other farm businesses (chi squared probability less than 0.00001%).

The positive relationship between agricultural qualifications and gross operating surplus does not apply in the mid assets group (\$500 000 to \$999 999). Whilst slightly more of the agricultural qualifications group are in the top profit category, those farm businesses with agricultural qualifications in the management team are more likely to make a loss than other farm businesses; 24% of the agricultural qualifications group have a negative gross operating surplus compared to only 12% of the other farm businesses (chi squared probability less than 0.00001%).

Neither the Agricultural Financial Survey data nor the literature provide any explanation for the variation in performance of those farm businesses with agricultural qualifications in the middle asset group compared to those with agricultural qualifications in the other two asset groups. Whilst a poor financial result in 1993/94 could be due to the drought which affected eastern Australia and low commodity prices (Martin, 1996), there is no obvious reason why farm businesses in the middle asset group with managers with agricultural qualifications should have been affected more than those with greater and lesser asset values.

There is a range of possible explanations for the differing performance of the mid asset group, including; an over representation of newly acquired or restructuring farm businesses which are not yet producing at normal, long term levels, and an higher than average proportion of those with agricultural qualifications in the broadacre industries which performed poorly in 1993-94 because of the drought and low wool prices. The average asset value of sheep and grain-beef-sheep farms is just above the mid assets range (Australian Bureau of Statistics, 1995), which means that many farm businesses in these industry groups are in the mid asset range. High relative standard errors for numbers with agricultural qualifications by industry in the AFS data prevent confirmation that farm businesses with agricultural qualifications form a higher proportion of the sheep and grain-sheep-beef industry groups than other industry groups. Further research is needed to investigate the comparatively poor performance of those farm businesses with agricultural qualifications in the middle asset group.

To summarise section 1.1, the results from the Agricultural Financial Survey and the Tasmanian interview survey suggest that businesses managed by those with industry-specific qualifications generally perform better than similar businesses without managers who are so qualified. In particular, farm businesses managed by those who have successfully completed formal, accredited agricultural education are more profitable than other farm businesses of similar asset value. Until now there were few research results in the area of the impact of industry-specific qualifications on business performance; this finding helps fill the gap revealed by the paucity of existing literature.

1.2. Schooling and profitability

Large farm businesses managed by those with a low level of school education are less profitable than other farm businesses of similar asset value.

The 19% of Australian farm businesses with no management team member having education to year 10 have a lower gross operating surplus than those with year 10 to 12 and those with agricultural qualifications. The averages are $47 323, $66 974 and $85 387 respectively (see Figure 17 Education level and gross operating surplus (AFS)). This is consistent with the literature reviewed in Chapter 2 which included a large number of studies which found a positive relationship between years of study and productivity and/or profitability. Notable studies in agriculture are Phillips (1994), Lockheed, Jamison and Lau (1980), Huffman (1977; 1974) and Welch (1970). Other more general studies discussed in Chapter 2, such as Maglen (1995) on rates of return to university degrees and Cooper, Gimenogascon and Woo (1994), also suggest that those with more years of education can be expected to earn higher incomes.

1.2.1 Low level of school education

A closer examination of the results relating to education and profit, as presented in Figure 19 Education, assets and gross operating surplus (AFS) A, B and C, suggests that the relationship between length of general schooling and profit is not clear cut. The below year 10 group appears to perform better than the year 10 to 12 and the non-agricultural post-school qualifications groups in the two lower asset categories.

Forty-two percent of all farm businesses with only below year 10 education are in the lowest asset category and a further 35% are in the mid asset category. Their relatively good performance compared to those with similar asset value but more years of education merits further examination. The most striking difference between those with below year 10 and others with no post school qualifications is the significantly smaller proportion which make a loss (10% for low assets, 6% for mid assets) compared to farm businesses with year 10 to 12 (23% and 12% respectively).

Those people who left school before year 10 are more likely to be older, many having completed their education at a time when rural schools did not offer classes at year 10 level (Ferguson & Simpson, 1995). These farm managers are thus likely to have many years of experience in farming. Whilst many other farm businesses will have older managers with below year 10 education as well as other managers with more years of schooling, it is possible that the relatively good profit performance of farm businesses with assets of less than $1 million is due to more years of experience in farming than other farm businesses of similar asset value.

The works of Mathews (1994) and Lundvall (1992) on organisational innovation and Arrow (1962) on 'learning by doing' suggest that learning occurs through experience. It is possible that the low education level group has been able to compensate for fewer years of schooling by more 'learning on-the-job' because they are older and have more experience of farming. Older farmers who have farmed in the same location for a long time will have accumulated farm-specific knowledge of micro climate and soil type which younger farmers may not possess. Such knowledge will enable the older farmers to make more effective decisions in relation to things such planting, harvesting and stocking rates. The older farmers may also be more risk averse than their younger counterparts, and so less likely to make decisions which result in the farm business making a loss.

1.2.2 Non-agricultural post-school qualifications

The non-agricultural post-school qualifications group has a higher proportion in lower profit categories in all three asset groups, and Figure 17 Education level and gross operating surplus (AFS), shows that the average gross operating surplus for all farm businesses with non-agricultural post-school qualifications is significantly lower than the average for those with only year 10 to year 12 schooling.

It is more likely that those with non-agricultural post-school qualifications are able to supplement farm income with off-farm income by using their qualifications than are other farm management teams, for example by using teaching or trade qualifications to obtain full or part-time jobs in local schools or businesses. Rendell, O'Callaghan and Clark (1996) found that non-farm income has a significant impact on family disposable income for almost half their sample of 87 family farms. Thus the lower profit for the farm businesses with non-agricultural post-school qualifications in this study may reflect a lower proportion of time and effort devoted to on farm tasks.

1.3. Training and profitability

More profitable farm businesses participate in more training than other farm businesses.

Eighty percent of Australian farm business participate in training, defined broadly to include field days, seminars, conferences and industry meetings as well as courses (Figure 4 Distribution of farm business training behaviour (AFS)), however many of the farm businesses attend only field days (25% of all farm businesses) and only 3% participate in courses of several sessions (Figure 20 Distribution of farm business training behaviour (AFS), and Figure 21 Methods of farm business training (AFS)).

The 20% of farm businesses which do not train have a significantly lower gross operating surplus; $68 102 for 'training' farm businesses compared to $39 788 for 'non-training' businesses. Training farm businesses have a higher gross operating surplus in all States, although the difference is only significant in Victoria, Queensland, Western Australia and Tasmania (see Table 7 Training and profit by State (AFS)). Farm businesses which train in the fruit, vegetable, grain and grain-sheep-beef industries are more profitable than farm business which do not train (Table 6 Profit and training by industry (AFS)). The numbers sampled in many of the other industry groupings are relatively small, hence differences in gross operating surplus are less likely to be significant.

There is limited evidence to support there being a threshold level of training participation before training benefits the farm business, as suggested by Phillips and Marble (1986), Jamison and Lau (1982) and Moock (1981). Although these studies in third world countries used primary schooling as the measure of education, rather than post-school training, the increase in profitability as the number of training events increases, especially beyond three per year (example Figure 8 Training and average gross operating surplus by low, mid and high value of assets (AFS)), is at least consistent with there being a threshold level of training participation.

All of the difficulties in isolating the impact of education on profitability which are discussed in section 1.1 above in relation to agricultural qualifications also apply to isolating the impact of training on profit. Some statements can be made, however, about the relationship between profit levels and 'quantity' of training and training 'type' or delivery method chosen by farm businesses.

Farm businesses which make a small profit attend fewer training events than those making a larger profit, and are also less likely to train than farm businesses which make a loss (Figure 23 Profit and number of training events (AFS)). Larger farm businesses by asset value attend more training than smaller farm businesses. This pattern generally applies to each of the various types of training (see Figure 26 Profit group and field day attendance by asset group (AFS), Figure 29 Profit group and seminars and workshops .by asset group (AFS) and Figure 30 Profit group and conferences and industry meetings by assets (AFS)).

The multiple regressions in Appendix F suggest that gross operating surplus is positively related to attending training events. Examples 1 and 2 in Appendix F, which use AFS data for all farm businesses and only those with a positive gross operating surplus respectively, both have negative and significant coefficients for the variable 'attending fewer than ten training events'. The Tasmanian survey data relating to profit and education and training variables are used in Examples 6 and 7. The variables representing 'not attending various courses' and those for 'not attending various types of training' have negative and significant coefficients. The multiple regressions should be treated with caution, for the reasons discussed in Appendix F. A major concern in interpreting the multiple regressions is the apparent interrelationship between the training and change variables, and the consequent difficulty in justifying the choice of one or the other as an independent variable in the determination of profit, the dependent variable.

1.3.1 The relationship between recent and past training participation

From the results discussed in the above paragraphs, there appears to be a demonstrated association between recent participation in training of all forms and higher profit. However, because it takes time for many training-influenced changes to practice to show up in profit figures, it is not always possible for a recent profit figure to have been influenced by recent training. Thus, the training measured by training data relating to the past twelve months, which was collected in the AFS, may not have had time to influence the profit measured by the AFS data for the same 12 months. However, recent training behaviour may be a reflection of past training behaviour. If so, recent training behaviour can be used as a proxy for past training behaviour.

Three studies discussed in Chapter 2, suggest that those with past experience of education and training are more likely to participate in current training; that is recent education and/or training behaviour is correlated with past behaviour. McKenzie and Long's (1995) Australian study which used data from the Australian Bureau of Statistics' 1993 Survey of Training, which covers all industries, found that employees with more years of school and post-school education had a higher incidence of participation in formal training courses. Two agricultural studies by Smith and Kahler (1982) in the United States and Anderson (1982) in Australia, found that farmers who sought training through extension services were more likely to have trained in the past, and also tended to be better educated.

There is evidence from the Tasmanian interview survey data that a farm business's pattern of past training is similar to recent training participation (see Table 11 Training participation over time (Tas survey)). The Agricultural Financial Survey data show a correlation between recent training behaviour and future training plans (see Figure 60 Training behaviour and training plans (AFS)), which lends support to the idea that training behaviour is similar over time. If training does contribute to higher profit, then farm businesses with recent training are likely to have benefited from earlier training, and it is that earlier training which contributes to present profitability.

1.3.2 Value of assets, training and profit

Farm businesses which attend more training events are more profitable; in particular, those with mid range assets ($500 000 to $999 999) and high value of assets ($1 million or more) which attend ten or more training events in one year have a higher average gross operating surplus than do other farm businesses of similar asset value. For example, the average for the mid asset group attending ten or more training events is $76 980, compared to an average of $45 214 for those attending four to nine events (see Figure 8 Training and average gross operating surplus by low, mid and high value of assets (AFS)). The Tasmanian survey data also shows that more profitable farm business train more (see Table 8 Number of training events in three years and profit (Tas survey)).

The literature on training and productivity, as distinct from formal educational qualifications and productivity, suggests a range of ways in which training improves productivity and/or profitability in individual organisations. For example, two studies of the impact of on-the-job training in United States businesses, Bergman (1995) and Business Council for Effective Literacy (1993), find improvements in areas from communication skills to skill flexibility which impact on productivity, product quality and profitability. It is therefore quite possible that training has contributed to higher profitability for participating Australian farm businesses by improving the quality of labour (including management labour).

1.3.3 Training delivery method and profit

The delivery method or 'type' of training may influence the impact of training on profitability. Farm businesses which attend more training events excluding field days are more profitable (see Figure 27 Profit and participation in training other than field days (AFS)). Section 1.1 above discusses the impact of one 'method' of training, namely formal agricultural education courses, which appears to have a positive impact on profitability.

There is very little literature about the relationship between particular training delivery methods and profit. The studies mentioned in section 1.3.2 above by Bergman (1995) and Business Council for Effective Literacy (1993) consider a range of on-the-job training programs, as do the Taiwan study of enterprise training (World Bank, 1995) and the US study by Bartel (1994). Both of the latter studies found increases in worker productivity attributable to the on-the-job training (see Chapter 2). The agricultural studies uncovered by literature searches and reviewed in Chapter 2, section 1.3 Education and agricultural indicators, consider general education rather than industry-specific training.

The studies of training in agriculture concentrate on individual training programs, and the outcomes of the programs are generally measured in terms of changes to practice. These studies are reviewed in Chapter 2, section 2.8 Education and adoption of innovations and discussed further in section 4. of this chapter.

Johnson, Bone and Knight (1996) suggest that a small group of leading farmers use both short term learning opportunities such as field days and seminars, and tertiary courses to manage change. In their study, they do not collect any financial data, so it is not possible to determine whether these leading farmers have more profitable farms.

The findings of this study suggest that those with more profitable farm businesses are more likely to have participated in seminars, workshops, conferences, industry meetings and courses. It is possible that training delivered in these ways is more effective in improving profitability than field days.

Training can only impact on profit if there is a change to practice as a result of that training. The impact of training on changes to practice is discussed in section 2. below, but the relationship between specific course related changes and profit is considered here. The Tasmanian survey allows more detailed examination of the relationship between course attendance, course-related change to practice and profit.

1.4. Training-influenced change and profit

Those who make changes to practice which are influenced by a training course have more profitable farm businesses than those who do not.

The Tasmanian survey data show that those who participated in one of the three surveyed courses have more profitable farm business. This result emerges from both the multiple regressions in Appendix F, and the data presented in Table 12 Profit and courses (Tas survey), in Chapter 4.

Sixty-four percent of the 45 course participants sampled had made a change to their practice which was influenced in some way by the course (Table 20 Changes to practice influenced by courses (Tas survey)). Those farm businesses which experienced a course-influenced change have a significantly higher gross operating surplus than farm businesses which did not make a course-influenced change. The average gross operating surpluses are $$76 697 and $34 541 respectively (Table 38 Course participants, course influenced change and profit (Tas survey)).

It is difficult to make conclusive statements about the impact of the courses on economic or sustainability outcomes on farms because of the difficulty of finding a control group that exactly matches the course sample, and because many things other than the three courses will impact on the profitability and sustainability of farms. There is, however, evidence that those who do make changes to their behaviour or practice following a course have more profitable farms.

Although it is not possible to say that the higher profit is caused by the course-related change, there is a strong suggestion that those whose behaviour is altered as a result of a course may benefit financially.

Changes to practice and the role of training in 'triggering' change is discussed further in section 2. below, where other results from this study are considered along with the literature relating to changes to practice, or innovations.

1.5. Education and training and profit - the direction of causation

The results discussed in sections 1.1 and 1.4 above show a positive relationship between profit and both agricultural education and training, which exists even when economic resources as measured by value of assets are taken into account. The multiple regressions in Appendix F are based on models which assume that the education and training cause profit to increase. The discussion in section 1.4 provides some support for the direction of causation being from education and training to profit, rather than from profit to training.

The literature, discussed below, includes several studies which present and test theoretical models which support the direction of causation being from education and training to productivity and/or profitability. The literature reviewed in the section of Chapter 2 'How does education and training impact on the decision to change?' concerns the ways in which education and training impact on farm management behaviour, and hence on outcomes for the farm business.

Welch (1970) is a landmark paper on the way in which education impacts on behaviour, decision making, and hence outcomes of the farm business. He found that education can affect productivity by improving the quality of labour and also via an allocative effect. The allocative effect is due to improved ability to process information, select inputs and allocate inputs across competing uses. Khaldi (1975) and Huffman (1974) confirmed Welch's (1970) finding that education improves the outcome of decisions. Huffman (1974) found that better educated farmers are more likely to apply the optimum amount of nitrogen fertiliser, while the better educated farmers in Khaldi's (1975) sample made decisions which resulted in higher crop yields. Thomas, Ladewig and McIntosh (1990) and Nelson and Phelps (1966) suggest that education assists people receive, decode and understand information, and hence make better decisions.

Studies by Rogers (1995), Longo (1990), Thomas, Ladewig and McIntosh (1990), Riesenberg and Obel Gor (1989) and Jones (1963) all suggest that the better educated are aware of a greater number of possible innovations. This occurs through use of the mass media and contact with expert advisers. When combined with the enhanced ability to select the best of these innovations, described by Welch's (1970) 'allocative effect', this greater awareness of possible innovations will lead to superior outcomes for farm businesses with better educated farm managers.

A final body of literature reviewed which supports a direction of causation from education to profitability is that which concluded that education alters values and attitudes away from the traditional, which in turn encourages development (Phillips, 1994; Foster, 1987; Holsinger, 1984; Lockheed, Jamison & Lau, 1980).

This relatively large body of literature which suggests that education and training impact positively on profitability should be balanced against the argument that those with a higher income are better able to afford the costs of training, including the opportunity cost of lost time working on the farm, and so are more likely to train. This argument is presented in detail in Chapter 2, in the section 4.3.2 Economic barriers, where the literature review uncovered only two research studies on the relationship between participation in training and economic resources such as farm size or income.

1.5.1 Direction of causation - conclusion

On balance, it seems to be fair to conclude that education and training *can* impact on farm profitability. The results of this study suggest that education and training *does* have a positive impact on the profitability of

Australian farm businesses. If lack of resources for training, as reflected in a low level of profit, is a barrier to training, then it is a barrier that must be overcome if these farm businesses are to improve their profitability. One way of facilitating access to training for low profit farm businesses is by using schemes such as the Department of Primary industries and Energy's Rural Adjustment Scheme to subsidise training for less profitable farm businesses.

Barriers to participation in training are consider in section 4. below. The next two sections consider the process of change in farm businesses, including further discussion of the role of training in fostering change.

2. What 'triggers' farm managers to make major changes to their farming practices?

Four major findings emerge from this study in answer to the second research question. The results of this study suggest that:

(i) Farm businesses which make changes to their practice which are designed to improve profitability are more profitable than those businesses which make no change;

(ii) Farm businesses most likely to make changes to their practice designed to improve profitability or viability are larger (measured by value of assets), more profitable, have some debt, have more educated managers and have more than one person in the management team;

(iii) Most changes to practice are influenced by interaction with, and information from, a number of sources, including peers, experts and training events;

(iv) Farm businesses which participate in training are more likely to make changes to their practice which are designed to improve profitability.

This section first discusses the extent of change to practice in Australian farm business, then considers each of the four major findings in turn and relates the findings to the literature reviewed in Chapter 2.

2.1. The extent of change to practice

Sixty-two percent of Australian farm businesses (AFS data) made no change to their practice over a three year period which was expected to improve profitability (Table 14 Changes to practice by type (AFS)). Average levels of 'technological, organisational and commercial innovation' are 43% for manufacturing industry and 21% for other Australian industries, not including agriculture (Australian Bureau of Statistics, 1995b; 1995c). However, these figures from manufacturing and other industries are not directly comparable with the change to practice data from this study, which covers a wider range of possible changes. The Australian Bureau of Statistics' (1995b; 1995c) data on innovation exclude, for example, changes to management practices and changes to human resourcing, both of which are included here as changes to practice.

The Tasmanian interview survey found that changes to practice are more widespread than is innovation in manufacturing and other industries, with all but 12% making at least one change in three years and most (57%) making between two and five changes (see Figure 17 Number of changes per farm business (Tas survey)). The AFS does not provide data on the number of changes per farm business. It is possible that the Tasmanian interview survey is biased toward more flexible and responsive farm businesses since over two thirds of the sample was selected because they had participated in a course. If finding (iv) from the list at the start of this section, namely, that course participants are more likely to make changes to practice, is correct, then the proportion of the survey making changes is expected to be greater than for the farm population as a whole. However, comparison of the results of this study relating to the extent of change to practice and the figures from Australian Bureau of Statistics' (1995b; 1995c) surveys of innovation in other sectors of the economy, point to farm businesses being relatively responsive and willing to make changes to their practice.

2.1.1 Comparison of extent of innovation with other studies

There are very few studies which consider the general level of innovation of farm businesses. A search of the literature identified only two studies which do consider innovation at a general level; Moore (1990) and Weston and Carey (1979). Most innovation studies in agriculture and other fields concentrate on the diffusion or adoption of a single innovation or a group of related innovations.

Moore's (1990) found that 16% of New Zealand farmers had never made a management change which lifted production levels. Changes in the present study are restricted to those made in the last three years, and so the results were not directly comparable with those for Moore's open ended period.

Weston and Carey (1979) found that 22% of Australian dairy farmers planned changes at the depth of the economic cycle, rising to 46% two years later on the upswing of the cycle. If the extent of innovation does move with the economic cycle, then the proportion of farm businesses which make changes to practice found here (62% over three years) could be at the low end of the range which occurs over the cycle. This is because the period 1991-92 to 1993-94 was one of low economic returns for agriculture (Martin, 1996), and so represents a low period of the farm economic cycle.

2.1.2 Types of changes to practice

The data show that, Australia wide, most changes to practice are in the general area of agricultural practice (48%), followed by land management (25%), with relatively small numbers making changes to financial management (14%) and marketing (11%) (from Chapter 4, Table 14 Changes to practice by type (AFS)). These types of change are ranked in a similar order in the Tasmanian data, although the proportion making each type of change is greater (see Table 4 Changes to farm practice over past three years (Tas survey)). This is because a higher than average portion of the Tasmanian sample have a manager who has completed an agricultural course, and the results of this study show that farm business managed by people with agricultural qualifications are more likely to make changes to practice than are other farm businesses (see section 2.3.3 Education and change below).

Table 28 Profit and changes to practice (AFS) shows that larger farm businesses by value of assets are more likely to make each of the four types of change to practice. Further, Figure 41 Type of change and profit by value of assets (AFS) shows that the more profitable farm businesses in each asset category are more likely to make each type of change, except changes to land management.

The very small number of research studies on general innovation in farm businesses do not consider types of innovations, and so do not provide points for comparison with the results of this study relating to types of innovation made by farm businesses. There are studies of the adoption of individual agricultural practices, and a number of studies of the adoption of conservation practices, which are the majority of practices included 'land management practices' in this study. Moore (1990) is one of the few studies which touches on management practices, however Moore focuses on current practices rather than adoption of new practices. None of the studies reviewed in Chapter 2 consider changes to marketing of farm output.

The following two subsections give a brief overview of the nature of the literature relating to changes to agricultural and land management practices respectively. Individual types of changes are discussed where relevant in the sections relating to the remaining three major findings pertaining to this second research question, What triggers farm mangers to make major changes to their farming practice?

2.1.3 Agricultural practice innovations

The studies of the adoption of individual agricultural innovations are concerned largely with the use of chemicals and related products. They vary from the application of fertiliser, for example Huffman (1977; 1974), to integrated pest management (partially by use of chemicals), for example Thomas, Ladewig and McIntosh (1990). Many use data from developing countries, for example Kunzru and Tripathi (1994) which uses Indian data and Ekanayake and Jayasuriya (1989) which uses Sri Lankan data. Changes to agricultural practices in this thesis include not only changes to fertiliser and chemical inputs, but also new equipment, change of enterprise mix and changes in labour resources.

These studies also provide no points of comparison for the general level of innovation relating to agricultural practices found here of almost half of all farm businesses making at least one change to agricultural practice to improve profitability over three years.

2.1.4 Land management practices

A number of research studies examined the adoption of conservation practices in developed countries including the United States, Britain and Australia. Like studies of adoption of agricultural practices, most studies are of a single type of conservation practice. There are a number of studies on adoption of conservation tillage practices in the United States in the 1980s, for example, Korsching, Stofferahn, Nowak and Wagener, (1983), Bultena and Hoiberg (1983) and Ervin and Ervin (1982). Another group of studies was about the uptake of government conservation programs in Britain and the United States, for example Morris and Potter (1995) and Napier, Cameron and Camboni (1988). These two groups of studies compared the characteristics of adopters and non-adopters, and/or of early and late adopters. An early Australian study by Earle, Rose and Brownlea (1979) also considered the characteristics of adopters, in this case adopters of soil conservation practices.

As discussed in Chapter 2, section 2.7.1 Farm decision making and values, attitudes and beliefs, the studies cited in the paragraph above, excluding the United States conservation tillage studies, but including others such as the Australian study by Vanclay (1992b), placed an emphasis on the role of values, attitudes and beliefs in influencing adoption. Values, attitudes and beliefs were beyond the scope of the data collected here.

Land management changes are made at about the same rate as for less profitable businesses of similar asset size. The literature offers no obvious explanation for why high profit farm businesses with assets of less than $1 million make more changes to practice of each type except land management, than lower profit farm businesses of similar asset value. The characteristics of those who make land management practices are considered in the section 2.3 below.

The fact that more profitable farm businesses make more financial management and marketing changes than other farm businesses of similar asset value confirms the view of the National Farmers Federation (1993) that farm business managers with skills in management and marketing will succeed in the changing environment of the late twentieth and early twenty-first centuries.

2.2. Changes to practice and farm business profitability

Farm businesses which make changes to their practice which are designed to improve profitability are more profitable than those businesses which make no change.

Thirty-eight percent of farm businesses (AFS data) made no change to their practice over a three year period (Table 14 Changes to practice by type (AFS)). This three year period (1991-92 to 1993-94) was a time of rapid change in domestic and global markets, and a period of declining farmers' terms of trade and historically low real farm incomes (Martin, 1996). The farm businesses which made changes to practice could be expected to be better positioned to respond to changes and survive and be profitable in the future.

The data from both the Agricultural Financial Survey and the Tasmanian interview survey show that those businesses which did make changes over the three year period are more profitable. Table 27 Gross operating surplus and changes (AFS and Tas survey) shows a significant absolute difference in average gross operating surplus between the change and no change groups; AFS data has an average gross operating surplus for farm businesses which have made a change to practice to improve profitability in the last three years of $70 621 compared to $49 240 for those which have not. Table 28 Profit and changes to practice (AFS) and Figure 39 Profit and changes to practice (AFS) both show that those farm businesses which earn a large profit (a gross operating surplus over $100 000) are most likely to make a change to practice.

The literature reviewed in Chapter 2 section 2.9 'Change and other characteristics', suggests that high income earners are likely to be early adopters of a given innovation (Rogers, 1995; Bultena & Hoiberg, 1983), and that those with larger businesses (which are able to generate larger absolute income) are likely to be early adopters (Rogers, 1995; Wozniak, 1987; Clearfield & Warner, 1984). These studies do not consider the overall level of innovation of a businesses, but rather the rate of diffusion of a particular innovation, however they are not inconsistent with the finding of this study that high income farm businesses are more likely to adopt innovations (or make changes to practice). The relationship between income level and farm size and having the resources necessary to make changes to practices are discussed later in the section entitled 'The characteristics of farm businesses which make changes to practice'.

2.2.1 Value of assets, changes to practice and profit

When value of assets is taken into account, farm businesses which make changes to practice have a higher average gross operating surplus, but the difference is significant only for the highest asset category where the 'change' group's average gross operating surplus is $122 323 compared to $94 477 for the 'no change' group (Figure 38 Average value of assets and training and change (AFS)).

The multiple regressions in Appendix F suggest that gross operating surplus is positively related to making changes to practice. Example 4 uses AFS data for farm businesses with a positive gross operating surplus. The coefficients on the change variable is positive and significant. The Tasmanian survey data in Examples 6 and 7 have negative and significant coefficients for making fewer than two changes. The multiple regressions should be treated with caution, because of the apparent interrelationship of the change and training variables, and the consequent difficulty of selecting the appropriate independent variables. However, the multiple regressions provide further evidence that when asset value is taken into account, making changes to practice increases farm business profitability.

2.2.2 Loss making farm businesses and change

Table 28 Profit and changes to practice (AFS) and Figure 41 Type of change and profit by value of assets (AFS) show that farm businesses which made a loss make changes to practice at a rate somewhere between that of the two highest profit categories. With only a few exceptions, this is true for each type of change to practice in each asset category, as well as for change overall. The exceptions are in marketing, and in land management changes for the two lower asset categories.

While it is not possible to be certain why those making a loss behave differently to those making a small, but positive, profit (less than $20 000), two reasons could be suggested. They are that these farm businesses have recently made major changes which will be profitable in time, but which have long lead times (for example, planting trees which take some years to bear a crop), or that those businesses making a loss are more likely to be motivated to search for changes which may improve profitability than farm businesses 'in the black'. Recent major changes are unlikely to have a positive impact on profit, and may even have a short term negative impact if they involve replacement of an activity that has been earning income with one which does not earn income in the short term.

2.2.3 Contribution to Australian farm profit

The 29% of Australian farm businesses with assets of less than $500 000 contribute only 10% of total farm profit as measured by gross operating surplus (GOS), while the 36% of farm businesses with assets of $1 million or more contribute 65% of the total (see Table 29 Contribution to Australian farm profit by assets and change (AFS)). Whilst small asset value farms which make no changes to practice make up 14% of all farm businesses, they represent only 4% of total farm profit. The pattern of contribution to gross operating surplus is similar to the pattern of contribution to total turnover and to the value of farm production (see Australian Bureau of Statistics, 1995). Altering the behaviour of the 11% of farm businesses with assets of $1 million or more which currently make no change to practice has the potential to make a greater impact on farm profit and the value of agricultural production than altering the behaviour of smaller farm businesses.

2.2.4 Goals and changes to practice

The discussion so far in this section implies an assumption that making changes to improve profitability is one of the major goals of farm businesses. It should be noted that a number of studies reviewed in the section 'Farmers' goals and decision making' support the view that economic goals are not farmers' only goals, and not always major goals (Patrick, Blake & Whitaker, 1983; Heffernan, 1982; Salmon, 1981a). Despite the possibility that at least some farm managers do not place a major focus on economic goals, there are several reasons which justify an economic focus for farm business behaviour, and research into factors which foster 'profitable' changes, such as this study.

First, farm businesses must be financially viable in order for farmers to achieve their non-economic goals; for example a goal of 'having a farming lifestyle' cannot be achieved if the business fails and the farm is sold. Second, the National Farmers Federation's (1993) call for improved skills to make farm businesses flexible and responsive to change implies that farm businesses which do not make changes may not survive, and so may not allow their owners and managers to achieve their non-economic goals. Third, there are other studies which, in contrast to those above, find that economic goals, including financial farm survival, are important (Murray-Prior, 1996; O'Brien, 1987; Gillmor, 1986; Cary & Holmes, 1982).

2.3. The characteristics of farm businesses which make changes to practice

Farm businesses most likely to make changes to their practice designed to improve profitability or viability are larger (measured by value of assets), more profitable, have some debt, have more educated managers and have more than one person in the management team.

The results of this study suggest that small farm businesses by value of assets (Table 25 Value of assets and type of change to practice (AFS)), making a low but positive profit (Table 28 Profit and changes to practice (AFS)), with a very high level of equity (Table 26 Equity and type of change to practice (AFS)), with better educated managers (Figure 32 Change to practice and educational qualifications (AFS); Figure 33 Number of changes and education level (Tas survey)) and managed by a single manager (Table 24 Size of management team and percentage making a change by category of change (AFS)) are least likely to make a change to practice to improve the profitability of the farm business. The subsections below explore each of these characteristics.

2.3.1 Change and available resources

Table 25 Value of assets and type of change to practice (AFS) and Figure 41 Type of change and profit by value of assets (AFS) show that farm businesses with higher asset values make more changes to practice. This applies to each of the four types of change. The relationship between profit and change was examined in the preceding section. Profit and value of assets are indications of the financial resources available to the farm business for making changes to practice.

The relationship found here between making changes to practice and both farm profitability and value of assets is consistent with the large number of studies which have found that farms with more resources available are more likely to adopt innovations (a fuller discussion is provided in Chapter 2, section 2.9.2. 'Other adopter characteristics'). Examples are Frank (1993), Frank & Chamala (1992) and Cruise & Lyson (1991). Rogers' (1995) review of diffusion of innovations research confirmed that businesses with more resources are more likely to adopt innovations. Lack of sufficient financial resources is also a barrier to innovation in Australian manufacturing industry (Australian Bureau of Statistics, 1995b).

Two aspects of the results of this project further support the link between available financial resources and changes to practice. First, farm businesses whose main activity is sheep farming are less likely to make a change than those whose main activity is in other industries. The sheep industry, which represents 16% of all farm businesses in Australia, has experienced low wool prices in recent years (Costin & Martin, 1995). Second, farm businesses in Western Australia, which was not affected by the drought which hit eastern Australia in the early 1990s (Martin, 1995), were more likely to make changes to practice than farm businesses as a whole. Farm businesses in the sheep industry typically had less income available to make changes than businesses in other industries, while those in Western Australia had more income available than those in other states.

2.3.2 Indebtedness

The approximately one quarter of all farm businesses with no debt are least likely to make each of the four types of change to practice, whilst the 14% of farm businesses with equity between 51% and 75% are the most likely to make each type of change (Table 26 Equity and type of change to practice (AFS)). The group with equity of less than 50% are a very small proportion of all farm businesses (6%). The number surveyed would therefore have been small, and hence not too much weight should be placed on this result.

Many changes to practice such as new equipment and changes to enterprise mix require capital expenditure which is likely to require borrowing. Having no debt therefore is likely to be a reflection of the fact there has been no change to practice, rather than be a contributing factor.

The literature reviewed contains only two studies which consider level of debt and adoption of new practices, both of which find farm businesses with debt are more likely to adopt conservation practices (Campbell & Junor, 1992; Gould, Saupe & Klemme, 1989). If the small group with equity of 50% or less are excluded, the results of this study in relation to changes to land management practices confirms the relationship between debt and adoption of conservation practices.

2.3.3 Education and change

The AFS data shows that farm businesses with better educated managers are more likely to make changes to practice (Figure 32 Change to practice and educational qualifications (AFS)), and Tasmanian interview survey data suggests that this group also makes more changes (Figure 33 Number of changes and education level (Tas survey)). In particular, farm businesses with better educated managers make more financial, marketing and land management changes to practice (Table 17 Education and percentage making a change by category of change (AFS)).

These results confirm that education is especially important for those functions which require adaption to change (Sloan, 1994; Chapman & Stemp, 1992; Bartel & Lichtenberg, 1987; Nelson & Phelps, 1966). Education assists in the decision to change process in the ways such as those suggested by Welch (1970), and already described in section 1.5 Education and training and profit - the direction of causation above.

2.3.4 Size of the management team and change

Individual farms are small 'institutions' in Lundvall's (1992) terms, with consequently limited opportunities for interactive learning within the 'institution'. This is reflected in the amount of change occurring in the small single and dual operator family farm businesses. These small businesses, which comprise 74% of all Australian farm businesses, are less likely to make changes to farming practices than those with larger management teams (Figure 37 Number in management team and changes to practice (AFS)).

Single manager farm businesses are less likely to make each of the four types of change (financial practices, marketing, agricultural practices and land management) than dual manager farms, which in turn are less likely to make each type of change than farm businesses with three or more in the management team (Table 24 Size of management team and percentage making a change by category of change (AFS)).

This finding is consistent with Warriner and Moul (1992) who found that there is a positive connection between farming with another family member (other than a spouse) and adoption of conservation tillage practices in Canada, compared to farming alone or as a couple.

Since individual farms have very small numbers of people between whom there can be interaction, they must rely on networking with other institutions for interactive learning and change, or innovation. Farmers network via farmer organisations, informal social contact with other farmers, government extension officers and rural educational institutions, in producer-purchaser arrangements with food processing companies and retailer-consumer relationships with input suppliers (Fulton, 1994; Solutions Through Research, 1993; Phillips, 1987). The next section, 2.4, examines influences on the change process, and considers data from the Tasmanian interview survey on the use of expert advisers by farm businesses.

2.4. Triggers and influences for change

Most changes to practice are influenced by interaction with, and information from, a number of sources, including peers, experts and training events.

Most changes were prompted by expert advisers, other farmers and training events (see Table 31 Prompts for change to practice (AFS)). Expert advisers, other farmers and training events were important at all stages of the decision-to-change process. They were major sources of awareness of subsequently implement strategies and practices (Table 33 How farmers become aware of important changes (Tas survey)) and major sources of influence on the decision to change (Table 34 Other influences for two most important changes (Tas survey)).

The Tasmanian interview survey data provide information on influences on the change process from initial awareness of the new strategy or practice, including other influences on the decision to change and sources of support once the decision had been made (see Chapter 2, sections 2.6 'Prompts for change' and 3. 'What are the support mechanisms or who are the people who mentor farmers as change is undertaken?'). It is clear from the number of changes for which listed influences are identified in Table 34 Other influences for two most important changes (Tas survey) (a total of 334) that most of the 109 'important' changes made by Tasmanian farm businesses were influenced by several sources or factors.

There being multiple sources of influence on change is consistent with change being a social process involving interaction and collaboration between individuals within organisations and within networks of organisations (Mathews, 1994; Lundvall, 1992). It is also consistent with the decision making models of Rogers (1995) and others, Klausmeier (1985), Argyris and Schon (1974), and Havelock (1971) which are summarised in Chapter 2, section 2.4.1 'Overview of the adoption or decision to change process'. These models identify a number of stages in the process, during which the decision maker seeks and obtains information or confirmation from a variety of sources. As well, Phillips's (1985) model of the stages that precede action by farmers (Chapter 2, section 2.6 'Interaction and change') describes the roles played by others in the learning process of farmers, where each layer of social distance fulfils a vital component of the learning strategy. This finding of multiple influences before change occurs is also consistent with Woods, Moll, Coutts, Clark and Ivin's (1993) conclusion that awareness is not sufficient to bring about a change.

The following four subsections consider the roles played by those within the farm business, peers, experts and mass media sources respectively in the decision to change process. The role of training is considered latter in the section 'Training and change'.

2.4.1 Those within the farm business

Family and staff are considered part of the farm business for the purposes of this discussion. They may or may not be members of the farm management team, but they are part of what Lundvall (1992) refers to as the 'organisation'. As can be seen from Table 31 Prompts for change to practice (AFS), 13% of all changes were prompted by family or staff.

The Tasmanian interview survey shows that family were not often the source of awareness of a change (Table 33 How farmers become aware of important changes (Tas survey)), and are more likely to be an 'other influence' than the critical factor in making the change (Table 34 Other influences for two most important changes (Tas survey) and Table 35 Triggers for the two most important changes (Tas survey)).

The literature on farmer decision making often ignored that part of the process which occurs within the farm business, concentrating only on external information sources and communication channels. Phillips (1985) was one of the few studies which described a role for 'intimates', who he said acted as a checkpoint for information and decision-making, reflecting the importance of intimacy, trust and support in decision-making. Others are Underwood (1985) and Scouller (1978), who found that the farmer's family were used frequently as information sources at every stage of the decision process.

2.4.2 Peers and the decision process

Other farmers were the prompt for 18% of changes from the AFS data (Table 31 Prompts for change to practice (AFS)) and the source of awareness for 26% of the Tasmanian interview survey two most important changes (Table 33 How farmers become aware of important changes (Tas survey)). They are the most frequently cited 'other influence' on change for the Tasmanian interview survey changes (Table 34 Other influences for two most important changes (Tas survey)).

These results show that other farmers had a major influence on farm business change, confirming the large number of studies reviewed in Chapter 2, section 2.6.1 The role of peers in the decision making process, which found that other farmers were a major source of information and influence in farm decision making (Fulton, 1995; Woods, Moll, Coutts, Clark & Ivin, 1993; Moore, 1990; Dillman; 1989; O'Brien, 1987; Phillips, 1985; Bultena & Hoiberg, 1983; Craig, 1983; Presser & Cornish, 1968).

The results lend support to the idea that learning which leads to innovation takes place within organisational and 'social' networks (Lundvall, 1992); to Abd-Ella, Hoiberg and Warren's (1981) finding that the probability of adoption of recommended farming practices increases with participation in organised groups; and Rogers' (1995) conclusion that earlier 'knowers'. of an innovation have more social participation. They are consistent with the role of peers in determining values, attitudes and beliefs which affect behaviour, as described in Chapter 2, sections 2.6.1 The role of peers in the decision making process and 2.7 Values, attitudes and beliefs, including works on the way in which groups of farmers influence values, attitude and beliefs by Woods, Moll, Coutts, Clark and Ivin (1993), Sproule, Godyn & Burfitt (1991) and Benedetti (1969).

Other farmers and family or staff are particularly important in prompting changes for farm businesses with a highest education level below year 10 (Figure 43 Highest education level in management team and prompt for change (AFS)), with assets of less than $1 million, for dual manager farm businesses and for those with 100% equity (Table 32 Prompts, assets, managers and equity (AFS)). Family and staff are more likely to prompt land management and agricultural practice changes than financial and marketing changes (Figure 31 Prompts for change by type of change (AFS)). The farm businesses whose most important change was prompted by family or other farmers had lower profits than those whose most important change was prompted by experts such as consultants and field officers (Figure 44 Average gross operating surplus and prompt (AFS)). These results are contrasted with those relating to changes prompted by experts in the next subsection.

2.4.3 Experts and the decision process

'Experts' including consultants, field officers, government agencies, industry organisations and agricultural purchasing and supplying companies, prompt 38% of changes (see Table 31 Prompts for change to practice (AFS)). These experts are the source of awareness for 24% of changes (as shown in Table 33 How farmers become aware of important changes (Tas survey)) and play a large role in influencing change (see Table 34 Other influences for two most important changes (Tas survey)).

The role of experts found here in the decision to change process is consistent with the large body of literature identified in the literature review that suggests contact with 'experts', such as extension officers, increases the probability of adoption, or early adoption, of innovations (examples of such literature are Fulton, 1995; Miller, 1994; Wozniak, 1987; Huffman, 1974).

Experts were more likely to prompt financial management and marketing changes than land management and agricultural practice changes (as illustrated in Figure 42 Prompts for change by type of change (AFS)). The farm businesses whose most important change was prompted by experts such as consultants and field officers had higher profits than those whose most important change was prompted by family or other farmers, or 'other' prompts (see Figure 44 Average gross operating surplus and prompt (AFS)).

Those farm businesses least likely to make changes to practice in general, and changes to financial management and marketing in particular, are the same group as those who, if they do make a change, were most likely to be prompted by internal or 'neighbourhood' influences (which include family, staff, other farmers and 'other' prompts), and least likely to be prompted by external expertise (training events and experts). This group tended to have lower education levels, no debt, low asset values, lower profit and only one or two managers.

In direct contrast, the group most likely to make changes, and most likely to make changes to financial management and marketing, were the same group who were most likely to be prompted by external expertise (that is training events and experts). This 'progressive' group tend to have agricultural qualifications, some debt, high asset values, higher profit and more than two managers. However, even this group, which have the characteristics which label them as progressive and successful farm businesses, were equally as likely to be prompted by internal or 'neighbourhood' influences as they were to be prompted by external expertise (see Figure 43 Highest education level in management team and prompt for change (AFS); Table 32 Prompts, assets, managers and equity (AFS);and Figure 44 Average gross operating surplus and prompt (AFS)).

The results here suggest that the use of experts for information leads to changes to practice which result in more profitable farm businesses. However, peers, family and friends are important sources of information and advice in the change process for all farm businesses, whether in the 'progressive' group or not.

2.4.4 Relative influence of information and advice sources by education level

Reeve and Black (1993) and Moore (1990) find that higher levels of education tend to be associated with more favourable attitudes toward expertise from outside the farm The results reported in Figure 43 Highest education level in management team and prompt for change (AFS) are partially consistent with this in that family, staff and other farmers were less important in prompting change for those with higher education levels. If the role of experts is extended to include training events (where experts are always expected to be involved), then those with higher educational qualifications were more likely to by influenced to change by experts.

2.4.5 Media as a source of awareness

The literature reviewed in Chapter 2, section 2.5 'Communication channels and awareness', suggested that print and electronic media were an important source of initial information for changes (Rogers, 1995; Longo, 1990; Gibbs, Linder & Fischer, 1987). The Tasmanian interview survey does not support this, with the media being the source of awareness for only nine of the 109 most important changes made by the farm businesses. It is possible that the bias in the sample toward those who had completed a training course could have affected the result, however Riesenberg and Obel Gor (1989) stated that better educated farmers rated publications and media more highly as information source than did those who were less educated.

2.5. Training and change

> *Farm businesses which participate in training are more likely to make changes to their practice which are designed to improve profitability.*

Those funding, running, facilitating and participating in training are involved because they expect the training to influence the behaviour of its participants, and hence impact on variables such as profit and sustainability of the farm business.

AFS data show that 68% of those farm businesses which participated in training in the past year had made a change to practice in the past three years. This is significantly higher than the 39% of non-training farm businesses which made a change to practice in that period (as shown in Table 18 Training participation and changes to practice (AFS)). If current training behaviour is an indication of past training behaviour, as discussed in section 1.3.1 The relationship between recent and past training participation above, then those farm businesses which trained in the last year also trained in previous years.

Further, the AFS data show that those who attend training other than field days were more likely to make a change to practice than those who only attend field days (see Table 19 Training method and farm businesses which make a change (AFS)) and those who attend more training events were more likely to make a change than those who attend fewer (as shown in Figure 36 Proportion of those attending training which made a change (AFS)).

Farm businesses which both train and made changes to practice were more profitable than other farm business (average gross operating surplus of $73 170 compared to $55 335) and contributed more than their share to total farm profit (see Figure 46 Profit and training and change (AFS); Table 37 Contribution to total farm profit by training and change behaviour (AFS)). Those farm businesses which attended training other than field days were most profitable (average gross operating surplus $83 651). Farm businesses with high asset values were more likely to both train and make changes to practice. Farm businesses with small asset values were most likely to neither train nor to have made changes to practice (Figure 40 Change, value of assets and average profit (GOS) (AFS)).

The literature did not include studies about participation in non-formal training in general and change. Rather, the studies related to education and adoption of innovations or to specific training programs and subsequent changes to practice. The literature relating to education and adoption of innovations has been discussed earlier in this chapter. The literature relating to specific training programs and subsequent changes to practice is considered in the following subsection.

2.5.1 Course-influenced changes

Almost two thirds of the Tasmanian course participants (64%) made a change to practice which was influenced by the course (as shown in Table 20 Changes to practice influenced by courses (Tas survey)). The average profit of the group which made a course-influenced change (gross operating surplus $69 371) is higher than the average of course participants who did not make such a change (gross operating surplus $34 450) (see Table 38 Course participants, course influenced change and profit (Tas survey)).

Woods, Moll, Coutts, Clark and Ivin (1993) reported very similar rates to this study of changes to practice following agricultural training programs of 63% (Spencer, 1993) and 64% (Cassidy, Wilson & Thompson, 1983). Newman (1990) reported a higher rate of change of 85% for a chemical spraying program. This compares to nine of the sixteen Tasmanian participants (56%) who made a change influenced by the Farm Chemical Accreditation course.

Changes could occur because of the acquisition of new knowledge and skills at the courses. However, the discussion in section 2.4 Triggers and influences for change above, pointed out that there usually need to be several influences on decision makers in order for a change to occur. As well as delivering new knowledge and skills, training courses provide an opportunity for interaction with other farmers and 'experts' such as extension officers and consultants. The interaction allows individual farmers to compare their values and attitudes with group norms and information to be gathered from a number of sources. The opportunity to alter values and attitudes in these ways increases the probability of a change to practice (Guba & Lincoln, 1989; Chamala, 1987; Phillips, 1987; Bennett, 1980; Fliegel, 1956).

The Tasmanian interview survey results provides evidence of the need for multiple influences for change to take place (see section 2.4 above). The results presented in Table 20 Changes to practice influenced by courses (Tas survey) show that while 64% of participants made a change influenced by the course, the course was the source of awareness of a subsequent change for 20%, but only an influence on change for the remaining 44%.

2.5.2 Reasons for not making a change as a result of attending a course

The most frequently reported reason given by the course participants who did not make a course-influenced change, was that the course reinforced the appropriateness of existing practices. This was especially so for the chemical course (Table 21 Reason for making no change as a result of a course (Tas survey)). Without very detailed information about individual farms and the practices on those farms it is impossible to make a judgment about whether existing practices were more suitable for the farm business than those espoused by the courses, or indeed the same as those espoused by the courses.

Failure to make a change to practice following a training course could be because there had not been an opportunity to trial the practice because it was too expensive or financially risky to trial, for example (Rogers, 1995; Russell, 1990; Nowak, 1982). It could be because it did not fit with the beliefs, values and context of the individual farm and the course had not caused the change of attitude necessary for a change of behaviour (Guba & Lincoln, 1989; Chamala, 1987; Phillips, 1987; Bennett, 1980; Fliegel, 1956).

2.6. Changes to practice, education and training

Section 2 identified that the changes to practice made in farm businesses are always a consequence of multiple sources of information and advice or influence. Education and training is one set of such sources of information, advice and influence on decision makers. Education and training is able to influence change in three broadly defined ways: first, by delivering new knowledge and skills; second, by providing interaction with 'experts' (that is, facilitators, trainers or teachers); and third, by providing opportunities for interaction with peers (that is, fellow training participants).

The opportunity for interaction with peers, family and friends facilitates changes in values, attitudes and beliefs. Indeed, interaction with such social and emotional connections may be necessary before change can occur. Interaction with peers also provides the opportunity for awareness of new practices (other farmers are identified in this section as an important source of awareness of new practices). Education and training present opportunities for interaction with other farmers and with facilitators (who are also 'experts'), as well as opportunities for receiving new information. Training methods which facilitate interaction between peers and with experts are considered in section 4. below.

3. Research Question 3: What are the support mechanisms or who are the people who mentor farmers as change is undertaken?

One major finding emerges from this study in answer to the third research question. The results of this study suggest that:

(i) Family or staff provide the most support in making a change to practice, followed by expert advisers and other farmers. More than one source of support is used in the implementation of most changes.

3.1. Who provides support in implementing change?

Those farm managers making all but 8% of changes identified in the AFS, and all but 19% of changes identified as one of the two most important in the Tasmanian interview survey, were able to nominate sources of support in implementing the change once the decision to change had been made (as set out in Table 39 Sources of support for most important change (AFS) and Table 45 Sources of support for the two most important changes (Tas survey)). The most frequent sources of support in making a change were social or emotional connections; that is, family or staff, followed by other farmers. Technical or expert sources of support (such as consultants and field officers) were cited less frequently than social and emotional sources of support.

Support in implementing a change is important if the change is to be sustained; that is if discontinuance is to be avoided (Rogers & Shoemaker, 1971). The literature reviewed in Chapter 2, section 2 suggested that the decision-to-change process does not stop with the decision to adopt or to change, but that there is an on-going review of the decision which could result in discontinuation. The models of the decision making process reviewed in Chapter 2, section 2.4, 'Diffusion of innovations' by Rogers (1995), Klausmeier (1985), Argyris and Schon (1974) Havelock (1971) all had a final stage that takes place after the decision to change has been made. It is in this final post-decision stage that support for the decision maker plays a role in promoting continuance with the decision.

The large proportion of the AFS and Tasmanian interview survey respondents able to identify sources of support confirms that the interaction with intimates, peers and experts which occurred during the earlier stages of the decision process continued during and after implementation (Rogers, 1995).

3.1.1 Family and staff

Family or staff provided the most support in implementing changes, providing the most support for 41% of changes (Table 39 Sources of support for most important change (AFS)), when only the source giving the 'most' support is considered. When all sources of support are considered, as in the Tasmanian interview survey, family and staff were still one of the most frequently mentioned sources of support, being mentioned as support for 43% of changes (Table 45 Sources of support for the two most important changes (Tas survey)).

Thus, those emotionally close to the decision maker are an important source of support in implementing decisions. Phillips (1985) also emphasised the importance of intimates in providing support for decision making.

3.1.2 Other farmers

Other farmers are the second most often cited source of support in the AFS data, being cited in relation to 18% of changes (Table 39 Sources of support for most important change (AFS)); other farmers were also mentioned by 39% of the Tasmanian survey.

Social support was just as important as physical infrastructure in ensuring that, once implemented, an innovation is not discontinued according to Rogers and Shoemaker (1971). The results from both the AFS and the Tasmanian interview survey confirm the role of social support from peers, or other farmers.

3.1.3 Experts

Whilst experts, such as those from output purchasing or input supplying companies, consultants and government extension officers were the most important sources of support for only 26% of changes (as set out in Table 39 Sources of support for most important change (AFS)), they were mentioned as a source of support for 58% of the Tasmanian interview survey changes (see Table 45 Sources of support for the two most important changes (Tas survey)).

Phillips (1985) stated that experts were the most important source of support for larger farm businesses. Table 59 Source of support and profit (AFS), Table 60 Source of support and assets (AFS), Table 61 Source of support and managers (AFS) and Table 62 Source of support and equity (AFS) present information on sources of support used by farm businesses according to various characteristics. 'Size' can be considered in relation to larger asset value and more profitable businesses. From these four tables, 'experts' were the most important source of support for more profitable farm businesses, but family and other farmers rated ahead of 'experts' as sources of support for farm businesses with larger asset values.

The relationship between having a more profitable farm business and the use of 'experts' as sources of support in making changes to practice is consistent with a greater frequency of changes prompted by experts among more profitable farm businesses. This relationship was discussed earlier in the section 'Experts and the decision process'. The greater frequency of experts as prompts for change and their frequency as source of support for more profitable farm businesses suggest that managers of the more profitable farm businesses have more interaction with experts than their counterparts who manage less profitable farm businesses.

3.2. Multiple sources of support

More than one source of support was used in implementing over half of the important changes identified in the Tasmanian interview survey (as shown in Table 44 Frequency of use of nil, one, and multiple sources of support (Tas survey)). Table 45 Sources of support for the two most important changes (Tas survey) suggests that 'emotional and social' sources of support (family, employees and other farmers) and 'expert' sources were equally likely to be used as sources of support in implementing a change, both being mentioned in relation to 61% of changes.

3.3. Support and training programs

On-going groups such as landcare and crop monitoring discussion groups provide social support for farmers in implementing new practices. Experts associated with such groups can ensure that infrastructure is available so that implementation is feasible and is seen to be feasible by farmers. They can provide information, opportunities for skill acquisition and assist farmers to evaluate the new practice. The networks established through interaction at 'one off' courses and training sessions can also be used as sources for support in implementing change.

The earlier conclusion that farm businesses which engaged in training were more likely to make changes to their practice.(point iv from section 2 above), is consistent with farmers who engage in training having appropriate support for implementing new practices from networks of other farmers and experts. These networks are established or reinforced at training courses and sessions. Training which emphasises opportunities for networking and interaction will be more effective in translating decisions to change into continuing changes to practice by providing support as change is undertaken.

The following section explores the factors which promote access to the networking and interaction opportunities by looking at factors which foster participation in training.

4. Research Question 4: What are the reasons which foster farmer, and their workforce, participation in training?

Four major findings emerge from this study in answer to the fourth research question. The results of this study suggest that:

(i) Farm businesses most likely to participate in training are large (measured by value of assets), more profitable, have some debt, have more educated managers and have more than one person in the management team.

(ii) A low level of education in the farm business management team (no manager with at least ten years of schooling) inhibits participation in formal and non-formal training.

(iii) Seasonal and day-to-day on-farm commitments are the main reasons given for not participating in training.

(iv) Effective training is seen as relevant, non-threatening and directly applicable to the farmer's situation. Training delivered in small groups with the opportunity for interaction with the facilitator/instructor and with fellow participants is effective.

The reasons which foster participation in training can be identified by looking at issues which promote access and at factors which encourage participation. These reasons can also be identified by examining factors which discourage participation - that is factors which are barriers to participation. By removing or reducing such barriers, participation should be encouraged. Hence both 'fostering factors' and 'barriers' are considered in this section.

The finding here that only 3% of farm businesses participated in formal training courses in a twelve month period confirms that there are barriers to participation in formal education for the existing farm workforce. However, this needs to be contrasted with the finding that 80% of farm businesses participated in training if training is defined broadly to include field days, seminars, workshops and conferences as well as formal courses (see Chapter 4, section 4.1.2 Participation in training (Australian data)). Therefore, factors which foster participation are considered in relation to training delivery method, as well as training in general.

It is worth noting that farm managers appear to participate in informal training at a greater rate than do other small business managers; Lynas and Ormond (1986) found that only 50% of Australian small business managers had ever participated in any training relevant to their business. A lack of interest in 'accredited' education and training is consistent with Swanson's (1990) finding that managers of small businesses were more interested in relevant training than in training which provided formal accreditation.

This section follows the pattern of the previous sections. It considers each of the four major findings in turn and relates them to the literature reviewed in Chapter 2.

4.1. Characteristics of farm businesses most likely to participate in training

Farm businesses most likely to participate in training are large (measured by value of assets), more profitable, have some debt, have more educated managers and have more than one person in the management team.

One way of identifying factors which foster training is to examine the characteristics of those farm businesses which train, particularly those which attend many training events, and contrast those characteristics with the characteristics of farm businesses which do not train, or attend few training events. An extension of this is to look at the characteristics of farm businesses which are and are not able identify suitable training events.

Before farm businesses participate in training they must be aware of suitable training programs, and have sufficient information about those training programs to determine whether or not they are desirable training programs for the farm business to attend. The results in Chapter 4, section 4 show that farm businesses which do not participate in training often have not identified any training opportunities which they believe would be worthwhile for their situation. That is there are not training events which they believe would have been desirable to attend, but for some reason did not attend. Furthermore, many farm businesses which do not participate in training also plan no training in the next three years; training plans are another measure of identification of worthwhile training.

Fifty-nine per cent of those who did no training also could not identify any training events worth attending. While most of those not reporting any 'missed' but desirable events were able to attend all those they identified as worth attending, 11% of all farm businesses did not identify any training opportunities which they regard as suitable or worthwhile for their context. The barriers to participating in training for this group extended beyond farm business commitments and distance. Another measure of whether farms are identifying 'desirable' training events is future intentions to train. Thirty-one percent of those who could not identify any training events worth attending in the past 12 months also planned no future training. This represents 13% of the total farm population (see Chapter 4, for example, section 4.1.1 Does education foster further training?).

Training participation and identification of training are considered in the subsections below in relation to various characteristics of farm businesses. The relationship between education and training participation and identification is left until section 4.2 Prior education and participation in training.

4.1.1 Economic resources and training

As discussed in section 1.3 Training and profitability above, larger and more profitable farms are more likely to participate in training events (Figure 54 Value of assets and number of training events attended (AFS) and Figure 23 Profit and number of training events (AFS)). Figure 54 Value of assets and number of training events attended (AFS) shows that those farm businesses with assets of $1 million or more were not only more likely to train, but were more likely to attend a larger number of training events, while those farm businesses with assets of under $500 000 were the group with the highest proportion of non-training farm businesses. The same groups were respectively most and least likely to identify and plan training (Figure 65 Value of assets, training undertaken, identified and planned (AFS)). Figure 58 Profit and training events (AFS) shows that farms which are covering costs (interest payments excluded), but making less than $20 000 per year were least likely to attend, identify and plan training, and those with gross operating surpluses over $100 000 were the most likely to attend, identify and plan training.

Farm businesses with no debt attended fewer training events; 71% attended fewer than four in one year compared to 43% of those with equity between 50% and 75% (Figure 57 Equity and number of training events (AFS)). The farm businesses with no debt were more likely to have a lower asset value (Australian Bureau of Statistics, Agricultural Financial Survey 1993-94, unpublished data), so this result may be a reflection of the asset value of these businesses rather than being related to level of indebtedness. Another possible explanation is that newer entrants to farming were more likely to have debt than those with longer experience. The experienced group may believe they are less likely to benefit from training than new entrants.

The finding here that larger, more profitable farm businesses are more likely to train lends weight to Johnson, Bone and Knight's (1996) suggestion that it is the 'leading' group of farmers who participate in training.

The finding that larger, more profitable farm businesses were more likely to train is also consistent with Smith & Kahler (1982) who found that farmers with larger acreages and higher profit are more likely to participate in training, and is consistent with Lees and Reeve's (1991) assertion that there was a high opportunity cost of education for farmers and their families which discouraged those with fewer economic resources from participating.

Larger, more profitable farm businesses were more likely to participate in training by all delivery methods, and particularly in training other than field days (Figure 26 Profit group and field day attendance by asset group (AFS); Figure 29 Profit group and seminars and workshops by asset group (AFS); Figure 30 Profit group and conferences and industry meetings by assets (AFS)). Farm businesses which made a loss were more likely to participate in all forms of training than those which made a small, but positive, profit. Unfortunately, the very small number of farm businesses whose existing workforce participates in formal training courses did not allow consideration of a breakdown of these businesses by farm business characteristics because the standard errors were very large.

The correlation for farm businesses which made a positive gross operating surplus, between profitability and participation in training other than field days raises the question of whether these forms of training delivery are more effective than field days in terms of impact on profitability. This issue is considered further in section 4.4 Effective training delivery methods below.

4.1.2 Size of management team

Single manager farms attended less training events than farm businesses with larger management teams and were less likely to identify training worth attending (Figure 52 Size of management team and number of training events (AFS); Figure 53 Size of management team and training identified and attended (AFS)).

This result may be due to the resource constraints discussed in the previous section; both in terms of human resources to replace the manager while training occurs, and financial constraints. Figure 25 Size of management team, training and profit (AFS) shows that there is some positive relationship between the number of training events attended and profitability for a given management team size. As discussed in section 1.5, the direction of causation could be argued to run from training participation to profitability, although there is an argument for the direction of causation to be from profitability to training participation.

4.1.3 Participation in training and changes to practice

As already noted in section 2.5 Training and change above, there is a strong correlation between farm businesses which trained and those which made changes to practice.

Johnson, Bone and Knight (1996) stated that their relatively small sample supported research identifying a 'leading group' of training participants who use both short term learning and formal courses, and who comprise only about a quarter of all farmers. Johnson, Bone and Knight's (1996) definition of short term learning extends beyond participation in training 'events' to include listening to the radio and reading. This thesis suggests that farmer participation in 'learning' is much more widespread, and that even if field days are not included as 'short term learning' events, then 55% of farm businesses were engaging in formal courses 'short term learning' (Figure 20 Distribution of farm business training behaviour (AFS)). Those farm businesses which did participate tended to be more profitable and were more likely to make more changes to practice. High profitability and willingness to make changes to practice in order to improve profitability are characteristics which could be ascribed to 'leading' farmers.

4.2. Prior education and participation in training

A low level of education in the farm business management team (no manager with at least ten years of schooling) inhibits participation in formal and non-formal training.

The largest group of those who attended no training events came from farms where the highest education level is year 9 or below. This group represented 42% of farm businesses which did not participate in training, but comprised only 19% of all farm businesses. Figure 49 Education and participation in training (AFS), shows participation in training according to the highest education level in the farm management team.

A low education level is also an impediment to identifying suitable training events. Failure to attend any training combined with no worthwhile training 'missed' is failure to identify suitable training. Farm businesses managed only by those with low education were over represented in those who participated in no training and also missed no events. Figure 50 Education, identification of training and training plans (AFS), shows that 28% of those with highest education year 9 or below failed to identify any suitable events in the past 12 months (that is, attended none and 'missed' none. This compares with less than 10% of farms where at least one person had more years of education.

This finding that those with less years of education were less likely to participate in training is consistent with McKenzie and Long's (1995) finding that Australian employees with more education had a higher incidence of participation in formal training courses.

Higher education levels are associated in this study with a greater likelihood of planning some training over the next three years. Sixteen percent of all farms planned no training over the next three years, and 46% of these have completed only year 9 or below. Figure 50 Education, identification of training and training plans (AFS), reflects this relationship between having fewer years of education and low participation in training. Figure 50 shows that almost one third of the lowest education level group not only did not participate in a training event in the past 12 months, but also planned no training in the next three years. This compares with less than 10% of farm businesses with higher education levels.

The correlation demonstrated in this study between education and perceived need for education confirms the finding of Daniels and Chamala (1989) that farmers with tertiary education or secondary level education up to at least year 10 demonstrated a greater perceived need for learning.

Adult learning literature provides some reasons for the correlation between education levels and perceived need for further education and training. Low actual or perceived literacy levels and lack of confidence as a learner are barriers to participation in training. Lack of confidence as a learner could be due to an unsatisfying or unsuccessful school experience or because of the length of time away from formal education (Salzberger-Wittenberg, Henry & Osborne, 1983 quoted in Tennant, 1991). Phillips (1987) suggests that in the past, children who were to inherit family farms were not encouraged to participate in post-compulsory education. Johnson, Bone and Knight (1996) found that farmers in New South Wales were reluctant to participate in formal courses because of a lack of confidence in their own abilities to perform successfully in a formal education setting. A fuller discussion appears in Chapter 2, section 4.2, 'Prior education as a barrier to training'.

4.2.1 Past training is a predictor of future training

As discussed in section 1.3.1 The relationship between recent and past training participation above, Table 13 Training participation over time (Tas survey) shows a strong correlation between recent and past 'propensity' to train, as measured by the number of training 'events' attended by the farm business. As well, the Tasmanian interview survey suggests that farm businesses which attended formal courses were more likely to attend training other than field days (Figure 51 Course attendance and other training (Tas survey)) and that those who had attended courses were more likely than other farmers to prefer to attend courses in the future (Table 58 Preferred delivery mode for identified future training (Tas survey)).

These three pieces of information are consistent with previous experiences of education and training fostering current participation in training, and with McKenzie and Long's (1995) finding that those with more education were more likely to participate in training, as mentioned above.

4.2.2 Implications of low education levels for Australian farm productivity

To summarise the discussion in this section, Australia's relatively poorly educated farm workforce (Australian Bureau of Statistics, 1994; Cameron & Chamala, 1993) not only limits our productivity directly in the ways suggested by Welch (1970), but has a compounding effect by inhibiting further training, and so further limiting our capacity to be flexible, adaptable and respond to change.

Two approaches are needed to overcome this disadvantage, one for new entrants to farming and one for the existing farm workforce, particularly farm managers. Initial entrants to farming should be encouraged to complete their schooling and to study post-school agricultural courses, although a survey of key stakeholders in agriculture and in agricultural education suggests that this is now occurring (Kilpatrick, 1996). The existing workforce needs access to training which recognises the barrier of low levels of formal education and the barrier created by farmers' loss of confidence in their ability to participate successfully in education and training. This issue is considered further in section 4.4 Effective training delivery methods below.

4.3. Reasons given for not attending training programs

Seasonal and day-to-day on-farm commitments are the main reasons given for not participating in training.

Australia wide, over half of all farm management teams identified, but missed, at least one training event which the managers considered desirable for that farm. Figure 59 Reasons given for not attending events identified as desirable (AFS) and Table 50 Reasons for not attending (Tas survey) show the reasons given by farm businesses for 'missing' training events identified as worthwhile. The majority of reasons given for 'missing' worthwhile training relate to on-farm commitments. This has implications for course delivery modes, as well as for scheduling of training events. Flexible delivery modes which allow for study at or near home at times which are convenient to individuals may overcome some of these 'barriers' to participating in training.

While some training barriers can be overcome by the provision of flexible delivery methods, electronic communication and provision of training 'events' in remote locations, there are also barriers in attitudes toward training and in the values which some farmers place on training, particularly those from smaller farm businesses. Some of these barriers are related to prior education. The reasons given for not attending training events were likely to exclude reasons relating to lack of confidence in ability to 'cope' in more formal training environment, as identified by Johnson, Bone and Knight (1996) and reasons relating to the cultural barriers identified in Chapter 2, section 4.31 Cultural barriers (for example, Lees & Reeve, 1991; Clarke, 1987). Stated reasons for missing identified training opportunities were also likely to exclude those reasons mentioned in the previous section relating to low levels of prior education.

4.4. Effective training delivery methods

Effective training is seen as relevant, non-threatening and directly applicable to the farmer's situation. Training delivered in small groups with the opportunity for interaction with the facilitator/instructor and with fellow participants is effective.

Responses from the Tasmanian survey course participants to the open-ended questions "what did you like most about the course" (Table 51 What people liked most about the course (Tas survey)) and "what did you like least about the course" (Table 52 What people liked least about the course (Tas survey)) give some indication of factors which fostered and factors which inhibited course participation.

About three-quarters of all those from each course cited the content or knowledge gained as the thing they liked most. This suggested there was a willingness to participate in training which is relevant to that particular farm business. A common suggestion for improving all three courses was that less material be covered per session, with most suggesting holding shorter sessions.

The practical nature of the courses and the opportunity for interaction with other farmers were mentioned as positive factors by those who attended all three courses. As well, face-to-face courses were the most popular training delivery method for identified future training needs for the Tasmanian farm businesses, followed by seminars or workshops (Table 58 Preferred delivery mode for identified future training (Tas survey)).

Knowles's (1990) andragogical model of adult learning suggests that adults choose to learn things they believe are directly applicable to their situation - that is they prefer training which is relevant and 'practical'. Others who found that farmers prefer small group learning/training environments with the opportunity for interaction were Fulton (1995), Carter and Batte (1993), Moore (1990), Riesenberg and Obel Gor (1989) and TAFE Curriculum Services Tasmania (1984; 1986; 1987a; 1987b). The discussion in section 2.4 Triggers and influences for change above suggests that interaction with others, including experts and peers, is an important prerequisite for change to behaviour. Changes to behaviour and farm management practices are expected outcomes of courses, and hence effective training could be expected to include opportunity for interaction with the 'expert' instructors and with fellow participants.

4.4.1 Delivery methods which influence behaviour

Sixty-four percent of the Tasmanian course sample made changes to their practice which were influenced by participation in one of the three courses (Table 20 Changes to practice influenced by courses (Tas survey)). As discussed in section 2.5.1 Course-influenced changes above, this proportion of participants being influenced to change is similar to the proportion for other agricultural course and programs reported in Woods, Moll, Coutts, Clark and Ivin (1993).

Those who participate in training other than field days are more likely to make changes to their practice than those who do not train or who attend only field days (see section 2.5 Training and change above), however, the Agricultural Financial Survey data does not include any information on whether the changes made by these farm businesses were influenced by specific training events.

4.4.2 Characteristics of training methods which promote access

Field days were successful in attracting farmers; Figure 20 Distribution of farm business training behaviour (AFS) shows that 76% of farm businesses participated in field days in a twelve month period. Aspects of field days that may encourage participation in training are: the relatively short time commitment (usually one day or less), being able to see an innovation or new practice in operation, the opportunity to question experts, the opportunity to listen to and question the farmers who have trialed the innovation, the ability to compare the adopters' situation (in terms of physical characteristics of the farm and other perceived characteristics which may influence adoption) with one's own, and the opportunity for interaction with peers.

All except the first of the above aspects of field days are also factors which encourage the adoption of innovations (see section 2.4 Triggers and influences for change above). Interaction with peers allows confirmation of group norms re values and attitudes relevant to the innovation. Peers also provide support when change is subsequently undertaken (see section 3 above). Others who found the field day format useful for awareness of innovations and/or influencing behaviour were Solutions Through Research (1993), Woods, Moll, Coutts, Clark and Ivin (1993) and Nieto and Henderson (1991).

Whilst distance as a 'barrier' to attending identified training events formed only 11% of reasons for missing events for the AFS survey and 19% for the Tasmanian survey (Figure 59 Reasons given for not attending events identified as desirable (AFS) and Table 50 Reasons for not attending (Tas survey)), most of the Tasmanian farmers interviewed preferred that training be delivered within 80 kilometres of their farm (Chapter 4, section 5.12 Preferred delivery characteristics). This suggests that training location may be a factor in fostering participation in training.

Cost of training did not appear to be a significant inhibiting factor, making up less than 10% of the reasons for missing training in the AFS survey and 12% in the Tasmanian survey (Figure 59 Reasons given for not attending events identified as desirable (AFS) and Table 50 Reasons for not attending (Tas survey)).

4.5. Summary of barriers to participation

The results here show that farm managers were more likely to participate in informal training than were other small business managers, however farm managers had a low level of participation in formal education and training. This was characterised by only 3% of farm businesses having someone undertaking a course in a twelve month period, and only 15% having at least one manager with agricultural qualifications. Barriers to training included a low level of education, being a small farm and having a single manager. Over one third of farm businesses reported that on-farm commitments prevented participation in training. Distance from where the training activity was held prevented less than one fifth of farm businesses from participating in training, and cost was a barrier for only 12% of farm businesses.

While some training barriers can be overcome by the provision of flexible delivery methods, including electronic communication, and by provision of training 'events' in remote locations, there were also barriers in attitudes toward training and in the values which some farmers placed on training, particularly those from smaller farm businesses. Some of these barriers were related to prior education and some farmers' lack of confidence in their ability to succeed in a formal training setting.

This study has established that over three-quarters of farm businesses have managers who attend field days, where there is the opportunity for interaction with peers. The results here also suggest that interaction with peers is a feature of effective training, that is, training which results in changes to farm practice. Interaction with peers facilitates change by influencing farmer values and attitudes toward the change. Putting these two findings together, it is argued that the popular and non-threatening field day format should be used to entice more farmers into training. This could be achieved by using peer interaction at field days to alter values and attitudes toward training. Farmers should be given the opportunity to experience success as learners in a modified training format which includes a large amount of peer interaction, but has features of more formal training, such as planned learning outcomes and the option of completing assessment. Once large numbers of farmers become confident of their ability to succeed in such a training setting, a 'training culture' would be established among farmers.

5. Research Questions 5: What are the future training needs in agriculture?

Two major findings emerge from this study in answer to the final research question. The results of this study suggest that:

> (i) Over 80% of farm businesses intend to participate in some training, including field days, in the next three years. Most intend to participate in training about agricultural practices.
>
> (ii) Areas identified by 'experts' as requiring more training for practising farmers are: management practices, especially financial management; risk management; marketing; and communication skills.

5.1. Training intentions

Over 80% of farm businesses intend to participate in some training, including field days, in the next three years. Most intend to participate in training about agricultural practices.

Eighty-three percent of Australian farm businesses plan some training in the next three years (Table 53 Area of intended training (AFS)).

5.1.1 Farm business characteristics and training intentions

The farm businesses which plan no training in the next three years were more likely to have a low value of assets, no or a low level of debt, make a positive gross operating surplus of less than $20 000 and be run by a single manager with a low level of education (Table 54 Training intentions by assets, profit, equity, managers and education (AFS)). The characteristics of those who do not plan training are a direct contrast to the characteristics of those who do plan to train. Farm businesses which plan training were more likely to have a high asset value, a moderate debt level, make a large gross operating surplus and be managed by three or more people, at least one of whom has an agricultural qualification. The characteristics of those planning no training were similar to the characteristics of those farm businesses which attended no training, while the characteristics of those who were most likely to plan training are similar to the characteristics of those who were most likely to participate in training (see section 1 above).

Sixty-six percent of those who plan no training in the next three years did not participate in any training in the last twelve months (see Chapter 4, section 5.1.1 Training behaviour over time). This represented 11% of all farm businesses.

The above results lend weight to the arguments put in section 4 above in relation to low levels of education and lack of human and economic resources being barriers to participation in training.

5.1.2 Subject of planned training

Most of those farm businesses which intended to train plan training in the area of agricultural practice; 80% of those intending to train, being 70% of all farm businesses, intend to train in the area of agricultural practice (AFS data). This contrasts with financial management and marketing where only around one fifth of farm businesses plan training (Table 53 Area of intended training (AFS)). Larger farm businesses by value of assets were more likely to plan training in all areas, particularly financial management, marketing and land management (Table 55 Intended training area by value of assets (AFS)).

The categories for future training plans from the Agricultural Financial Survey do not allow a direct comparison with surveys such as that discussed by Johnston (1994) which reported that 70% of farmers wanted to upgrade 'management' skills. From the Tasmanian survey, it appears that the demand for management training is lower than Johnston (1994) reported, with just over half of the course sample wanting more training in the management area, compared to less than one third of others surveyed. The most popular future training area for both groups was agricultural practices (Table 57 Summary of identified training needs by course/non-course samples and area (Tas survey)).

Farm managers identified training needs are contrasted with areas identified by 'outside experts' as areas where farm managers need to upgrade skills in the following section.

5.2. Outside identification of training needs

Areas identified by 'experts' as requiring more training for practising farmers are: management practices, especially financial management; risk management; marketing; and communication skills.

Outside experts such as industry leaders, extension officers and educators have identified a need for farmer skills improvement in management, especially financial management, marketing and communication (Kilpatrick, 1996a; Woodford & Collins, 1993; Pollard, 1992; Blackburn, 1992; Sproule, Godyn & Burfitt, 1991).

The results relating to area of planned future training from the AFS do not mirror the areas identified by 'outside experts' as the areas where farm managers need to upgrade skills, with relatively small numbers planning training in financial management and marketing. The future training demands of a small sample of former Whole Farm Planning course participants (Kilpatrick, 1996b) more closely match the areas identified by 'outside experts'. The needs identified by the Tasmanian course sample (as discussed in the previous paragraph) fall somewhere between the AFS and Whole Farm Planning course participants in closeness of match to the needs identified by 'outside experts', with the course participant sample in particular demanding management training. Neither the AFS nor Tasmanian survey provides information on farmer demand for training in communication skills.

These results suggest that farm managers should be made aware of the need for and benefits of training in the areas of management, especially financial management, and marketing. Suitable training programs will then be required. These should be developed to include the features of effective training programs identified in section 4 above.

6. Areas for further research identified in this thesis

6.1.1 Education, training and profit

Further investigation of the relationship between education and training and profitability is suggested. One area for further research is the group with mid range asset values identified here where there is not a positive relationship between agricultural qualifications and profit. The multiple regressions in Appendix F also suggest that further research is required to determine the factors which influence the size of the gross operating surplus of farm businesses which make a negative gross operating surplus.

Another area for further research is how training impacts on profit. This work should extend the analysis of how training influences change on farms, examined here for the three Tasmanian courses.

6.1.2 Changes to practice and training

This study is the only identified study which considers general levels of participation in training, especially non-formal training, and business profitability. Further research is needed into the extent to which training leads to changes to practice, and how those changes impact on profitability and other outcomes for the farm business such as environmental sustainability.

6.1.3 Support networks

The role which education and training can play in developing and maintaining support networks should be investigated further, and should form part of any consideration of effective training delivery methodologies.

6.1.4 Barriers to training participation

Further research is needed into effective training delivery methods, particularly for that section of the existing farm workforce who have commitments on the farm, and of whom a substantial proportion appear to lack an orientation toward training. The role which education and training can play in developing and maintaining support networks should be part of any consideration of effective training delivery methodologies.

6.1.5 Future training directions

Further research into ways of encouraging as wide a cross section of farm managers as possible to upgrade their skills in management, marketing and communication is desirable.

The reasons for the discrepancy between the areas where experts say farmers need to train, and the areas of training need perceived by farmers themselves, require investigation.

6.1.6 Multi-faceted methodology

This study has used a multi-method approach, with a large quantitative data set illuminated by a smaller sample of semi-structured, face-to-face interviews. The approach has proved successful, and should be used for other studies. The method has the potential to be used both for other studies in the area of education and training, and further afield.

7. Conclusion

The conclusions from this study relate to the five research questions: the impact of education and training on profitability; the factors which trigger and influence changes to practice; sources of support in implementing change; barriers to participation in training and future training directions.

7.1.1 Impact of education and training on profitability

The results presented here strongly suggest that formal industry-specific, agricultural education contributes to farm business profit. Further, participation in informal, non-accredited training, such as seminars, workshops, conferences and industry meetings, also contributes to profit.

This study shows that education and training influence decisions made on farms. It also shows that changes made to practice contribute to farm businesses profit. Change is the link between education and training, and profitability and long term viability; that is, education and training foster profit-enhancing change.

These conclusions which link education and training to improved profitability and viability are in accord with the views of the National Farmers' Federation Australia and other agricultural leaders who have recognised the need for more training in agriculture, and the development of a culture that values continuing training for farm managers and their workforce (Asimus, 1996; National Farmers' Federation, 1993).

7.1.2 The triggers for change

The ability to adapt to the changes impacting on farm businesses is a prerequisite for future business viability in a world of widespread change. These changes are in the areas of technology, markets, policy settings and community expectations relating to stewardship of the land. This study confirms that education and training assists farm businesses respond to change, and in this way, education and training enhances the chances of survival and success.

Training events, including formal and informal courses, seminars, conferences, industry meetings and field days, play an important role in making farmers aware of new strategies and practices. They also foster the adoption of practices of which the farm management team was already aware.

Interaction with peers and with experts, such as private consultants, financial advisers and field officers, is a key factor in the decision-to-change process. Indeed, most changes require interaction with both social and emotional connections (that is, other farmers, family and friends) and technical or expert contacts. Training events which encourage interaction are likely to be successful in facilitating changes to practice.

7.1.3 Support in implementing change

Farm managers are able to identify sources of support in implementing most changes. These people who provide support come from mainly from social and emotional connections. Thus, the importance of interaction with others continues beyond the point where a decision to change is made, and into the implementation phase.

Participation in education and training facilitates the establishment of networks among participants. It also establishes 'expert' contacts for participants; that is, contacts with the education and training facilitators or instructors. These peer networks and expert contacts can provide support in implementing change.

7.1.4 Barriers to participation in training

Since education and training assists farm businesses to be responsive and financially successfully, it is essential to identify factors which foster and inhibit participation in education and training, and devise and implement strategies to reduce or remove those barriers. This study suggests that while some of the fostering and inhibiting factors are related to the characteristics of individual farm businesses, others are related to how and when training is delivered.

The typical profile which emerges of a farm business which is not participating in training is a small farm business making a little more than break even profit, managed by a single manager with a low level of education. The factors inhibiting training for such a farm business can be divided into resource and cultural barriers to training.

Resource barriers are lack of human resources to replace the farm manager on the farm while training occurs, and economic barriers due low profit levels which prevent purchase of replacement labour and discourage expenditure on training and associated costs such as travel.

Cultural barriers are related to past negative experiences with education, indicated by an early exit from schooling and non-participation in post-school education, and exacerbated by lack of a training culture among farmers who are outside the 'leading' group of progressive farmers.

Those farm businesses which have attended training at the more formal end of the spectrum are more likely to go on participating in more formal training. The challenge is to entice the other farm businesses into courses, seminars, workshops, conferences and industry meetings.

For training to be effective, it must be relevant to the farmer participants. Interaction between participants and with expert instructors/facilitators is a feature which should be encouraged in training programs, because such interaction increases the effectiveness of training by fostering changes to practice. Interaction and networking are especially important for single manager and dual manager farm businesses which have limited opportunity for interaction with others within the farm businesses.

Field days are a popular type of informal training, with the data here revealing that mangers from over three-quarters of farm businesses attend at least one field day in a year. The field day format is one of practical demonstration, opportunity for questions, and informal interaction with other farmers and experts. This format is successful in attracting farmers, and could be used more widely to foster farmers' confidence in their ability to participate successfully in training. The results here suggest that farmers who have had successful training experiences are more likely to participate in further training, including formal, accredited education and training.

7.1.5 Future training

Outside experts identify a need for training in management and marketing skills, yet few farm businesses here identify a need for, or plan, training in these areas. Farm business managers should be made aware of the benefits of such training and programs should be developed which include the features of effective training programs identified above.

In conclusion, all farm businesses should become aware of the benefits of education and training in fostering profitable change and hence improving the chances of long term farm business viability. Increased education and training will assist Australian agriculture overcome the disadvantages of a relatively poorly educated farm workforce compared to our international competitors and compared to other Australian industries, and enhance the ability of Australian farm businesses to be flexible and adaptable in response to changing domestic and global circumstances.

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APPENDIX A - QUESTIONNAIRE

Rural training programs: effectiveness and profitability

Date of interview____________ Tape number and reference ______________

1. Please tell me about the history of your farm over the past three years.

- *What you have produced,*
- *who has worked on the farm, and*
- *any achievements and significant events.*

- **Products (include changes in output levels)**

- **Workforce (family and staff)**

- **Achievements and significant events (include positive and negative events)**

Please outline the reason behind each achievement and event.

1.____

Reason____

____

2. ____

Reason____

____

3.____

Reason____

____

4. ____

Reason____

____

2. What have you done over the past 3 years which has improved/maintained the long term profitability or viability of the farm?

[These may have been listed in question 1.]

Rank these actions/changes in order of your perceived importance to the long term profitability or viability of the farm.

[Interviewer to probe to 'unravel' single changes from a strategy of related changes.]

	Ranking
Changes to production level(s) and/or crop mix	
Changes in chemical use	
'New' technology or equipment	
Pasture planning	
Increased or reduced farm size (specify which)	
Other land management (include landcare/sustainability and irrigation)	
Changes to record keeping	
Changes to financing	
Changes to farm workforce	
Improved job skills (including management skills)	
Other management practices (specify)	
Marketing	
new client/market	
new marketing method (advertising, packaging, etc.)	
industry body marketing	
Other (specify)	
No deliberate changes	

Consider the two most important changes above. Please describe the sequence of events for each change by answering the following questions.

(Separate answers for each change for questions 3-6)

3. How did you first become aware of the strategy/action/ new technology?

	Change 1	Change 2
Attending field days, informal workshops, talks, conferences, or seminars		
Formal training courses which do not lead to a qualification (these will generally consist of more than one session)		
Study for a qualification (e.g. TAFE)		
From government agencies (include DPIF, TDR (TDA), educational institutions if not via one of the first 3 methods)		
From agricultural or other input suppliers		
From the purchaser of your output		
From your family		
From your staff		
From consultants or financial institutions (include accountants, lawyers)		
From other farmers (including at discussion groups)		
From rural industry organisations		
The media (print, radio or TV)		
Other (please specify)		

4. Were there other factors which influenced you to make the change?

	Change 1	Change 2
Attending field days, informal workshops, talks, conferences, or seminars		
Formal training courses which do not lead to a qualification (these will generally consist of more than one session)		
Study for a qualification (e.g. TAFE)		
Advice from government agencies (include DPIF, TDR (TDA), educational institutions if not via one of the first 3 methods)		
Agricultural companies or other input suppliers		
The purchaser of your output		
Family		
Staff		
Consultants or financial institutions (include accountants, lawyers)		
Other farmers (including at discussion groups)		
Rural industry organisations		
The media (print, radio or TV)		
Change in prices		
Climate		
Other external factors (specify)		
Other (please specify)		
Nil		

5. What was the factor which was the most critical in making your decision to go ahead with the change?

Change 1____

Change 2____

6. Once you had decided to make the change, who provided you with support? Please rank in order of importance.

	Change 1	Change 2
Family		
Government agency		
Other farmers		
Purchasers of the farm's production		
Suppliers of inputs		
Farming or industry organisation		
Your staff		
Consultants or financial institutions (include accountants, lawyers)		
Other (specify)		
Nil		

If possible can you give the sequence of support received?

	Change 1	Change 2
Family		
Government agency		
Other farmers		
Purchasers of the farm's production		
Suppliers of inputs		
Farming or industry organisation		
Your staff		
Consultants or financial institutions (include accountants, lawyers)		
Other		

COURSE PARTICIPANTS

For farmers who attended the farm chemical, intensive pasture planning and/or dairy farm productivity courses only.

Other farmers go to question 8 on page 14.

Course(s): [circle]

Dairy Date ______________________

Chemicals Date ______________________

Pasture improvement Date ______________________

7a. Did any other member of your family or staff attend the course?

[Including another offering of the same course]

Yes

No

7b. Did you find the course(s) useful?

Yes

No

7c. Did you make any changes to the way you manage or operate your farm as a result of attending the course(s)?

Yes

No

If No go to question 7d on page 12.

CHANGES MADE

Have, or do you expect, any of the changes to improve the profitability or long term viability of your farm?

Yes

No

If No go to question 7e on page 12.

SUCCESSFUL CHANGE

If there was more than one change, consider the change which you expect will *most* improve the profitability or long term viability of your farm.

The change was number ***1*** / ***2*** ***covered earlier.*** [circle which]

Go to question 7e on page 12.

or

The change was to:

[tick one]

Production level(s) and/or crop mix	
Chemical use	
Technology or equipment	
Pasture planning	
Farm size (specify increase or reduction)	
Other land management (include landcare/sustainability and irrigation)	
Record keeping	
Financing	
Farm workforce	
Improve job skills (including management skills)	
Other management practices (specify)	
Marketing	
new client/market	
new marketing method (advertising, packaging, etc.)	
industry body marketing	
Other (specify)	

(i) Did you first find out about the new action/ strategy/ technology at the course?

Yes

No

If not, how did you first find out about it?

Attending field days, informal workshops, talks, conferences, or seminars	
Other formal training sessions which do not lead to a qualification (these will generally consist of more than one session)	
Study for a qualification	
From government agencies (include DPIF, TDR (TDA), educational institutions if not via one of the first 3 methods)	
From agricultural companies or other input suppliers	
From purchasers of your output	
From your family	
From your staff	
From consultants or financial institutions (include accountants, lawyers)	
From other farmers including at discussion groups	
From rural industry organisations	
The media (print, radio or TV)	
Other (please specify)	

(ii) Were there factors other than the course which influenced you to make the change?

Yes

No

If yes, what were they?

	[tick]
Attending field days, informal workshops, talks, conferences, or seminars	
Other formal training sessions which do not lead to a qualification (these will generally consist of more than one session)	
Study for a qualification	
Advice from government agencies (include DPIF, TDR (TDA), educational institutions if not via one of the first 3 methods)	
Agricultural companies or other input suppliers	
Purchasers of your output	
Family	
Your staff	
Consultants or financial institutions (include accountants, lawyers)	
Other farmers including at discussion groups	
Rural industry organisations	
The media (print, radio or TV)	
Other (please specify)	

(iii) Was there one factor which stands out as the most critical in making your decision to go ahead with the change?

It was the course ______

or circle a factor in above list.

(iv) Once you had decided to make the change, who provided you with support?

Please rank in order of importance.

	Ranking
Family	
Government agency	
Other farmers	
Purchasers of the farm's production	
Suppliers of inputs	
Farming or industry organisation	
Your staff	
Consultants or financial institutions (include accountants, lawyers)	
Other (specify)	
Nil	

If possible can you give the sequence of support received?

	Change 1	Change 2
Family		
Government agency		
Other farmers		
Purchasers of the farm's production		
Suppliers of inputs		
Farming or industry organisation		
Your staff		
Consultants or financial institutions (include accountants, lawyers)		
Other		

NO CHANGES

7d. Why not?

[Interviewer to probe for to get below the initial surface response]

[tick all applicable]

Course was too theoretical	
Other course delivery problems	
Prefer old way of doing things/ old way more suitable for my farm	
Not enough capital to implement changes	
Cost not worth expected return	
Didn't apply to my farm	
Other (specify)	

ALL COURSE PARTICIPANTS

Answer for each course attended.

7e. What did you like most about the way the course was delivered?

Course ______________________

____

____

Course ______________________

____

What did you <u>like least</u> about the way the course was delivered?

Course ______________________

____

____

Course ______________________

____

____

How could the course delivery <u>have been improved</u>?

Course ______________________

____

____

Course ______________________

____

____

ALL RESPONDENTS

8. Have you made any deliberate changes to the way the farm was managed or operated or to farm finances which were unsuccessful?

Yes

No

If no, go to question 9 on page 18.

What were those changes? Give two if possible.

Consider one of the unsuccessful changes. Why did you decide to make the change? Please describe the sequence of events by answering the following questions.

8a. How did you first find out about the strategy/ action/ technology?

	[tick]
Attending field days, informal workshops, talks, conferences, or seminars	
Formal training courses which do not lead to a qualification (these will generally consist of more than one session)	
Study for a qualification	
From government agencies (include DPIF, TDR (TDA), educational institutions if not via one of the first 3 methods)	
From agricultural companies or other input suppliers	
From purchasers of your production	
From your family	
From your staff	
From consultants or financial institutions (include accountants, lawyers)	
From other farmers (including at discussion groups)	
From rural industry organisations	
The media (print, radio or TV)	
Other (please specify)	

8 b. Were there other factors which influenced you to make the change?

	[tick]
Attending field days, informal workshops, talks, conferences, or seminars	
Formal training courses which do not lead to a qualification (these will generally consist of more than one session)	
Study for a qualification (e.g. TAFE)	
Advice from government agencies (include DPIF, TDR (TDA), educational institutions if not via one of the first 3 methods)	
Agricultural companies or other input suppliers	
The purchaser of your output	
Family	
Staff	
Consultants or financial institutions (include accountants, lawyers)	
Other farmers (including at discussion groups)	
Rural industry organisations	
The media (print, radio or TV)	
Change in prices	
Climate	
Other external factors (specify)	
Other (please specify)	
Nil	

8c. What was the factor which was the most critical in making your decision to go ahead with the change?

____

8d. Once you had decided to make the change, who provided you with support? Please rank in order of importance.

	Ranking
Family	
Government agency	
Other farmers	
Purchasers of the farm's production	
Suppliers of inputs	
Farming or industry organisation	
Your staff	
Consultants or financial institutions (include accountants, lawyers)	
Other (specify)	
Nil	

8e. Why was the change unsuccessful? ______________________________

____

____

ALL RESPONDENTS

9. Farm workforce (include management and bookkeepers)

Number of family members involved:

full time ___________

part-time and seasonal___________

Apprentices and trainees __________ (including _______ family members)

Other employees

full time _________________

part-time and seasonal_________________

10. Details for farm manager and each member of farm workforce.

Person	1	2	3	4	5	6
Is this person a manager?						
Age						
below 25						
25 - 49						
50+						
Highest educational qualification						
below Year 10						
Year 10 - Year 12						
post-school qualifications (major area)						
agricultural practice						
management						
other						

11. Which of these outside consultants have been employed/used in past 3 years?

	[tick]
Accountants	
Bookkeepers	
Lawyers	
Farm contractors	
Private agricultural consultants (including soil tests)	
Department of Primary Industry and Fisheries	
Tasmania Development and Resources (TDA)	
Field officer from company which purchases your production	
Bank advisers	
Private vets	
Other (specify)	

12. How many training and information sessions have been attended by the family involved in and staff of the farm management unit in the last 3 years?

List name of sessions/courses if possible.

Type of activity Subject area	Formal qualifications (TAFE, Uni)	Other courses	Field days, workshops, conferences, seminars, discussion groups, etc.
Business management			
this year			
1 - 3 years ago			
Sustainability			
this year			
1 - 3 years ago			

Type of activity Subject area	Formal qualifications (TAFE, Uni)	Other courses	Field days, workshops, conferences, seminars, discussion groups, etc.
Productivity and Technology			
this year			
1 - 3 years ago			

13. In your opinion, have education, training or advice experiences in the past three years improved the profitability, productivity or long term viability of your farm?

Yes

No

Uncertain

14. Do you think training and/or education is important to the profitability, productivity and viability of your farm?

Yes

No

Uncertain

15. Were there courses relevant to the long term profitability or viability of the farm which you or your staff would have liked to attend, but did not?

Yes

No

If no, go to question 16 on page 23.

Which ones?

Course 1____

Course 2____

Course 3____

Why didn't you or your workforce attend?

[Tick as many reasons as applicable.]

	Course 1	Course 2	Course 3
Distance			
Cost (include cost of travel, accommodation)			
Person needed on the farm			
Wrong time of day			
Wrong time of year			
Available courses, etc were unsuitable for other reasons (e.g. poor instructor, wrong emphasis)			
Available courses, seminars, field days, etc were too theoretical			
Personal reasons (e.g. illness, family responsibilities)			
Other (please specify)			

16. What training experiences would you or your farm workforce like to undertake in the next 3 years?

Content/Area [list for up to 4]

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

How would you prefer these courses be run?

Course number	1	2	3	4
Mode				
workshop or seminar (one session)				
field day				
face-to-face course (several sessions)				
correspondence/distance				
Location				
less than 80km from farm				
more than 80km from farm but within Tasmania				
outside Tasmania				
Time				
this year				
next year				
2 years' time				
Time of day				
Time of year				

Categories for question 1.

Classification for reasons for significant events and achievements

[Use event reference numbers.]

	(no.)
Financing	
Marketing	
new client/market	
new marketing method (advertising, packaging, etc.)	
industry body marketing	
Technology	
'Product' and/or crop mix or output level	
Chemical use	
Pasture planning	
Other land management (include landcare/sustainability)	
Farm workers and/or labour skills	
Other management (specify)	
External factors	
climatic	
market prices	
exchange rates	
interest rates	
Personal factors	
Profit or loss	
Other (specify)	

APPENDIX B - FINANCIAL DETAILS FORM FARM DETAILS

Rural training programs: effectiveness and profitability

Interview date __________ Reference no. ____________

(i) Industry segment(s)

Cereals __________

Other crops __________

Livestock __________

Livestock products __________

Which is the major segment? Please circle.

(ii) Farm size (hectares) __________

(iii) Value of assets owned by the business (including financial assets)

1990/91 ________________

1991/92 ________________

1992/93 ________________

(iv) Amounts owing by farm business

1990/91 ________________

1991/92 ________________

1992/93 ________________

(v) Interest paid on amounts owing

1990/91 ________________

1991/92 ________________

1992/93 ________________

(vi) Cash operating surplus

Farm business income (including rent and interest income) less expenses (including interest paid, rates and taxes, but not income tax or company tax).

1990/91 ________________

1991/92 ________________

1992/93 ________________

(vii) Yield

The measure will depend on the industry sector. Examples are:

tonnes/hectare of major crop, quantity of wool, kilos of butter fat, litres of milk, livestock sold.

	Product 1	**Product 2**	**Product 3**
1990/91	____________	____________	____________
1991/92	____________	____________	____________
1992/93	____________	____________	____________

APPENDIX C - PARTICIPANT INFORMATION SHEET

UNIVERSITY OF TASMANIA

Department of Management
PO Box 1214
Launceston
Tasmania 7250
Australia
Tel (003) 243 460 Fax (003) 243 369

August 15, 1994

Rural training programs: effectiveness and profitability, information sheet

Dear Survey Participant,

Thank you for agreeing to take part in this survey.

This project is sponsored by the Tasmanian Farmers and Graziers Association, the National Farmers Federation, the Tasmanian Rural Industry Training Board, Tasmania Development and Resources, the Department of Industrial Relations, Vocational Education and Training and the Australian National Training Authority.

The results of this project will be used to improve the relevance and effectiveness of training programs for Australian farmers.

Chief investigator:
Sue Kilpatrick, Lecturer, The Business School, University of Tasmania at Launceston.
Interviewers:
Ms Jenny Jones and Ms Catherine Doherty

Purpose of the study:
To investigate the 'triggers' for changes to farm management practices, the steps required to implement changes and the link between changes and profitability.

Study procedures:
You will be asked to talk about the operation of your farm over the past 3 years, about training courses undertaken by yourself and other farm personnel, advice received from outside people and agencies and about cash operating surplus, debt, interest payments and productivity for the past 3 years. Financial questions will conform to the format required by the Australian Bureau of Statistics' Agricultural Financial Survey.

Your interviewer will take some notes, and a tape recording will be made of the interview for later transcription.

Confidentiality:
All data collected will remain strictly confidential. All data will be aggregated and your name will not be attached to any form or tape recording. At the completion of the study all data will be shredded.

Freedom to refuse or withdraw:
This study is sponsored and supported by the Tasmanian Farmers and Graziers Association, however, your participation is entirely voluntary. You may withdraw from the study at any stage.

Contact persons:
If you have any questions or concerns about participation in this study, please contact one of the following:

Mrs Sue Kilpatrick, Lecturer,
The Business School,
University of Tasmania at Launceston.
PO Box 1214, Launceston, 7250,
telephone (003) 243460

Professor John Williamson, Head,
Department of Secondary and Post-compulsory Education
University of Tasmania at Launceston.
PO Box 1214, Launceston, 7250.

or,

Mr George Rance, Executive Director
Tasmanian Farmers and Graziers Association
Cnr Cimitere and Charles Sts
Launceston 7250, telephone (003) 316377

Concerns or complaints:
This project has been approved by the University of Tasmania Ethics Committee (Human Experimentation).
Concerns or complaints should be addressed to:
University Ethics Committee (Human Experimentation)
Chair, Dr. Margaret Otlowski, telephone (002) 231987
Secretary, Chris Hooper (002) 202763.

Results of this investigation:
The results of this study will be used to improve training programs for rural Australia. They will be circulated widely via the National Farmers Federation, state farmer organisations, the Rural Industry Training Board, The Department of Industrial Relations, Vocational Education and Training, Tasmania Development and Resources and the Department of Employment, Education and Training.

You may keep this information sheet for future reference.

Yours sincerely

Sue Kilpatrick

Sue Kilpatrick

APPENDIX D - PARTICIPANT
APPOINTMENT LETTER

UNIVERSITY OF TASMANIA

Department of Management
PO Box 1214
Launceston
Tasmania 7250
Australia
Tel (003) 243 330   Fax (003) 243 369

August 15, 1994

<<name>>
<<address 1>>
<<address 2>>

Dear <<name>>,

Thank you for agreeing to participate in the Rural Training Programs: Effectiveness and Profitability survey.

This note confirms our meeting on <<date>> at approximately <<time>> at your property. The interview will take about one to one and a quarter hours.

I have enclosed some questions about the finances and output of your farm business which you may find easier to complete in advance. Note that it is not necessary to give exact figures, good estimates are sufficient. I will collect these completed questions when I call on you.

I have also enclosed an information sheet about the survey for your information. If you have any questions, or are unable to make our meeting, please contact me on (003) 243 330. You can leave a message with the secretary if I am not in when you call.

Thank you again for agreeing to participate.

Yours sincerely,

Sue Kilpatrick

APPENDIX E

CHANGES TO PRACTICE SECTION OF AGRICULTURAL FINANCIAL SURVEY 1993-94

SECTION 22: CHANGES TO FARMING PRACTICES

In the last 3 years what changes have you made to improve the profitability of your farm?

142

Financial management	☐
Marketing	☐
Agricultural practices	☐
Land management	☐
Other *(Specify)*	☐
None → Q.146	☐

If only one change → Q.144

SECTION 22: CHANGES TO FARMING PRACTICES

142 IN THE LAST 3 YEARS WHAT CHANGES HAVE YOU MADE TO IMPROVE THE PROFITABILITY OF YOUR FARM?	**22**		
Financial Management ☐	100V	OFFICE USE	INCLUDE • Re-financing of loans or mortgages • Changes to financial records or management system • Use of computer for financial management or changes to software or hardware • Changes to the use of financial information in farm management decisions • Employment of staff/family to monitor finances
Marketing ☐	110X	OFFICE USE	INCLUDE • Changes to selling places or buyers of farm output • Changes to the way farm output is sold • Joining or leaving marketing group or organisation
Agricultural practices ☐	120C	OFFICE USE	INCLUDE • Change in way crops are grown or livestock managed • Change of crops or livestock (not seasonal changes) • Changes to chemical use • Changes to farm safety practices • Change to employment numbers or skill mix (not by training existing employees) • Purchase of capital equipment
Land management ☐	130J	OFFICE USE	INCLUDE • Changes to land management practices • Changes to soil management • Planting trees for land management • Whole farm planning
Other *(Specify)* ☐	140L	OFFICE USE	
None → Q.146 ☐	150T	OFFICE USE	
If only one change → Q.144			

90	OFFICE USE ONLY
280J	

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

What was the most important change?

143

- Financial management ☐
- Marketing ☐
- Agricultural practices ☐
- Land management ☐
- Other *(Specify)* ☐

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

143	WHAT WAS THE MOST IMPORTANT CHANGE?	22		
			OFFICE USE	
	Financial management ☐	155C		
			OFFICE USE	
	Marketing ☐	160W		
			OFFICE USE	
	Agricultural practices ☐	165J		
			OFFICE USE	
	Land management ☐	170A		
			OFFICE USE	
	Other *(Specify)* ☐	175L		
	....			
	....			

90	OFFICE USE ONLY
290L	

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

Which of the following prompted you to make that change?

144

Attending field days, demonstration days, workshops, seminars or conferences	☐
Formal courses which do not lead to a formal qualification	☐
Study for formal qualifications	☐
Information and advice received from government agencies? (including agricultural departments or educational institutions if not included above, development authorities etc.)	☐
Information and advice received from agricultural companies or purchasers of your output	☐
Information and advice received from your family or staff	☐
Information and advice received from consultants or financial institutions (including accountants and lawyers)	☐
Information and advice received from other farmers	☐
Information and advice received from industry organisations	☐
Land management groups	☐
The media (print, radio or TV)	☐
Other *(Specify)*	☐

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

144 WHICH OF THE FOLLOWING PROMPTED YOU TO MAKE THAT CHANGE?	**22**		
ATTENDING FIELD DAYS, DEMONSTRATION DAYS, WORKSHOPS, SEMINARS OR CONFERENCES ☐	180F	OFFICE USE	
FORMAL COURSES WHICH DO NOT LEAD TO A FORMAL QUALIFICATION ☐	185T	OFFICE USE	
STUDY FOR FORMAL QUALIFICATIONS ☐	190K	OFFICE USE	
INFORMATION AND ADVICE RECEIVED FROM GOVERNMENT AGENCIES (including agricultural departments or educational institutions if not included above, development authorities etc.) ☐	195W	OFFICE USE	
INFORMATION AND ADVICE RECEIVED FROM AGRICULTURAL COMPANIES OR PURCHASERS OF YOUR OUTPUT ☐	200C	OFFICE USE	
INFORMATION AND ADVICE RECEIVED FROM YOUR FAMILY OR STAFF ☐	210J	OFFICE USE	
INFORMATION AND ADVICE RECEIVED FROM CONSULTANTS OR FINANCIAL INSTITUTIONS (including accounts and lawyers) ☐	215V	OFFICE USE	
INFORMATION AND ADVICE RECEIVED FROM OTHER FARMERS ☐	220L	OFFICE USE	
INFORMATION AND ADVICE RECEIVED FROM INDUSTRY ORGANISATIONS ☐	225X	OFFICE USE	
LAND MANAGEMENT GROUPS ☐	230T	OFFICE USE	
THE MEDIA (print, radio or TV) ☐	235C	OFFICE USE	
OTHER *(Specify)* ☐	240W	OFFICE USE	

90	OFFICE USE ONLY
300F	

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

Who has provided you with the most support in implementing this change?

145

- Government agencies ☐
- Family ☐
- Employees ☐
- Consultants or financial institutions ☐
- Other farmers ☐
- Industry groups ☐
- Land management groups ☐
- Other *(Specify)* ☐

Including yourself, how many of your family or employees are involved in the management of the farm?

146

For those family members and employees, what is the highest level of educational qualification attained by each of them?
(Please indicate the number of people for each category)

147

- Below Year 10 ☐
- Year 10 to Year 12 equivalent ☐
- Trade qualification, certificate, associate diploma, diploma, degree or higher degree ☐

If no-one has a trade qualification or higher → **Q.149**

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

		22	
145	WHO HAS PROVIDED YOU WITH THE MOST SUPPORT IN IMPLEMENTING THIS CHANGE?		OFFICE USE
	Government agencies ☐	250A	
			OFFICE USE
	Family ☐	255L	
			OFFICE USE
	Employees ☐	260F	
			OFFICE USE
	Consultants or financial institutions ☐	265T	
			OFFICE USE
	Other farmers ☐	270K	
			OFFICE USE
	Industry groups ☐	275W	
			OFFICE USE
	Land management groups ☐	280R	
			OFFICE USE
	Other *(Specify)* ☐	285A	
	....		
	....		
146	INCLUDING YOURSELF, HOW MANY OF YOUR FAMILY OR EMPLOYEES ARE INVOLVED IN THE MANAGEMENT OF THE FARM?	290V	
147	FOR THOSE FAMILY MEMBERS AND EMPLOYEES, WHAT IS THE HIGHEST LEVEL OF EDUCATIONAL QUALIFICATION ATTAINED BY EACH OF THEM? *(Please indicate the number of people for each category)*		
	BELOW YEAR 10	295F	
	YEAR 10 TO YEAR 12 OR EQUIVALENT	300L	
	TRADE QUALIFICATION, CERTIFICATE ASSOCIATE, DIPLOMA, DIPLOMA, DEGREE OR HIGHER DEGREE	305X	
	If no-one has a trade qualification or higher → **Q.149**		

90	OFFICE USE ONLY
310K	

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

For those family members or employees who have trade qualifications, certificates, associate diplomas, diplomas, degrees or higher degrees, what was their main field of study? *(Please indicate the number of people for each field of study)*

148

Agriculture ☐

Business management ☐

Other *(Specify)* ☐

Are any of those family members or employees involved in the management of the farm currently studying, excluding secondary school studies?

149

Yes ☐

No ☐ → Q.151

What is their main field of study?
(Please indicate the number of people for each field of study)

150

Agriculture ☐

Business management ☐

Other *(Specify)* ☐

During the last 12 months, how many of each of the following events did your family members or employees, involved in the management of the farm, attend?

151

Field days/Demonstration days ☐

Workshops/Seminars ☐

Conferences ☐

Other *(Specify)* ☐

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

		22	
148	FOR THOSE FAMILY MEMBERS OR EMPLOYEES WHO HAVE TRADE QUALIFICATIONS, CERTIFICATES, ASSOCIATE DIPLOMAS, DIPLOMAS, DEGREES OR HIGHER DEGREES, WHAT WAS THEIR MAIN FIELD OF STUDY? *(Please indicate the number of people for each field of study)*		
	AGRICULTURE	310T	
	BUSINESS MANAGEMENT	315C	
	OTHER *(Specify)*	320W	
149	ARE ANY FAMILY MEMBERS OR EMPLOYEES INVOLVED IN THE MANAGEMENT OF THE FARM CURRENTLY STUDYING, EXCLUDING SECONDARY SCHOOL STUDIES		OFFICE USE
	Yes ☐	325J	OFFICE USE
	No ☐ → Q.151	330A	
150	WHAT IS THEIR MAIN FIELD OF STUDY? *(Please indicate the number of people for each field of study)*		
	AGRICULTURE	335L	
	BUSINESS MANAGEMENT	340F	
	OTHER *(Specify)*	345T	
151	DURING THE LAST 12 MONTHS, HOW MANY OF EACH OF THE FOLLOWING EVENTS DID YOR FAMILY MEMBERS OR EMPLOYEES, INVOLVED IN THE MANAGEMENT OF THE FARM, ATTEND?		
	FIELD DAYS/DEMONSTRATION DAYS	350K	
	WORKSHOPS/SEMINARS	355W	
	CONFERENCES	360R	
	OTHER *(Specify)*	365A	

90	OFFICE USE ONLY
320R	

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

In the last 12 months, were there any of these events that your family or employees involved in the management of the farm would like to have attended but couldn't?

152

Yes ☐
No ☐ → Q.154

What prevented them from attending these events?

153

- Distance ☐
- Cost of course ☐
- Farm/business commitments — seasonal ☐
- Farm/business commitments — time of day ☐
- Personal reasons ☐
- Other *(Specify)* ☐

In the next 3 years, will any of the family members or employees involved in the management of the farm be attending field days, demonstration days, workshops, seminars or conferences?

154

Yes ☐
No ☐ *(No more questions)*

What do you expect will be the main area of interest for those events?

155

- Financial management ☐
- Marketing ☐
- Agricultural practices ☐
- Land management ☐
- Other *(Specify)* ☐

SECTION 22: CHANGES TO FARMING PRACTICES *(Cont'd)*

		22	
152	IN THE LAST 12 MONTHS, WERE THERE ANY OF THESE EVENTS THAT YOUR FAMILY OR EMPLOYEES INVOLVED IN THE MANAGEMENT OF THE FARM WOULD LIKE TO HAVE ATTENDED BUT COULDN'T?		OFFICE USE
	Yes ☐	370V	OFFICE USE
	No ☐ → Q.154	375F	
153	WHAT PREVENTED THEM FROM ATTENDING THESE EVENTS?		OFFICE USE
	Distance ☐	380X	OFFICE USE
	Cost of course ☐	385K	OFFICE USE
	Farm/business commitments - seasonal ☐	390C	OFFICE USE
	Farm/business commitments - time of day ☐	395R	OFFICE USE
	Personal reasons ☐	400W	OFFICE USE
	Other *(Specify)* ☐	405J	
15~~3~~4	IN THE NEXT 3 YEARS, WILL ANY OF THE FAMILY MEMBERS OR EMPLOYEES INVOLVED IN THE MANAGEMENT OF THE FARM BE ATTENDING FIELD DAYS, DEMONSTRATION DAYS, WORKSHOPS, SEMINARS OR CONFERENCES?		OFFICE USE
	Yes ☐	410A	OFFICE USE
	No ☐ *(No more questions)*	415L	
155	WHAT DO YOU EXPECT WILL BE THE MAIN AREA OF INTEREST FOR THOSE EVENTS?		OFFICE USE
	Financial Management ☐	420F	OFFICE USE
	Marketing ☐	425T	OFFICE USE
	Agricultural practices (incl. machinery) ☐	430K	OFFICE USE
	Land Management ☐	435W	OFFICE USE
	Other *(Specify)* ☐	440R	

90	OFFICE USE ONLY
330V	

APPENDIX F

MULTIPLE REGRESSIONS

Technical note on multiple regressions

Multiple regressions attempt to specify and test a model which explains a dependent variable (for example gross operating surplus) in terms of a number of independent variables, such as value of assets, debt, industry, region proxied by State, number of changes and training undertaken.

The hypothesis here is that the profit measures are determined by value of assets, and some or all of the other variables.

The profit measures are continuous variables, as are assets and debt. Most of the other independent variables are class variables, having two or more levels. For example attended or did not attend the Dairy Farm Management Course or have highest education level school leaver, agricultural qualifications or other post-school qualifications. Some variables, such as number of field days, can be cast in either form. Ordinary least squares regression is suitable for a combination of continuous and (a small number of) class variables (Zikmund, 1994). Excel version 5.0 Data Analysis tool kit and SAS proc REG procedure are used here. Another technique which is suitable for a larger number of class variables is general linear models regression, which is accomplished here using the proc GLM feature of the SAS Statistical package (SAS Institute, 1990).

If plotted, a GLM regression with one continuous and several class variables is a series of parrallel lines. The value of the intercept changes for each possible combination of classes, for example each state and industry is a single line. A model with six States, all thirteen ABS industry classifications and a four level event variable would actually be 6 x 13 x 4 = 312 separate models, all with the same slope (value of assets coefficient) if plotted. It is not possible to calculate coefficients for all of the levels of a class variable using the GLM proceedure for technical reasons (see Searle, Speed & Milliken, 1980 for a technical explanation).

GLM models can quickly become difficult to interpret as the number of class variables, and the number of classes within each variable, rises. The SAS GLM procedure also produces an analysis of the variance (ANOVA) result, with F values for each variable, as well as F and R^2 statistics for the model as a whole. These features appear in Examples 1 and 4, which are examples of multiple regressions from the Agricultural Financial Survey data including event and change variables respectively.

Agricultural Financial Survey

Many model specifications were trialed. A number of models have similar power in explaining gross operating surplus and have a similar goodness-of-fit, as measured by F value and R^2 coefficient. Three examples are included here. They are two regressions including a variable for number of training events attended and one regression with a change/no change class variable. One of the training regressions and the change regression are for farm businesses with a positive gross operating surplus only. As the Examples below show, the regressions of profit makers only explain a higher percentage of the variation in gross operating surplus. All three exclude the approximately 60 large multi-state farm businesses because the focus of this study is on family farms rather than large corporate agribusiness.

The value of assets (variable X12) is highly significant in explaining the variation in the gross operating surplus of farm businesses in both models.

The training model (Example 1 and Example 2) has the independent continuous variable value of assets (X12), class variables EVENTS (nil, one to three, four to nine and ten or more), industry (SELIND) state (SSTATE) and the interaction variable EVENTS*SSTATE. All have significant F values (TYPE III SS). The model is a good fit, with R^2 of 0.770636 and F value 129.66 for positive gross operating surplus farm businesses and R^2 of 0.645811 and F value 82.00 for all farm businesses.

Example 4 is a similar regression with the event variable replaced by a change variable (NOCHNG), which is 0 if there has been a change and 1 if there has not been a change to farm practice in the past three years.

The Type III SS F values indicate the significance of each independent variable in explaining gross operating surplus (see SAS Institute, 1990). Value of assets, state and industry are highly significant in the models presented in Examples 1, 2 and 4. The training variable and training-state interaction variable are significant in the first two models, while the change variable and change-state interaction variable are significant in the model in Example 4.

Value of coefficients

The signs of the event and state class variables for each of the possible models are determined by summing the coefficients of the event*state interaction variable and the individual event or state variable. The relevant coefficient is zero for the level not calculated for each class variable. Some examples of the 7488 (6*4*13*6*4) possible models are shown in Example 3. This shows for example, that attending four to nine training events has a positive effect on gross operating surplus for New South Wales sheep farm businesses and Queensland beef cattle farm businesses.

All independent variables in Example 4 are significant. This model shows that change has a positive effect on gross operating surplus in New South Wales and South Australia.

Which model?

The multiple regressions here do not suggest any clear reasons for choosing one model over another. Training and change variables appear to be interchangeable in the model. This is consistent with the results presented in Figure 17 Training and changes to practice, Australian farm businesses (AFS) which show that the majority of those farm businesses which make a change to practice also participate in training. Three-quarters of farm business either train and make changes to practice, or do not train and make no change to practice. Training and change are interrelated variables.

The literature reviewed in Chapter 2 section 2.8. Education and training and adoption of innovations, and further discussion in Chapter 5 Discussion and Conclusion section 1.5. Education and training and profit - the direction of causation, argue that the direction of causation runs from training to change to practice. If this is the case, then the model in Examples 1 and 2 is preferred.

The model in Example 2, which applies only to farm businesses with a positive gross operating surplus, has higher F-value and R^2 value than that in Example 1 where all farm businesses are included. This suggests that the gross operating surplus of those farm business which made a negative gross operating surplus is influenced more strongly by variables which are not included in the model. Further research is needed to determine those influencing variables.

Example 1 Training regression - all farm businesses (ABS)

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: X8
WEIGHT: NRWT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	39	2291570954540460.00	58758229603601.40	82.00	0.0	0.645811	1295.7101
ERROR	1754	1256788180341610.00	716526898712.43		ROOT MSE		X8 MEAN
CORRECTED TOTAL	1793	3548359134882070.00			846479.12		65329.36192412

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
X12	1	1582989795542160.00	2209.25	0.0	1	195263871124531.00	272.51	0.0001
EVENTS	3	2894848998545.72	1.35	0.2575	3	500525479776690.00	232.85	0.0
SELIND	12	66403927054043.70	7.72	0.0001	12	57379253849585.10	6.67	0.0001
SSTATE	6	107383658011055.00	24.98	0.0001	6	519443399693869.00	120.82	0.0
EVENTS*SSTATE	17	531898724934649.00	43.67	0.0	17	531898724934649.00	43.67	0.0

PARAMETER		ESTIMATE		T FOR H0: PARAMETER=0	PR > |T|	STD ERROR OF ESTIMATE
INTERCEPT		9144660.84926044	B	28.51	0.0	320746.98960740
X12		0.04044037		16.51	0.0001	0.00244974
EVENTS	0	-8792854.79181230	B	-26.30	0.0	334327.01101936
	1	-8924750.98058680	B	-25.13	0.0	355129.68576347
	2	-3177.20939280	B	-0.08	0.9388	41398.82744101
	3	0.00000000	B	.	.	.
SELIND	10	2498.36943431	B	0.16	0.8702	15284.33835723
	13	24689.31562344	B	1.36	0.1740	18152.75563015
	21	10414.38919433	B	0.69	0.4903	15092.35561258
	22	-12238.10851607	B	-0.87	0.3855	14097.50345192
	23	-21078.15780513	B	-1.36	0.1730	15462.99550063
	24	-30482.30195025	B	-2.10	0.0356	14496.45251333
	25	-32842.61337262	B	-2.36	0.0182	13895.99871424
	30	13761.27530379	B	0.95	0.3442	14545.92625425
	40	8452.71398608	B	0.30	0.7618	27885.60186257
	51	-5564.37723035	B	-0.22	0.8293	25809.08177113
	61	25112.78259602	B	1.40	0.1619	17948.28142153
	62	170308.50562984	B	4.74	0.0001	35938.55435723
	90	0.00000000	B	.	.	.
SSTATE	1	-9058190.59270432	B	-28.42	0.0	318732.97725450
	2	-9095534.54036038	B	-28.47	0.0	319423.86593314
	3	-9145421.47064237	B	-28.68	0.0	318872.23292634
	4	-9109821.83646948	B	-28.51	0.0	319491.34030620
	5	-9012496.49270636	B	-28.34	0.0	318010.91653425
	6	-9137940.89075186	B	-28.75	0.0	317815.53570358
	7	0.00000000	B	.	.	.
EVENTS*SSTATE	0 1	8728530.33727350	B	26.16	0.0	333619.91328333
	0 2	8766389.65136998	B	26.24	0.0	334044.05531330
	0 3	8790340.49174405	B	26.32	0.0	334029.72448390
	0 4	8762371.16205851	B	26.17	0.0	334847.72722535
	0 5	8711873.51828282	B	26.10	0.0	333772.59867480

Example 1 Training regression - all farm businesses (ABS) (continued)

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: X8

PARAMETER		ESTIMATE		T FOR H0: PARAMETER=0	PR > |T|	STD ERROR OF ESTIMATE
0	6	8796614.01685266	B	26.27	0.0	334859.82932239
0	7	0.00000000	B	.	.	.
1	1	8864807.00794413	B	24.99	0.0	354683.27665332
1	2	8899049.53305202	B	25.07	0.0	355035.32627087
1	3	8938206.84898148	B	25.18	0.0	355032.02888053
1	4	8900462.62952204	B	25.06	0.0	355230.01294221
1	5	8851676.69164791	B	24.98	0.0	354322.11958711
1	6	8931384.41814131	B	25.23	0.0	353941.52962355
1	7	0.00000000	B	.	.	.
2	1	-45047.25750614	B	-0.99	0.3213	45409.80362163
2	2	-14405.27677608	B	-0.32	0.7484	44910.12034056
2	3	-1931.28186513	B	-0.04	0.9671	46824.05836522
2	4	-14299.30612007	B	-0.30	0.7666	48170.00104626
2	5	-70477.77559352	B	-1.46	0.1448	48309.33110170
2	6	0.00000000	B	.	.	.
2	7	0.00000000	B	.	.	.
3	1	0.00000000	B	.	.	.
3	2	0.00000000	B	.	.	.
3	3	0.00000000	B	.	.	.
3	4	0.00000000	B	.	.	.
3	5	0.00000000	B	.	.	.
3	6	0.00000000	B	.	.	.

NOTE: THE X'X MATRIX HAS BEEN DEEMED SINGULAR AND A GENERALIZED INVERSE HAS BEEN EMPLOYED TO SOLVE THE NORMAL EQUATIONS. THE ABOVE ESTIMATES REPRESENT ONLY ONE OF MANY POSSIBLE SOLUTIONS TO THE NORMAL EQUATIONS. ESTIMATES FOLLOWED BY THE LETTER B ARE BIASED AND DO NOT ESTIMATE THE PARAMETER BUT ARE BLUE FOR SOME LINEAR COMBINATION OF PARAMETERS (OR ARE ZERO). THE EXPECTED VALUE OF THE BIASED ESTIMATORS MAY BE OBTAINED FROM THE GENERAL FORM OF ESTIMABLE FUNCTIONS. FOR THE BIASED ESTIMATORS, THE STD ERR IS THAT OF THE BIASED ESTIMATOR AND THE T VALUE TESTS H0: E(BIASED ESTIMATOR) = 0. ESTIMATES NOT FOLLOWED BY THE LETTER B ARE BLUE FOR THE PARAMETER.

Example 2 Training regression - positive gross operating surplus (ABS)

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: POSGOS
WEIGHT: NRWT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	39	2470067973399670.00	63335076241017.30	129.66	0.0	0.770636	839.9555
ERROR	1505	735167110171685.00	488483129682.18		ROOT MSE		POSGOS MEAN
CORRECTED TOTAL	1544	3205235083571360.00			698915.68		83208.65297629

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
X12	1	2079009468545140.00	4256.05	0.0	1	387918567376273.00	794.13	0.0
EVENTS	3	590815891649.57	0.40	0.7507	3	253371594915757.00	172.90	0.0
SELIND	12	56160629966166.10	9.58	0.0001	12	44566273030648.90	7.60	0.0001
SSTATE	6	63873136160063.40	21.79	0.0001	6	277948733422637.00	94.83	0.0
EVENTS*SSTATE	17	270433922836658.00	32.57	0.0	17	270433922836657.00	32.57	0.0

PARAMETER		ESTIMATE		T FOR H0: PARAMETER=0	PR > |T|	STD ERROR OF ESTIMATE
INTERCEPT		7024304.35184584	B	24.86	0.0	282585.32991084
X12		0.06575063		28.18	0.0	0.00233321
EVENTS	0	-6606264.92152159	B	-22.37	0.0	295254.69048250
	1	-6833760.03847723	B	-22.13	0.0	308812.11166149
	2	-9077.67744533	B	-0.25	0.8051	36773.12735369
	3	0.00000000	B	.	.	.
SELIND	10	-18263.24130013	B	-1.27	0.2044	14384.32470315
	13	-4722.34299009	B	-0.28	0.7774	16704.21932903
	21	-18753.53238039	B	-1.32	0.1859	14171.03841114
	22	-38802.16536968	B	-2.90	0.0038	13399.47132848
	23	-57206.62131717	B	-3.95	0.0001	14491.02340590
	24	-55425.37396605	B	-3.98	0.0001	13914.67273337
	25	-56964.66524893	B	-4.23	0.0001	13464.96845145
	30	-16821.11024768	B	-1.23	0.2196	13697.21843183
	40	2067.14835739	B	0.08	0.9375	26340.29427822
	51	-25863.82057936	B	-1.09	0.2768	23775.44442883
	61	-14286.76906951	B	-0.85	0.3979	16893.56233736
	62	121273.59853858	B	3.78	0.0002	32118.53020353
	90	0.00000000	B	.	.	.
SSTATE	1	-6944499.92692495	B	-24.77	0.0	280358.70485981
	2	-6973457.17849556	B	-24.81	0.0	281040.68886538
	3	-7005896.07156493	B	-24.95	0.0	280784.60697262
	4	-6991387.91034315	B	-24.90	0.0	280757.22693619
	5	-6913113.38088698	B	-24.72	0.0	279612.61326940
	6	-7007167.26033705	B	-25.04	0.0	279871.21905345
	7	0.00000000	B	.	.	.
EVENTS*SSTATE	0 1	6566866.31197161	B	22.32	0.0	294269.49237152
	0 2	6604104.61265190	B	22.41	0.0	294715.94393537
	0 3	6597818.29815126	B	22.35	0.0	295198.23599804
	0 4	6587816.67156934	B	22.30	0.0	295386.48478766
	0 5	6551505.45985197	B	22.25	0.0	294442.79773497

Example 2 Training regression - positive gross operating surplus (ABS) (continued)

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: POSGOS

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > !T!	STD ERROR OF ESTIMATE
0 6	6620627.56373095 B	22.40	0.0	295591.86711374
0 7	0.00000000 B	.	.	.
1 1	6789791.57734127 B	22.04	0.0	308114.35729577
1 2	6816984.50741098 B	22.09	0.0	308550.22406057
1 3	6848442.71120138 B	22.17	0.0	308974.15897593
1 4	6833534.89461708 B	22.15	0.0	308479.12398342
1 5	6791658.24651005 B	22.06	0.0	307853.74654038
1 6	6850732.08793210 B	22.26	0.0	307749.27028167
1 7	0.00000000 B	.	.	.
2 1	-20246.70412796 B	-0.50	0.6138	40112.29162494
2 2	-1124.71606887 B	-0.03	0.9774	39743.14645426
2 3	29543.10623456 B	0.70	0.4844	42237.08736423
2 4	5229.30228612 B	0.12	0.9034	43068.58644873
2 5	-26257.69560023 B	-0.62	0.5355	42365.56821327
2 6	0.00000000 B	.	.	.
2 7	0.00000000 B	.	.	.
3 1	0.00000000 B	.	.	.
3 2	0.00000000 B	.	.	.
3 3	0.00000000 B	.	.	.
3 4	0.00000000 B	.	.	.
3 5	0.00000000 B	.	.	.
3 6	0.00000000 B	.	.	.

NOTE: THE X'X MATRIX HAS BEEN DEEMED SINGULAR AND A GENERALIZED INVERSE HAS BEEN EMPLOYED TO SOLVE THE NORMAL EQUATIONS. THE ABOVE ESTIMATES REPRESENT ONLY ONE OF MANY POSSIBLE SOLUTIONS TO THE NORMAL EQUATIONS. ESTIMATES FOLLOWED BY THE LETTER B ARE BIASED AND DO NOT ESTIMATE THE PARAMETER BUT ARE BLUE FOR SOME LINEAR COMBINATION OF PARAMETERS (OR ARE ZERO). THE EXPECTED VALUE OF THE BIASED ESTIMATORS MAY BE OBTAINED FROM THE GENERAL FORM OF ESTIMABLE FUNCTIONS. FOR THE BIASED ESTIMATORS, THE STD ERR IS THAT OF THE BIASED ESTIMATOR AND THE T VALUE TESTS H0: E(BIASED ESTIMATOR) = 0. ESTIMATES NOT FOLLOWED BY THE LETTER B ARE BLUE FOR THE PARAMETER.

Example 3 Some intercepts from the training regression in Example 2 (ABS)

Dependent variable: gross operating surplus (GOS)

$$GOS = A + I + 0.06575 * \text{Assets}$$
(t ratio 28.18)

Intercept: State and events (A)		+	Industry (I)	
NSW, no event	40405.9		Fruit (1.27)	-18263.2
NSW, 1-3 events	35836.1		Vegetable (0.28)	-4722.3
NSW, 4-9 events	50480.1		Grain (1.32)	-18753.5
NSW, >9 events	79804.5		Grain sheep beef*(2.9)	-38802.2
Vic, no event	48686.9		Sheep beef cattle*(3.95)	-57206.6
Vic, 1-3 events	34071.7		Sheep*(3.98)	-55425.4
Vic, 4-9 events	40644.8		Beef cattle*(4.23)	-56964.7
Vic, >9 events	50847.2		Dairy (1.23)	-16821.1
Qld, no event	9961.7		Poultry(0.08)	2067.1
Qld, 1-3 events	33091		Pigs (1.09)	-25863.8
Qld, 4-9 events	38873.7		Sugar (0.85)	-14286.8
Qld, >9 events	18408.3		Cotton* (3.78)	121273.6
SA, no event	14468.3		Other	0
SA, 1-3 events	32691.4			
SA, 4-9 events	29068.1			
SA, >9 events	32916.5			
WA, no event	56431.6			
WA, 1-3 events	32691.4			
WA, 4-9 events	29068.1			
WA, >9 events	32916.5			
Tas, no event	31499.8			
Tas, 1-3 events	34109.2			
Tas, 4-9 events	8059.4			
Tas, >9 events	17137.1			

F 129.66, R^2 0.7770636 t ratios in brackets.
0 event and 1-3 events significantly less than 4-9 and 10+ events.

Examples:

WA grain, sheep, beef			*Qld beef cattle*		
no event	17629.4	+ 0.06575 * Assets	no event	-47003	+ 0.06575 * Assets
1-3 events	-6110.8	+ 0.06575 * Assets	1-3 events	-23873.7	+ 0.06575 * Assets
4-9 events	-9734.1	+ 0.06575 * Assets	4-9 events	-18091	+ 0.06575 * Assets
10+ events	-5885.7	+ 0.06575 * Assets	10+ events	-38556.4	+ 0.06575* Assets
NSW sheep					
no event	-15019.5	+ 0.06575 * Assets			
1-3 events	-19589.3	+ 0.06575 * Assets			
4-9 events	-4945.3	+ 0.06575 * Assets			
10+ events	24379.1	+ 0.06575 * Assets			

Example 4 Change regression - positive gross operating surplus (ABS)

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: POSGOS
WEIGHT: NRWT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	26	2222055997490290.00	85463692211164.80	131.79	0.0	0.693277	967.2602
ERROR	1516	983092812339527.00	648478108403.38		ROOT MSE		POSGOS MEAN
CORRECTED TOTAL	1542	3205148809829810.00			805281.38		83253.85113268

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
X12	1	2079035662236450.00	3206.02	0.0	1	1485047929531340.00	2290.05	0.0
NOCHNG	1	10809874043.40	0.02	0.8973	1	18145319170463.70	27.98	0.0001
SELIND	12	56123384213881.20	7.21	0.0001	12	60641665652549.10	7.79	0.0001
SSTATE	6	64350421504997.80	16.54	0.0001	6	77290077923078.20	19.86	0.0001
NOCHNG*SSTATE	6	22535719660914.50	5.79	0.0001	6	22535719660914.50	5.79	0.0001

PARAMETER		ESTIMATE	T FOR H0: PARAMETER=0	PR > |T|	STD ERROR OF ESTIMATE
INTERCEPT		380398.75163480 B	3.54	0.0004	107340.16752609
X12		0.09844610	47.85	0.0	0.00205720
NOCHNG	0	997069.67345300 B	5.78	0.0001	172487.13282984
	1	0.00000000 B	.	.	.
SELIND	10	-11946.48248249 B	-0.72	0.4713	16580.85904858
	13	-13478.90330240 B	-0.70	0.4836	19235.78813631
	21	-27786.79191287 B	-1.71	0.0883	16289.94265168
	22	-39994.27078207 B	-2.59	0.0096	15420.55573706
	23	-75689.93850121 B	-4.52	0.0001	16736.39111227
	24	-65411.71684554 B	-4.08	0.0001	16047.32324942
	25	-77365.35578824 B	-4.99	0.0001	15506.95689015
	30	-23446.62876674 B	-1.49	0.1374	15776.59760468
	40	-6129.70125176 B	-0.20	0.8398	30325.67160142
	51	-22688.72648326 B	-0.83	0.4076	27391.07114219
	61	-14631.66995661 B	-0.76	0.4471	19238.58608205
	62	65176.54163732 B	1.77	0.0764	36761.10119980
	90	0.00000000 B	.	.	.
SSTATE	1	-363263.51604464 B	-3.40	0.0007	106688.65993456
	2	-359189.33546462 B	-3.36	0.0008	106775.92554754
	3	-383401.81573122 B	-3.59	0.0003	106876.81600595
	4	-381031.86066290 B	-3.54	0.0004	107494.75639215
	5	-336062.84450564 B	-3.13	0.0018	107523.66507287
	6	-354759.25068509 B	-3.22	0.0013	110099.04555124
	7	0.00000000 B	.	.	.
NOCHNG*SSTATE	0 1	-995836.25812022 B	-5.77	0.0001	172653.23517940
	0 2	-998968.59170233 B	-5.78	0.0001	172745.12457333
	0 3	-1002436.59018655 B	-5.80	0.0001	172768.58370299
	0 4	-996666.47975170 B	-5.75	0.0001	173240.48625927
	0 5	-1006690.81913471 B	-5.81	0.0001	173201.74891505
	0 6	-1027973.30850447 B	-5.85	0.0001	175635.45875575
	0 7	0.00000000 B	.	.	.

Example 4 Change regression - positive gross operating surplus (ABS) (continued)

```
                              GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: POSGOS

                                                 T FOR H0:       PR > !T!        STD ERROR OF
PARAMETER                         ESTIMATE      PARAMETER=0                        ESTIMATE

                 1 1           0.00000000 B          .              .                 .
                 1 2           0.00000000 B          .              .                 .
                 1 3           0.00000000 B          .              .                 .
                 1 4           0.00000000 B          .              .                 .
                 1 5           0.00000000 B          .              .                 .
                 1 6           0.00000000 B          .              .                 .
                 1 7           0.00000000 B          .              .                 .

NOTE: THE X'X MATRIX HAS BEEN DEEMED SINGULAR AND A GENERALIZED INVERSE HAS BEEN EMPLOYED TO SOLVE THE NORMAL EQUATIONS.
      THE ABOVE ESTIMATES REPRESENT ONLY ONE OF MANY POSSIBLE SOLUTIONS TO THE NORMAL EQUATIONS. ESTIMATES FOLLOWED BY
      THE LETTER B ARE BIASED AND DO NOT ESTIMATE THE PARAMETER BUT ARE BLUE FOR SOME LINEAR COMBINATION OF PARAMETERS
      (OR ARE ZERO). THE EXPECTED VALUE OF THE BIASED ESTIMATORS MAY BE OBTAINED FROM THE GENERAL FORM OF ESTIMABLE
      FUNCTIONS. FOR THE BIASED ESTIMATORS, THE STD ERR IS THAT OF THE BIASED ESTIMATOR AND THE T VALUE TESTS
      H0: E(BIASED ESTIMATOR) = 0. ESTIMATES NOT FOLLOWED BY THE LETTER B ARE BLUE FOR THE PARAMETER.
```

Tasmanian survey

A number of model specifications were trailed for gross and cash operating surplus profit measures for the three industries. Variables which an initial model show to be highly insignificant were removed one by one until either the statistical significance of the model (measured by the F statistic) and the explanatory power of the model (measured by the R^2) were satisfactory or until all the variables remaining had t ratio probabilities of less than approximately 0.6.

Multiple regressions using type of change and education level, but excluding training events and advisers, produce a poorer fit than models which also include training events (by type) and advisers for the dairy and livestock industries. Significant changes are of consistent sign.

It is possible to formulate many similar models of the relationship between gross operating surplus and education, training and change. Below are three examples: an ordinary least squares regression for all farm businesses with independent variables assest, and class variables agricultural education and whether or not between two and five changes had been made (Example 5); and two GLM regressions, one for crop and livestock farms (Example 6); and one for dairy farms (Example 7). Education, the three courses studied, number of changes to practice and use of business advisers are consistently statistically significant in different model formations.

Example 5 Ordinary least squares regression all industries (Tas survey)

Dependent variable: GOS

Regression Statistics	
Multiple R	0.73871659
R Square	0.5457022
Adjusted R Square	0.51607409
Standard Error	47376.8452
Observations	50

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1.2402E+11	4.1341E+10	18.4183895	5.432E-08
Residual	46	1.0325E+11	2244565462		
Total	49	2.2727E+11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept*	-32288.415	14160.6335	-2.2801533	0.02728105	-60792.264
Assets 92/93*	0.07082515	0.01127442	6.28193144	1.0929E-07	0.04813094
Ag quals**	26436.391	13533.0763	1.953465	0.05686215	-804.25274
2 to 5 changes*	40829.0577	13458.7034	3.03365463	0.00396442	13738.1189

significant at 95% level.* * significant at 90% level.*

Example 6 General linear models regresion: crop and livestock industries (Tas survey)

Key
CHEMCOS is Farm Chemical Accreditation course (1 is yes, 0 is not completed).
CHNGMID is making two to six changes to practice.
SEM 1 is fewer than two seminars over three years, SEM 2 is two or more.
FD 1 is less than one field day per year, FD 2 is 1 or 2 field days per year, FD 3 is more than 2 field days per year.
BUSCOURS is attended a business or computer training course (1 is yes, 0 is not completed).
DISCUSS is membership of a discussion group (1 is yes, 0 is no).
ASSET is value of farm business assets.

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                   General Linear Models Procedure

                Number of observations in data set = 48

NOTE: Due to missing values, only 41 observations can be used in this analysis.

                   General Linear Models Procedure

Dependent Variable: GOS
                                   Sum of          Mean
Source                  DF        Squares        Square   F Value      Pr > F

Model                    9    1.20312E+11   1.33680E+10      7.37      0.0001

Error                   31    5.62479E+10   1.81445E+09

Corrected Total         40    1.76560E+11

                  R-Square           C.V.      Root MSE              GOS Mean

                  0.681423       89.64537      42596.35              47516.51

                   General Linear Models Procedure
Dependent Variable: GOS

Source                  DF      Type I SS   Mean Square   F Value      Pr > F

ASSET                    1    89699072635   89699072635     49.44      0.0001
CHEMCOS                  1     3150474832    3150474832      1.74      0.1973
DISCUSS                  1     2450337063    2450337063      1.35      0.2541
FD                       2     3355736815    1677868407      0.92      0.4073
SEM                      1     1495333520    1495333520      0.82      0.3710
BUSCOURS                 2     2395240758    1197620379      0.66      0.5239
CHNGMID                  1    17765566454   17765566454      9.79      0.0038
```

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General Linear Models Procedure
Dependent Variable: GOS

Source	DF	Type III SS	Mean Square	F Value	Pr > F
ASSET	1	49781315465	49781315465	27.44	0.0001
CHEMCOS	1	7431047508	7431047508	4.10	0.0517
DISCUSS	1	2596691627	2596691627	1.43	0.2407
FD	2	2648069580	1324034790	0.73	0.4901
SEM	1	3829784493	3829784493	2.11	0.1563
BUSCOURS	2	199457404	99728702	0.05	0.9466
CHNGMID	1	17765566454	17765566454	9.79	0.0038

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General Linear Models Procedure

Dependent Variable: GOS

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
chemical course	1	7431047508	7431047508	4.10	0.0517

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		35703.76526 B	1.03	0.3129	34805.00188
ASSET		0.06674	5.24	0.0001	0.01274
CHEMCOS*	0	-32623.15278 B	-2.02	0.0517*	16120.30809
	1	0.00000 B	.	.	.
DISCUSS	0	20064.51830 B	1.20	0.2407	16772.23643
	1	0.00000 B	.	.	.
FD	1	1220.48855 B	0.07	0.9483	18675.85053
	2	18057.11403 B	1.09	0.2830	16528.61649
	3	0.00000 B	.	.	.
SEM	1	-23389.62302 B	-1.45	0.1563	16099.35514
	2	0.00000 B	.	.	.
BUSCOURS	0	2576.56525 B	0.09	0.9273	28008.88054
	1	13211.44554 B	0.30	0.7625	43338.97532
	2	0.00000 B	.	.	.
CHNGMID*	0	-45404.64605 B	-3.13	0.0038*	14510.52719
	1	0.00000 B	.	.	.

General Linear Models Procedure
Least Squares Means or mean adjusted for all the other variables in the model.

CHEMCOS	GOS LSMEAN	T / Pr > |T| H0: LSMEAN1=LSMEAN2
0	39072.6035	-2.02373
		0.0517
1	71695.7563	

Example 7 General linear models regresion: dairy industry (Tas survey)

Key

SCHOOL 1 is no post school qualifications, 0 is some post-school qualifications held by farm management team.
PPCOS is Intensive Pasture Management course (1 is yes, 0 is not completed).
DAIRY is Dairy Farm Management course (1 is yes, 0 is not completed).
CHNG changes to practice (1 is <2, 2 is 2-5 and 3 is more than 5).
SEM 1 is fewer than two seminars over three years, SEM 2 is two or more.
BUSADVIS is types of business adviser (2 is two or fewer, 3 is three or more).
DISCUSS is membership of a discussion group (1 is yes, 0 is no).
ASSET is value of farm business assets.
DEBT is amount owing by farm business.

```
Number of observations in data set = 35

NOTE: Due to missing values, only 29 observations can be used in this
      analysis.

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                          General Linear Models Procedure

Dependent Variable: GOS
                                        Sum of           Mean
Source                   DF            Squares         Square   F Value     Pr > F

Model                    10        1.00726E+11    1.00726E+10      5.05     0.0015

Error                    18        3.58906E+10    1.99392E+09

Corrected Total          28        1.36616E+11

                   R-Square               C.V.       Root MSE              GOS Mean

                   0.737289           83.38792       44653.34              53548.93
                                The SAS System                           139
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                          General Linear Models Procedure

Dependent Variable: GOS

Source                   DF        Type I SS    Mean Square   F Value     Pr > F

SCHOOL                    1       5609878563     5609878563      2.81     0.1108
ASSET                     1      56604158177    56604158177     28.39     0.0001
DEBT                      1        631176224      631176224      0.32     0.5806
DISCUSS                   1       1175572476     1175572476      0.59     0.4525
PPCOS                     1       5720941766     5720941766      2.87     0.1075
DAIRY                     1       3291015248     3291015248      1.65     0.2152
SEM                       1       3895509564     3895509564      1.95     0.1792
CHNG                      2       5645402713     2822701357      1.42     0.2685
BUSADVIS                  1      18151957130    18151957130      9.10     0.0074
```

General Linear Models Procedure

Dependent Variable: GOS

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SCHOOL	1	8849878305	8849878305	4.44	0.0494
ASSET	1	31479983401	31479983401	15.79	0.0009
DEBT	1	7011408886	7011408886	3.52	0.0771
DISCUSS	1	360112965	360112965	0.18	0.6759
PPCOS	1	11063146054	11063146054	5.55	0.0300
DAIRY	1	6782419636	6782419636	3.40	0.0817
SEM	1	2793426437	2793426437	1.40	0.2520
CHNG	2	14005669864	7002834932	3.51	0.0515
BUSADVIS	1	18151957130	18151957130	9.10	0.0074

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General Linear Models Procedure

Dependent Variable: GOS

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
Between 2 and 5 changes* compared with fewer or more changes	1	14003266837	14003266837	7.02	0.0163*

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		97076.49873 B	2.09	0.0512	46475.13803
SCHOOL	0	47575.37181 B	2.11	0.0494*	22582.26523
	1	0.00000 B	.	.	.
ASSET		0.07475	3.97	0.0009*	0.01881
DEBT		-0.15958	-1.88	0.0771*	0.08510
DISCUSS	0	-7969.24707 B	-0.42	0.6759	18752.18482
	1	0.00000 B	.	.	.
PPCOS	0	-48981.59982 B	-2.36	0.0300*	20794.45800
	1	0.00000 B	.	.	.
DAIRY	0	-49513.35519 B	-1.84	0.0817*	26846.27228
	1	0.00000 B	.	.	.
SEM	1	-28340.76083 B	-1.18	0.2520	23944.00793
	2	0.00000 B	.	.	.
CHNG	1	-56256.45162 B	-1.39	0.1818	40501.75971
	2	36345.20452 B	1.63	0.1203	22284.83492
	6	0.00000 B	.	.	.
BUSADVIS	2	-61226.65971 B	-3.02	0.0074*	20292.37130
	3	0.00000 B	.	.	.

General Linear Models Procedure
Least Squares Means

DAIRY	GOS LSMEAN	T / Pr > |T| H0: LSMEAN1=LSMEAN2
0	13450.7701	-1.84433
		0.0817
1	62964.1253	

General Linear Models Procedure
Least Squares Means

PPCOS	GOS LSMEAN	T / Pr > |T| H0: LSMEAN1=LSMEAN2
0	13716.6478	-2.35551
1	62698.2476	0.0300

APPENDIX G

SEMINARS AND COURSES

Topics of agricultural seminars, workshops and conferences

(Numbers in brackets where more than one farm has attended.)

Feeding for profit (4)
Milk productivity (3)
Edgells growers seminar (3)
Herd health (3)
Irrigation (2)
Ragwort (2)
Hop farming (2)
Mastitis clinic (2)
Drainage seminar (2)
Pivot Fertilizer Co. seminar (2)
Pasture seminar (2)
Cow nutrition (2)
OZ Meat Australia workshop
Dairy milkers workshop
Breeding for Dollars
Electric fencing
Potato Research Conference
Seed Growers Association meeting
Grain feeding
Dairy shed management
Pyrethrum workshop
Calf rearing
Jersey breeding
Lactos seminar

Topics of agricultural and other relevant courses

Whole farm planning course (7)
Farm Best Practice (4)
First aid (2)
Horticulture (2)
Biodynamics
Cheese making
Crop course
Treegrowing
Poppies (overseas)
Radiation safety
Fire fighting
Veterinary chemicals
Chainsaw operators course
Forklift driving
Soils