Appendix 1: Literature Review
A1.1 Overview

This literature review is the first phase of the project. The principal aims of this literature review are to:

1. Establish the range of factors that influence weed management on grazing properties;
2. Bring sociological insights to understanding the decision making process of farmers when considering adoption of agricultural innovations;
3. Enable refinement of survey questions and interpretation of the resulting data, such that the principal motivations and barriers to effective weed management on grazing properties can be identified;
4. Assist in developing a set of recommendations to identify opportunities and provide direction for further weed management extension activities.

A1.2 Introduction

Weeds are recognised as a major threat to both agricultural and native vegetation systems in Australia (Nugent et al. 1999). The naturalised flora of Australia consists of about 2700 species believed to be non-native. Of this total, 798 are considered a major problem in natural ecosystems. Those posing a problem for agricultural systems number 1266 species, 35% of which represent a major problem. Sixteen of these species are currently subject to nationally or state-coordinated eradication programs throughout their known range because of their perceived impacts on agricultural ecosystems (Groves et al. 2003).

A common definition of a weed is simply a plant growing where it is not wanted. A species may be labelled a weed because of its geographical origin, because of its impact on a particular land use, or because of more encompassing effects on ecosystem structure and function (Grice and Brown 1996). Typical characteristics of weeds that make them unwanted include: contamination of agricultural produce; livestock poisoning; restriction to livestock movement and access to pastures; and because they occupy space and resources that could be utilised by more beneficial species (Grice 2003).

Weeds are an important economic problem in agricultural systems. Weeds have a direct impact by affecting the productivity of crops and pastures, resulting in a reduction in on farm income. The economic impacts of weeds are not confined to an individual farm. There may also be industry-wide impacts if weeds affect the supply and market price of a commodity. Externalities are prevalent where uncontrolled weed populations on an individual farm spread to neighbouring farms, imposing additional costs (Jones 2000).

Shortcomings of existing approaches to weed management in Australia have been highlighted by the National Weeds Strategy (ARMCANZ 1999). Reasons for these shortcomings identified in the strategy include:
• **Slow development of weed problems.** People do not identify a strange solitary plant or small group of similar plants as potential weeds. By the time realisation is achieved, the problem is costly and difficult to address.

• **Sleeper weeds.** Plants that appear benign for many years may suddenly spread rapidly after disturbance or after a change in conditions (e.g. land use).

• **Weeds invasion and disturbance are closely linked.** Most of the significant weeds are plants that are able to colonise disturbed areas. It is important to be aware of the danger of invasion following a disturbance event and to minimise opportunity for weed invasion.

• **Failure to recognise the scope of the weed problem.** Many people only consider a weed to be important if it affects them personally.

• **Difficulty in identifying who should pay for weed management.** Government has increasingly applied the ‘beneficiary pays’ principle for assigning the costs of weed control. Failure to identify the true beneficiary has led to inequities in assigning these costs. For example, farmers must pay to control noxious weeds that may not cause them personal economic harm, simply to prevent its spread into other areas. In such cases the true beneficiary may be the whole community in that region.

• **Treating the symptom rather than the cause.** Weeds are often a symptom of degradation caused by mismanagement. Failure to treat the problem rather than the symptom will mean that direct weed control will require numerous applications and only achieve short-term success.

• **Problems with weed legislation.** Difficulties inherent in adhering to or enforcing the legislation that aims to improve weed control include: slowness of enforcement proceedings against landholders, giving the weed time to spread; reluctance by landholders to report new infestations of noxious weeds for fear that they will be compelled to personally bear the costs of control measures that have no immediate benefit to them; and insufficient government personnel to implement weed legislation effectively.

• **Over-reliance on chemical control.** The effectiveness and simplicity of herbicide control has also mitigated against the development of alternative approaches to weed control. Adoption of alternative strategies is now a matter of necessity due to the long-term disadvantages of herbicide control (e.g. resistance, human health, environment etc.).

• **Over-expectation of biological control.** A failure on the part of landholders to realise biological control is just one component of an integrated weed management program can result in reduced input into alternative methods for control if a biological agent is readily available.

• **No process for resolving conflicts of interest.** Stakeholders may hold different opinions on weed issues, such as responsibility for weed control and differences of opinion regarding the relative economic, social and biological values of particular plant species.
A1.3 Weeds in Pasture Systems

The temperate perennial pasture zone of southern Australia, which is the focus of this research, covers an estimated 26 million hectares, and produces nearly half of southern Australia’s sheep and cattle products. This region has a temperate climate and higher rainfall, which fosters the growth of perennial species. Pastures in this region have typically been sown with mixtures comprising perennial grasses and legumes. However, other species usually establish themselves within a few years, and most pastures in the higher rainfall zones are typically complex mixtures of sown, volunteer exotic, and native plant species. A significant part of the total biomass is often species that are considered weeds for at least part of their lifecycle (Kemp et al. 1999).

A1.3.1 The cost of pasture weeds

Over half of Australia’s land area is used for grazing livestock on plant communities typically referred to as grasslands or pastures (Dowling et al. 2000). Weeds in pasture systems are estimated to cost landholders and the community between $1 and $1.87 billion per year (Burton and Dowling 2004; Sinden et al. 2004). Weeds are not only a cause of pasture degradation but may also be a symptom of pasture decline. They compete directly with more desirable pasture species for light, water and nutrients, lowering livestock productivity and reducing profit margins because of the costs of control. Weeds also harbour pests such as rabbits and foxes, and can act as hosts for plant diseases that can devastate crops growing nearby (Taylor and Sindel 2000).

Campbell (1997) divides significant pasture weeds into the following non-exclusive groups, according to their deleterious effects on livestock production.

Poisonous weeds. Weeds in this category cause death, ill-health, photosensitisation, bloat and allergies, resulting in significant losses in livestock production. Their greatest impact on production, however, occurs as a result of non-utilisation of affected pastures and non-achievement of breeding potential. Paterson’s curse (Echium plantagineum) is an example of a weed in this category, being poisonous to livestock when consumed in large quantities, resulting in reduced livestock performance and even death.

Competitive weeds. Weeds in this category deprive pastures of water, nutrients and light. Invasion occurs primarily through their ability to establish, vigorous growth, and massive seed production. Annual grasses, such as Vulpia (Vulpia spp.) are typical of weeds in this category, and have become serious weeds of perennial grass pastures in temperate areas of Australia.

Unpalatable and/or unproductive weeds. Weeds in this category are unpalatable to livestock, and so tend to be avoided, enabling them to develop and multiply unhindered. They reduce the quantity of high quality pasture available, lowering the carrying capacity of land and resulting in production losses. Serrated tussock (Nassella trichotoma) is an example of a weed in this category.

Injurious and/or restrictive weeds. These weeds may possess structures that injure humans, working animals and livestock, and may form barriers that exclude people and livestock and harbour native and pest animals. Thistles, e.g. Saffron thistle (Carlthamus lanatus), and burrs, e.g. Bathurst burr (Xanthium spinosum) are among the types of weeds represented in this category.
Weeds that depreciate the quality of livestock products. Weeds in this category reduce the price for meat and livestock products through contamination of the external fibre (e.g. from Bathurst burr), and damage to pelts (e.g. from the awned seeds of annual grasses), while others, such as Parthenium weed (*Parthenium hysterophorus*), produce taints in meat and milk products.

### A1.4 Pasture weed management

Maintaining and improving the feed supply for livestock is the underlying objective of pasture weed management (Taylor and Sindel 2000). Recommendations for pasture weed management strategies are undergoing a transition. The use of herbicides and regular resowing of pastures has been effective in the past, but their use is now restricted by the growing realisation of the unfavourable economic, herbicide resistance, environmental, and human health issues associated with these practices. The emphasis of pasture weed management is now on the integration of weed management methods that aim to control pasture weeds in the long term by establishing and maintaining useful and well-adapted pasture species in a healthy and vigorous condition (Dowling et al. 2000).

#### A1.4.1 Current state of pasture weed management

Management practices that sustain and revive the pasture resource and provide long-term solutions to weeds have been developed (Burton and Dowling 2004). However, adoption of these practices has not been widespread, and only a relatively small proportion of landholders achieve effective weed control. Research indicates that awareness of the weed problem is high and landholders recognise the need for action. Lees and Reeve (1994) conducted an extensive mail survey of over 2000 producers as part of the Temperate Pasture Sustainability Key Program (TPSK). Meat and Livestock Australia initiated this project for the purpose of developing principles for manipulating pasture composition so as to improve the productivity and sustainability of grazing systems. The producer survey showed that producers listed stocking rate, weeds and grazing management as the most important factors affecting pasture quality and persistence. Further, in all but one region, producers ranked weed management as the highest priority issue in need of research. While the survey did not elicit producers’ reasons for their ranking of issues in need of research, this high priority may indicate that weed control is regarded as a burdensome task which producers would prefer not to have to undertake.

#### A1.4.2 The social dimension of pasture weed management

The social dimension is increasingly being recognised as being vital to sound weed management practices (Grice 2003). Sindel (1996) surveyed graziers in northern NSW to investigate grazier attitudes towards weeds, research and education. Issues identified by this survey were: the spread of weeds from properties where weeds were permitted to grow unchecked; and the need for legal constraints to ensure control of noxious weeds was carried out by all landowners in an area. Some respondents to this survey mentioned worsening weed problems as being due to their inability to afford the time and financial costs involved in managing them. Such limiting factors were particularly significant where farms were left unattended for long periods, or were managed by older farmers (Sindel 1996).
A1.4.3 Land Stewardship

It is obvious that not all farmers are as effective as others at controlling weeds. This issue is highlighted in a paper by Rush (1996), who offers a practitioners’ perspective of weed management based on his experience managing a mixed sheep and cattle grazing enterprise in North Central Victoria. Rush identifies a highly developed ‘weed ethic’ among the ‘best farmers’ in his region, who were diligent in controlling serious weeds. He pointed out that this diligence was not shared by all the farmers in his district, who had widely differing views towards weed control.

The concept of a land stewardship ‘ethic’ has been widely discussed in the sustainable land management literature. It is held that adherence to a land stewardship ethic would result in land users accepting a moral responsibility to manage the land as stewards on behalf of future generations. The land stewardship ethic has been used as a policy rationale in a number of the natural resource management strategies and programs of the late 1980s and early 1990s, including Landcare. However, confidence in the concept has been eroded by developments of the late 1990’s. Despite the empirical evidence of widespread beliefs among landholders that are concordant with a land stewardship ethic, the 1996 State of the Environment report demonstrated that serious land and river degradation problems continued unabated. Confidence in the concept was further eroded by the failure of research to find much empirical evidence that landholders who expressed attitudes consistent with a land stewardship ethic were more likely to have adopted a range of sustainable practices (Reeve et al. 2005).

It is possible that the apparent widespread acceptance of a land stewardship ethic amongst landholders may reflect widely held notions of ‘good farm management’. A farmer’s idea of good management is essentially value driven, and is therefore a personal issue, reflecting an individual’s goals and priorities. Economic considerations may be paramount for some farmers, while others may be more influenced by social factors (Kilpatrick et al. 1999). According to Vanclay (2002), local context also has a strong influence on a farmers’ idea of good farm management. He suggests that an individual’s concept of good management conforms to locally approved practices, or ‘social norms’. It is therefore important to recognize that the desire to be a ‘good manager’ will not, in all cases, compel farmers to control weeds. The priority given to weed control will, like any other component of farm management, vary between farmers.

A1.4.4 Processes Influencing Adoption of Weed Management Strategies

Good management is never simply an application of good science (Freudenberger and Freudenberger 1994). Agricultural ecosystems are extremely complex and involve interrelated economic, ecological and social components (Ridley 2004). The conversion of research findings to change of practice on farm is a major challenge facing agricultural extension (Keeble et al. 2004). Practice change is often slow, and efforts to promote adoption of new agricultural practices will face a number of challenges. Few studies have specifically examined the processes relating to adoption of weed management strategies in grazing systems. However, there is a wealth of literature relating to the extension of agricultural innovations, and to a lesser extent, of sustainable land management practices.
Adoption is not a simple matter of developing and then promoting an innovation, expecting awareness to result in implementation. Adoption is primarily a process of dynamic learning and refinement of decision making over time (Pannell and Zilberman 2000). There is a technical basis for adoption, whereby the qualities of an innovation will itself influence its rate of adoption. There is also a social basis for decision making about farm innovation or change. Finally, farmers are a diverse group of individuals, and this will be reflected in their approach towards innovation and change in farm management practices.

A1.4.4.1 Decision making processes

Barr and Cary (2000) have undertaken an extensive review of the adoption literature with relation to sustainable agricultural practices. As weeds are a land degradation issue and their control is an important component of sustainable management, the review by Barr and Cary provides many insights relevant to adoption of weed control practices. Based on the findings of various researchers, Barr and Cary have identified eight stages of decision-making as being important in the adoption process. These eight stages are represented in Figure A3.4.1, below.

A number of conditions have been identified as necessary to achieve adoption of an agricultural innovation. The farmer must firstly be aware that an innovation exists and is potentially of practical relevance to them. Reaching this point of awareness is a trigger which prompts the farmer to take note of an innovation and begin to collect information about it in order to decide whether or not to go the next step of trialing the innovation. Secondly, the farmer must perceive that the innovation is worth trialing. This will typically involve small-scale trials, gradually resulting in full adoption or disadoption as the farmer gains knowledge and confidence in its performance. The farmer must also perceive that the innovation promotes their objectives. A farmers objectives will be influenced to varying degrees by personal factors, social pressures and community expectations. However, research suggests that economic factors, that is, whether an innovation is profitable, will have the most impact on an adoption decision (Pannell and Marsh 1998).

A1.4.4.2 Qualities of innovations

There are qualities of innovations that may increase or decrease their adoption potential. Adoption is unlikely if management strategies are not in the best interests of individual farmers. Some key considerations (following Frank and Chamala 1992; Vanclay 1992; Bullen and Woods 1999) that affect the adoption of new farming technologies are as follows.

i. Complexity. Adoption probability reduces with increasing complexity.

ii. Divisibility. Partial adoption is viewed as a form of trial adoption. Techniques that cannot be easily divided into manageable parts require farmers’ total commitment to the new innovation before implementation, and so are less likely to be adopted.

iii. Compatibility. Farmers are more likely to adopt innovations that are suited to their farm and personal objectives.
iv. Economics. The more likely the economic benefit, the more probable an innovation will be adopted.

v. Expense. Much innovation requires considerable capital outlay, which many farmers may be unable to afford.

vi. Knowledge requirements. Innovations with high additional learning needs are less likely to be adopted.

vii. Risk and uncertainty. Most farmers are averse towards risk and uncertainty, so more risky strategies are unlikely to be adopted.

viii. Conflicting information. Farmers receive information from numerous sources, which often contradict each other. This increases uncertainty and lowers the probability of adoption.
ix. Perception. If farmers are aware that they are personally affected by land degradation, they are more likely to adopt appropriate management techniques.

x. Social context. Social networks of farmers have a crucial role in providing information about an innovation, and also provide social support for adoption or non-adoption of an activity.

xi. Flexibility. Farmers prefer land management practices to be flexible, allowing them to change in response to market and climate conditions.

The characteristics of technologies that have been readily adopted have been widely studied and identified. Vanclay and Lawrence (2002) observed that the more readily adopted technologies were generally: commensurate with other farm activities; clearly profitable; did not require a substantial capital or intellectual outlay; involved little risk; did not require a major change to farm management; were simple; could be adopted in parts; were widely and uniformly supported by extension agencies, other farmers and farm literature; and did not reduce farmers flexibility.

A1.5 Risk and uncertainty

It is obvious from the information presented above that uncertainty and risk are integral to the decision making process. Uncertainty results from imperfect information, while risk in this context relates to the uncertain consequences of adopting an innovation, such as the loss of capital if the innovation does not produce any benefits (Vanclay 2002).

A1.5.1 Uncertainty and learning

Uncertainty leaves room for misunderstanding and misperceptions about the innovation. In some cases, there may be an option value from not adopting (Pannell 1999). In other words, a farmer who is not sure about the benefits of an innovation may choose not to adopt it, so that resources which would be tied up in the innovation will instead be available for other future purposes. In other cases, the existence of uncertainty will foster a desire for information to inform the decision about whether to consider adopting a new innovation. Formal training, one-on-one learning from experts, media sources, extension services, personal experience, and trialing are among the major sources of information used by farmers. Information and learning sources valued by farmers will vary depending on the characteristics of the individual, including education (Kilpatrick et al 1999; Reeve and Black 1998).

Few studies have examined adoption and awareness of weed management practices or what can be done to increase the rate of change. It is therefore difficult to identify particular learning or communications processes that will improve the uptake of new weed management practices, or to assess the capacity of scientific and technical information to meet farmers’ needs. It has been suggested that identifying how farmers learn about weed management practices is key to designing effective extension strategies to overcome uncertainty and increase adoption (Marra et al. 2003).

A1.5.2 Risk and risk attitudes

A management decision that is risky, but potentially profitable, may be desirable to individuals more willing to take risks, but not to others who are less willing. Differences in willingness to take risks can be conceptualised in terms of ‘risk attitudes’, and can
generally be divided into three types: risk averse, risk preferring and risk neutral. Risk averse individuals will generally be more cautious people who prefer less risky sources of income or investment. They are likely to sacrifice some level of expected return rather than risk the possibility of a loss. Risk preferring individuals are characterized as being more adventurous, likely to select the alternative with some probability of a better outcome and more willing to accept high probabilities of a poor outcome. Risk neutral individuals are intermediate between risk averse and risk preferring individuals. This type of person will select the highest expected outcome regardless of the probabilities associated with potential gains or losses. They will primarily be concerned with achieving a sustainable outcome over time. Risk attitudes are not rigid, but likely to change over time with increased experience, goals and financial resources, and similar factors (Kaan 1999).

Research by Musser et al. (2002) with farmers in the Eastern Cornbelt of the U.S.A. examined risk attitudes of farmers, professional farm managers and agricultural lenders using agricultural choice dilemmas. It was found that differences in risk attitudes can lead individuals in similar circumstances to make different decisions, and that differences in risk preferences are a factor in adoption of alternative management options. They also suggested that risk attitudes of all individuals involved in farm decision making, including business partners, investors, and family members, will influence the decision making process.

A1.6 Heterogeneity in farming

Farmers are not homogenous. Farmers vary in innumerable ways, including: wealth; size of enterprise; age; stage of life; propensity to adopt new ideas; chemical preferences (e.g. organic farmers); attitudes towards risk and approaches to learning (Vanclay 2004). Diversity in farmer attitudes towards risk and uncertainty can be approached on the basis of segmentation analysis.

A1.6.1 Market segmentation

Segmentation research attempts to explain observed variations in farmer behaviour and values using a variety of techniques that range from qualitative to quantitative. Segmentation studies often provide useful insights into the way individuals assess agricultural technology and extension messages. The rationale for this approach is that understanding the producers in each segment will be helpful in refining communications and delivery of extension programs, and for assessing the effectiveness of policies and programs designed for the industry overall (Angus Reid Group 1998).

Barr and Cary (2000) group farmers into seven ‘market segments’, based on review of eight segmentation studies examining farmers’ sowing and management of perennial pasture in south east Australia. Text Box 1 shows the market segments identified in this review.
TEXT BOX 1: Market Segments for Pasture Management (Source: Barr and Cary, 2000).

The Committed: In all the studies used, this group usually represented less than 15 per cent of the population. Members of this group had a high proportion of their farm sown to exotic perennial pastures, and their pastures were regularly top dressed and grazed rotationally or strategically. Members of this group were driven by production and profit and had a good understanding of their production system. These producers placed a high value on information, and awareness of farm innovation generally lead to attitude change and then behaviour change.

The Pasture Part Timers: This group comprised up to 15 per cent of the farm population surveyed. They had a smaller proportion of their farm under perennial pasture, often regularly top-dressed their pastures and practiced rotational grazing. Farmers in this group were motivated by the desire to increase productivity and income, but were constrained by commitment to another business or work interest.

The Crop Focused: These producers were found only in the mixed cropping zone. They saw pastures as a means to improve soil fertility for the next crop and sometimes as a means to maintain sheep until they were required to graze stubble. They often had a negative view towards grasses, particularly perennial pastures, with lucerne tending to be the preferred fodder crop.

Belt Tighteners: This was the largest group identified by the various studies, representing between 30 per cent and 40 per cent of farmers. This group generally claimed to have large areas sown to improved perennial pasture, and usually practiced set stocking. Members believed that conservative grazing strategies would be more profitable than innovation in the long run. These farmers were identified as risk averse, with a decision making style that flowed from awareness to action (trialing) to attitude change. The results of trials are slow to appear in a grazing system, and O’Keefe (1993) argued that this helps explain the low innovativeness of grazing industries in comparison with cropping industries.

Sceptics: Members of this group comprised between 10 per cent and 20 per cent of the sample. They distrusted the advantages described for pasture improvement. Many in this group believed strongly in the importance of low stocking rates. They often had large properties and this may have enabled them to produce a living despite low stocking rates.

Comfortable: This group represented the second largest group, making up 20 per cent to 40 per cent of the population. Many in this group claimed to have significant areas of perennial pastures, but did not see the need for re-sowing, top-dressing, or a change from set stocking. These farmers were typically older, and often grazed beef cattle because of their lower management needs. They were not interested in increasing their workload or accepting additional risks, as they had sufficient income for the foreseeable future and recognized their children as unlikely to succeed them in the farm business.

Retreatists: Mainly found around major population centers, this group was mostly composed of rural residential dwellers or absentee hobby farmers. Pasture was chiefly judged on an aesthetic basis, and group members had little time to undertake significant management tasks. Many of the studies reviewed did not include this group, as its members generally failed to qualify as farmers according to ABS criteria.

A1.6.2 Farming styles research

Another approach to understanding diversity in farmer practice may be found in the rural sociological theory 'farming styles' developed by Prof. Jan Douwe van der Ploeg at Wageningen Agricultural University in The Netherlands. The theory is based upon the view that farming is a social process, with cultural, economic, political and farm management components. Application of this concept involves recognising consistencies in the social goals of farmers, so that individuals can be categorised into appropriate 'styles'. The proposed benefits are better targeted extension and, ultimately, a change in agricultural research priorities so that they better reflect the needs of farmers (Howden et al. 1998). Although farming styles research is still in its infancy, it
seems there could be a strong interaction between farming styles and innovation characteristics (Barr and Cary 2000).

A1.7 What is a weed to a grazier?

Weeds are defined by people’s perceptions of their desirability. Recognition of context and perception is critical when formulating a definition of a grazing weed. Research by Kersten (1996) with graziers of western N.S.W. highlighted the differences in criteria used by researchers to those used by graziers when evaluating plant species. Graziers focused on the value of plants for their stock, valuing such characteristics as palatability, availability, provision of shade and usefulness as windbreaks. Researchers, on the other hand, evaluated native grasses on their ability to survive, perenniality and seed production, independent of their value as stock feed. The desirability of plants will vary throughout the year. For example, some grasses, such as Barley grass (*Hordeum* spp.) are palatable and nutritious and considered useful until they produce spiky seeds that cripple lambs, blind sheep and contaminate wool. The form of animal production will also impact which plants are considered weeds. For example, ‘good sheep country’ may become ‘good cattle country’ when infestations of Bathurst burr (*Xanthium* spp.) reach levels where wool contamination is an issue. Appreciating these differences in perception and context is essential when investigating differences in management approaches towards weed control (Webber 1996).

A1.8 Environmental factors

Although this review is focused on understanding the sociological factors influencing weed management, it is worth noting that farms, like farmers, are heterogeneous. There is no single management practice that is suitable across all farming regions, all farms within a region, or even all areas within a farm. For example, farms will vary greatly in factors such as size, soil types and fertility, vegetation cover, topography, available labour, financial resources, climate, and weeds present. The suitability of a technique to the physical characteristics of the farm will need to be considered in any management decisions. Consequently, farmers’ responses to a new innovation will depend, not just on the characteristics of farm managers, but on the physical characteristics of the farms they manage (Pannell 1998).

A1.9 Conclusions and Recommendations

The temperate perennial pasture zone of southern Australia produces nearly half of southern Australia’s sheep and cattle products. Weeds in pasture systems represent considerable costs to landholders and the community. Management practices that sustain and revive the pasture resource and provide long-term solutions to weeds have been developed, but adoption of these practices has been slow and only a relatively small proportion of landholders control weeds effectively.

An understanding of landholders’ decision processes is necessary to influence change. The adoption of an agricultural practice is not merely a technical process whereby a farmer will simply decide to adopt a better practice once they are made aware of it. Rather, it is an ongoing process wherein farmers constantly re-evaluate adoption decisions. Risk, uncertainty and learning are important considerations in understanding adoption behaviour. High levels of uncertainty can negatively influence rates of
adoption of an agricultural practice, and providing information to reduce uncertainty is a key consideration for weed orientated extension.

Innovations also vary in terms of risk and the amount of learning they involve, and this will influence adoption rates. The qualities of some innovations will appeal more to some farmers than others, depending on the physical and social context of the farm and the management goals (motivations) of the farmer. The results of segmentation studies involving graziers in south east Australia have demonstrated the usefulness of grouping farmers according to attitudes towards management and change. The use of such grouping techniques may be useful in identifying motivations, or triggers, that are likely to prompt different groups of graziers to adopt better weed management practices. Such information would be expected to reveal opportunities for targeted weeds extension activities that are effective in inducing real change in weed management practices.