Weed 120: The Sociology of Weeds -
Motivating, Building Capacity and Educating Graziers
Who Fail to Control Weeds
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Who Fail to Control Weeds

Annamieke van der Meulen
Ian Reeve
Brian Sindel

Institute for Rural Futures
Agronomy and Soil Science

University of New England
Armidale NSW

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SUMMARY

Weeds are a costly problem in livestock grazing systems. Weed management practices that provide long-term solutions to weed problems have been developed. However, adoption of these practices has not been widespread, and only a relatively small proportion of landholders achieve effective weed control. The challenge is to communicate information to, and motivate, the large proportion of landholders that are not controlling weeds effectively. An understanding of the social dimension of weed control is necessary to bring about change.

The purpose of this project was to conduct social research to understand the decision making process of weed managers across the southern Australian sheep and cattle grazing industries, identify motivations for action, barriers to the adoption of better weed management and develop strategies for overcoming these barriers and capitalising on the motivations.

The project commenced with a literature review to establish the range of factors that influence weed management on grazing properties. This was used to develop an interview schedule for on-farm face-to-face interviews. A total of 122 interviews were conducted in northern and southern NSW and north-eastern Victoria. Farm visits were in the company of weeds authority staff, who provided estimates of weed levels and management effort. Interviewees were provided with a questionnaire to mail back at their convenience. After analysis of the face-to-face interviews and the mail-back survey a telephone survey of a random sample of producers in the southern sheep-wheat and higher rainfall grazing regions was carried out. A total of 815 completed interviews were obtained. The project methodology also included a number of validation phases, including the circulation of findings to weeds authority staff, a workshop with weeds authority staff at Armidale and a workshop with weeds research and extension staff in Sydney. After incorporation of input from weeds authority and weeds research and extension staff, and analysis of the findings from the farm visits and two surveys, a number of principles for the design of weed extension strategies have been developed. These are based on the motivations and barriers identified in the research and provide a sound basis for effective weeds extension strategies.

**Principle 1:** There is a wide range of motivations for controlling weeds, and extension strategies have to be tailored to a particular weed, a particular agricultural production system, and a particular social and institutional setting.

**Principle 2:** The greater the diversity of control methods, the greater the possibility producers will find a way of controlling the weed that suits their situation.

**Principle 3:** Effective weed management involves deliberation, diversity and diligence and encouraging each of these requires a different extension approach.

**Principal 4:** Producers fall into different groups according to the level of deliberation, diversity and diligence into their weed management. Different groups need to follow different adoption paths.

**Principle 5:** Gaining reasonably precise estimates of weed levels by telephone interview is not practicable.
In addition to the principles for the design of weeds extension strategies listed above, the findings in this report have also led to a number of check questions that are should be considered carefully in the design. For each check question, the report explains how the answers to the question will determine the approach to be taken in extension, and provides examples of such approaches.

**Check question 1:** What are the key characteristics of the weed?

**Check question 2:** How do the weed and the production system interact?

**Check question 3:** Upon whom do the costs of not controlling the weed fall? Does weed control require collective action to be successful? Are those who will benefit from weed control the same as those who have to bear the costs of achieving control?

**Check question 4:** Does the production system affected by the weed generate returns sufficient to invest in weed control? Will the value of increased production cover the cost of weed control? If controlling the weed is not economically rational for the individual, will it spread and generate further private and public costs, such that collective control is rational, even if it is not rational for the individual?

**Check question 5:** Who believes the weed is a problem? Producers, agricultural professionals or both?

**Check question 6:** Why is the weed currently a problem? Is it lack of control methods, or are the available control methods ineffective, or are the methods effective but poorly used, or are the methods effective but not being used at all?

**Check question 7:** If methods known to be effective are not being well used, why are they not resulting in effective weed control?

**Check question 8:** Is lack of time and money the real reason that producers are not controlling weeds effectively?

The appendices to the report provide a literature review and detailed reports on the analysis and findings from each of the two surveys. A compilation of resources for the evaluation of weeds extension programs is also provided.
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1 Background

Weeds are a costly problem in livestock grazing systems. Weeds 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. Management practices that sustain and revive the pasture resource and provide long-term solutions to weeds have been developed. However, adoption of these practices has not been widespread, and only a relatively small proportion of landholders achieve effective weed control. The challenge is to communicate information to, and motivate, the large proportion of landholders that are not controlling weeds effectively.

An understanding of the social dimension of weed control is necessary to influence change. Farmers and farms are not homogenous, but vary in many ways, including size of enterprise, propensity to adopt new ideas, soil types and fertility, vegetation cover, topography, climate, and weeds present. Farmers will differ in their opinions about the desirability of a plant, so that ‘one grazier’s weed is another grazier’s feed’. Understanding how these kinds of factors influence weed management is crucial to promoting improved management of weeds across grazing industries.

1.1 Objectives

The purpose of this project was to conduct social research to understand the decision making process of weed managers across the southern Australian sheep and cattle grazing industries, identify motivations for action, barriers to the adoption of better weed management and develop strategies for overcoming these barriers and capitalising on the motivations.

Specific objectives of this research were to:

1. Establish the broad scope of potential reasons why graziers do not adopt improved management practices, with particular reference to existing proven management practices,

2. Identify producers’ motivations and perceived disincentives for effective weed management,

3. Work collaboratively with researchers from a complementary project to develop and recommend strategies, tactics, processes (and associated evaluation methods) for motivating effective weed management,

4. Communicate results to weed regulatory, extension, and research professionals, including those working on MLA approved projects,

5. Complete, and have approved by MLA, a final report comprising the results of objectives 1 to 4.
2 Methodology

2.1 Literature review

A literature review formed the first phase of this project. The principal aims of this literature review were 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.

Information was distilled from the literature produced by industry groups, government and non-government agencies, research organisations, and from scientific journals and conference proceedings. Review of the written literature was supplemented by consultation with stakeholder organizations, including catchment management authorities, weed advisory boards, local councils. The complete literature review is presented in Appendix 1.

2.2 Field visits

The data for this study were derived from personal interviews with livestock producers in temperate pasture systems (average annual rainfall >500 mm) of New South Wales and Victoria. A questionnaire was left with the interviewees for completion and return at their convenience. A literature review, together with discussions with weeds regulatory and extension staff, informed the development these survey tools. A total of 122 interviews were conducted in north-east (31) southern New South Wales (58) and in south-east Victoria (33).

The majority of interviews (88) were conducted on the property of the participating livestock producer. In New South Wales another 34 interviews were conducted off-farm with livestock producers participating in the Lockhart Drum Muster (31) and a small number (3) that took place at a location specified by the interviewee, usually at local government headquarters.

Property owners were first contacted by the local weeds authority officer, to arrange permission for the IRF researcher to accompany them onto the participants’ property, and to arrange a suitable time for an interview to occur. An advantage of this approach was a personal introduction to landholders by a locally known and trusted individual. This was important in gaining access to landholders who would not normally respond to less personal mail and telephone survey, so reducing non-response bias (Armstrong and Overton 1977). Another advantage was that, for each property visited, weed incidence and weed management effort was rated on an eight-point-scale, aided by the weed officers’ local weed expertise and knowledge of management history. These ratings assisted in profiling graziers with respect to their effectiveness in controlling weeds.

The interviews were conducted with primary weed managers (i.e. individuals with primary or shared responsibility for weed control decisions). Participants were asked to
name plants locally problematic to grazing, and describe the reasons why these plants were a problem. Interviewees were also asked what they considered important when choosing methods of weed control, and what they regarded as the key element in a good weed control program.

The mail questionnaire returned by interviewees gathered data on: weed awareness, views about how much weeds were reducing returns, use and opinions of various weed control strategies, difficulties encountered with weed control, farmer demographics and farm characteristics, attitudes towards weed control, and perceptions of the usefulness of various sources for information relating to grazing weeds. The full report, including the detailed results of the field survey and supporting documentation, is presented in Appendix 2.

2.3 Telephone survey

Australian Bureau of Statistics (ABS) Agricultural Census data was used to prepare a list of the local government areas in New South Wales, Victoria, South Australia, Tasmania and Western Australia which contained 90 per cent of the total number of cereal-sheep and cattle establishments in those States. The list was adjusted to ensure that only local government areas in the southern cereal and higher rainfall zones were included. GIS software was used to obtain a list of postcode areas covering these local government areas. Telephone interviews were carried out by a market research firm, Taverner Research of Sydney, drawing telephone numbers randomly from within these postcodes. Only respondents with more than 500 sheep and/or 60 cattle were included in the survey. Sampling was stratified by State to provide the best possible confidence intervals on estimates of proportions for each State, while maintaining a total sample size of 800. With a sample of 48 in Tasmania and samples of 188 in each of the remaining States, it was possible to obtain confidence intervals on estimates of proportions around ±10 per cent (calculated with the finite population correction) in each of the State. Unless otherwise noted, the figures in tables in this report are weighted to the actual distribution of establishments across States. A total of 815 interviews were obtained. The full report, including a the detailed results of the telephone survey and supporting documentation, is presented in Appendix 3.

2.4 Communication of results

2.4.1 Discussion group with New England Weed Authority

Once the data from the field visits had been analysed, a discussion group was held at IRF on December 1, 2005, to present the main results (see Appendix 2) to the staff of New England Weeds Authority – an organisation active in both an extension and regulatory capacity. These officers had been involved in the project from the earliest stage, providing important insight into the weed control situation on grazing properties. The majority of these staff had also accompanied Ms van der Meulen on the field visits carried out in the New England Region.

This discussion group served as an important check point, with the feedback from these officers being noted and used in future stages of the project. The group also provided validation that the results of the field survey accurately depicted the weed control situation on grazing properties. Such verification was necessary to the development of the telephone questionnaire, so that the questions were designed on sound principles. Further, it provided IRF with an opportunity to communicate results to the staff of New England Weeds for use in planning and evaluating their own activities.
2.4.2 Circulation of results via email

To further validate the results of the field visit data, and especially to ensure that the results were equally applicable across all parts of the perennial grazing regions of southern Australia, a summary of the results was circulated (via email) to weed control and extension officers in Southern NSW, Victoria, South Australia and Western Australia. These officers were first telephoned to introduce the project and obtain their cooperation in providing feedback on the report.

A copy of the email and associated summary is presented in Appendix 2. This email was sent on March 3 2006, with responses generally received within 2 weeks of this date. Most officers responded by email, although some provided feedback via telephone. Responses were generally affirmative, with no significant issues arising that contradicted the results.

2.4.3 Journal article and conference proceedings

In order to communicate the results to a wider audience of weed professionals, the main findings of the research were consolidated into two conference papers. These papers are provided in Appendix 6.

Dr Reeve presented the paper ‘Insights into motivations and barriers for weed control in temperate grazing systems of southern Australia’ at the Facilitating Adoption of No-tillage and Conservation Farming Practices Conference, at the Sustainable Farming Training Centre at Tamworth on March 29, 2006.

Ms van der Meulen is to present the paper ‘Insights into motivations and barriers for weed control in grazing districts of southern Australia’ at the 15th Australian Weeds Conference in Adelaide on September 25, 2006.

2.4.4 Workshop

On 18 July 2006, MLA hosted a workshop in North Sydney involving the Weed 120 and Weed 124 Project teams (IRF and Rural Enablers, respectively) and professionals working in weeds research and extension. This workshop was organized by IRF, for the purpose of providing research and extension staff with a brief introduction to the issues they need to consider in the design, delivery, and evaluation of weed communication strategies. Weeds research and extension agents involved in this workshop represented Weeds Australia, the University of Sydney, and the Department of Primary Industries in Queensland, New South Wales, and Victoria. These individuals were identified by MLA as working in areas relevant to the two Projects.

After presentation and discussion of the findings from the two Projects, participants were assigned into two groups to discuss one of two topics relevant to the projects being carried out by the workshop participants. The two topics were:

1. Assisting woolgrowers to use an integrated approach in the management of serrated tussock in native pasture systems with poorer soil and difficult terrain.

2. Working with extension staff and woolgrowers to control Prairie Ground Cherry and Silver Leaf Nightshade in disturbed environments, involving bio-economic modelling and other tools.

In each group, members of the Weed 120 and Weed 124 Project teams were present to facilitate and guide discussion. Each group were to identify challenges and strategies specific to their topic, drawing on the findings of the Weed 120 and Weed 124 Projects.
The results are presented in Appendix 4, which is the summary report for this workshop.

2.5 Evaluation resources

A small collection of evaluation resources was compiled with a view to providing weed research and extension staff with the tools they will need to evaluate the impact of their weeds extension programs. The evaluation resources are provided in Appendix 5.
3 Discussion of Project Findings

3.1 Introduction

This section draws together the findings of the various phases of the project, as well as providing a number of observations about broader extension issues that have become apparent in the course of undertaking the project. In the latter case, and where appropriate, reference is made to the findings of the parallel project to this one, Weed 124.

3.2 The magnitude of the problem

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. 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 impacts on agricultural ecosystems (Groves et al. 2003).

Many of the factors contributing to the on-going problems with weeds in Australia are well recognised (ARMCANZ 1999). They include:

- the gradual development of weed problems,
- the phenomenon of sleeper weeds,
- the tendency of weeds to colonise disturbed areas,
- persistent failure to recognise the scope of weed problems,
- mixed private and public benefits to weed control and the difficulty in identifying who should pay for weed management,
- treating the symptom rather than the cause,
- problems with weed legislation,
- over-reliance on chemical control,
- unduly high expectations of biological control, and
- the lack of a process for resolving conflicts of interest where weeds may be a benefit to some but a cost to others.

As a consequence, weed levels on many farms are higher than they need be, and there would be both private and public benefits in reducing weed levels. Weeds in pasture systems are estimated to cost landholders and the community between $1 billion and $1.87 billion per year (Burton and Dowling 2004; Sinden et al. 2004).
3.3 Policy context

The potential public, industry and private benefits in reducing weed levels is the central justification for public policy directed at improved weed management. The benefits from improved weed control include:

- increased production (private benefit),
- maintaining product quality and market access (private and industry benefit),
- eventual decrease in weed control costs across the industry (private and industry benefit),
- eventual decrease in weed control costs on public land (public benefit),
- reduction in threats to biodiversity in public reserves (public benefit).

The costs of achieving the benefits listed above can be borne privately or publicly or both. As in other areas of agricultural and natural resource management policy, the appropriate policy approach is determined by the balance of public and private costs and benefits, and by whether or not coordinated action is required to obtain the benefits. Some examples of this are:

- if a weed is non-invasive and no threat to the industry or the environment, i.e. costs and benefits are entirely private, then control may be left individual decision making,
- however, if in the above situation there is a loss of production, and there is a government agency with a mandate to increase agricultural production, then public funding may be used for research and extension to improve control of the weed,
- if failure to control a weed results in product quality or market access problems that disadvantage the whole industry, then industry-wide research, extension and compliance monitoring may be funded privately (industry levies on individuals), possibly augmented by matching public funds,
- if failure to control a severely invasive weed imposes costs on other landholders, regardless of which commodities they produce, compliance may be obtained through extension and regulation with a legislative basis, with the costs of monitoring and prosecution publicly funded, possibly with some recovery of costs through imposition of fines,
- if failure to control a weed does not affect agricultural productivity but threatens to degrade biodiversity on public reserves, then control may be encouraged by publicly funded education and extension activities.

In general, the more severe the spillover effects from one property to another (i.e. the more readily the weed spreads) and the more severe the costs to production and product quality, the more likely there is to be public investment in weed control and the more likely there is to be some form of compliance monitoring and penalties for non-compliance.
However, for many weed species, the threat to production (or the political appreciation of the threat to production) and the spillover effects have not become sufficiently large to warrant major public investment in regulatory approaches to obtain compliance. Consequently, there is a large number of weed species where the policy approach is one of moderate to minimal public investment in education and extension to encourage voluntary adoption of control practices, with the costs of adoption being largely borne privately.

This policy approach has been widely used in agriculture and natural resource management for a considerable period of time and has evolved many variants. There has also been much research into this form of extension, both in Australia and internationally. This research has been located in various schools of thought or paradigms in the social sciences.

Consequently, there are a wide range of extension approaches which vary according to the source of public funding (Commonwealth, State or local government), the extent of industry contribution, the extent of individual contribution and the rationale underpinning the approach. The latter rationales are located in such areas as:

- economics – adoption as private rational calculation and extension as a response to market failure,
- constructionist sociology – adoption as assimilation of new practices into how farming is seen by the individual and extension as a dialogue between professional and farmer perceptions of agricultural production,
- social and behaviourist psychology – adoption as a behaviour explained by personality and attitudinal traits, and extension as communicating information to specific groups of farmers defined by these traits,
- realist sociology and hard systems – the Wageningen school where adoption and extension are conceptualised as components of an Agricultural Knowledge and Information System,
- social ecology and soft systems – adoption as an interactive process of observation, reflection and action and extension as facilitation and capacity building, and
- education – adoption as learning and extension as teaching.

While the more enthusiastic proponents of a particular rationale might wish to claim its universal applicability, a pragmatic and less partisan assessment would conclude that different rationales are suited to developing weeds extension strategies in different situations. For example, an economic rationale would apply to a region where farming was profitable and farmers were young, well-informed and information-hungry. If the market had failed to provide information on simple practices to combat a particular weed, then all that is needed is some public investment to make the information available and farmers rationally pursuing their self interest will do the rest.

On the other hand, an educational or social ecological rationale might apply to a region where farming was less profitable, returns to weed control were lower and the methods of control complex and demanding.
Further discussion of the rationales for extension strategy design and the social institutions by which strategies are implemented lies outside the scope of this project, although discussion of these issues is to be found in the Weed 124 project report.

3.4 Adoption paths and segments

Regardless of the extension approach and the social and institutional context within which extension programs are implemented, there will be always a requirement that farmers become aware of new practices, assess the applicability to their situation and possibly trial and adopt the practices. It is this aspect that is the central focus of this project.

It is generally accepted that the practice of farming requires constant adjustment to the production system and enterprise mix in response to input and commodity prices, emerging natural resource management issues, new technologies and changing personal goals and family circumstances. In addition, the adoption of a particular practice is often dependent upon other practices already having been adopted. From this perspective, the sequence of adoption of new practices and the discarding of old ones can be seen as an adoption path leading from one way of farming towards some other way, with various practices adopted and discarded along the way. Of course, any one farm will be on a number of paths simultaneously, e.g. reducing sheep flock size and increasing cattle numbers in response to commodity prices, moving from cattle breeding towards steer fattening in response to declining physical capacity with age, moving from pasture re-sowing to grazing management in response to rising costs of pasture establishment.

For a particular set of adoption paths, the population of farms will be located at different points along the paths. The farms at a particular point will tend to be similar in terms of their production systems, practices in use and practices which can potentially be adopted. The position of a farm on an adoption path may also reflect the personal goals, family situation, risk preferences and farming style of the farm business partners. It is these groupings of farms that are of interest in segmentation and social marketing approaches to extension (see Appendix A1.6.1 of this report and section A1 of the Weed 124 Project report).

The adoption path with which this project is concerned is that from ineffective or non-existent weed control towards effective weed control. The on-farm interviews, interviews with weeds officers and telephone interviews with farmers suggested that there are three key factors involved in improving weed control. These have been labelled as the 3Ds of effective weed control:

- Deliberation (planned, strategic and integrated weed control),
- Diversity (of methods), and
- Diligence (in application of methods).

While it is obvious that an improvement in any of the three factors will lead to better weed control, the findings from the mail-back survey support the view that there is not a simple linear adoption path from the unplanned, reactive, and ad hoc application of a few simple weed control methods to the planned, strategic, integrated and diligent application of a diversity of methods. The nature of the possible adoption paths and the
segmentation of farms relative to these paths can be conveniently summarised in a three-dimensional space (Figure 3.1).

*Figure 3.1 The 3Ds of effective weed management define a 3D space.*

The data from the mail-back survey suggested that farms were not distributed uniformly in this three-dimensional space (Figure 3.2). The fact that relatively few farms lie in the lower, left, back part of Figure 3.2 is consistent with the realities of weed management, i.e. the use of a range of weed control methods results in some of the methods being the more complex ones, which require a certain amount of planning in their use. So it is unlikely that very many farmers will be using the more complex methods in an unplanned, reactive way.

### 3.5 Motivations and barriers

Before proceeding to a fuller discussion of adoption paths towards improved weed management and the implications for weeds extension strategies, it is necessary to introduce the other area of emphasis in this project – motivations and barriers.

It is generally accepted that adoption of a new farming practice involves a number of steps. An example of the sequence of steps in adoption is shown in Figure 3.3. Further examples are given in section A1 of the Weed 124 Project report.
Many of the models of the adoption decision process assume initial steps relating to awareness, problem recognition, and acceptance that the problem is amenable to management action. However, for many weeds, the problem is already recognised and management action is being taken, but with unsatisfactory results. Many of the properties visited for the on-farm interviews had weed levels regarded by the accompanying weeds officers as somewhat or very unsatisfactory, yet in all cases the managers were undertaking weed control practices.

The telephone survey asked farmers about whether particular weeds were in their district, were regarded as a weed and were easy or difficult to identify. The results from these questions are reported in Appendix 3.7. It can be seen there are distinct differences between weeds, with:

- some common broadleaf species such as blackberry and gorse being almost universally regarded as ubiquitous, a weed and easy to identify,

- grasses, such as barley grass, being almost universally regarded as ubiquitous and easy to identify, but with opinion divided as to whether it was a weed or not,

- grasses, such as tussock grass, being almost universally regarded as a weed, but with substantial numbers of respondents who believed it was not in their district and substantial numbers who were unsure whether it was easy or hard to identify, and
• grasses, such as Chilean needle grass and African love grass, where substantial numbers are unsure whether it is in their district, unsure whether it is a weed and unsure whether it is easy or hard to identify.

Figure 3.3 Eight stages of decision-making in the adoption process (after Barr and Cary, 2000).

These differences highlight the need for weed extension strategies to be tailored very specifically to individual weeds. There is strong evidence from the telephone survey that there is a need to raise awareness of the existence of some of the lesser known grass weeds and of their impacts on production, whereas there is no need for investment in awareness raising for weeds such as gorse and blackberry.

If farmers are already using weed control practices, but without achieving satisfactory levels of control, then it is important to have an understanding of what is motivating their current control efforts and what they regard as difficulties that work against increased effort or effectiveness.

In the telephone survey, data on motivation was obtained from the responses to the question:
...when you are thinking about the jobs you have to get done in the coming few days or weeks, what reasons will cause you to put weed control in a particular paddock or place on your property at the top of the list?

It was found that there were a wide range of motivations reported. Grouping these into 11 main categories, it was found that motivations relating to weed life cycle, fitting in with other farming operations, times of year and high weed levels were mentioned by between 20 and 40 per cent of interviewees. It is worth noting that the motivation that is often the basis of extension communication – awareness of the impacts on productivity – was mentioned by only 16 per cent of interviewees. However, in the mail-back survey, when asked specifically about the reduction of returns by weeds, over 90 per cent of respondents indicated that reduced pasture production or costs of controlling weeds resulted in a big reduction, or some reduction in returns. This suggests that, although many producers are well aware that weeds are costing them money, it is not necessarily this aspect that motivates day-to-day decisions about weed control.

Interviewees could supply more than one motivation and there were 63 different combinations of motivations given, the most popular of which – the single motivation of fitting in with other farming operations – was given by only 14 per cent of interviewees.

In addition to motivations relating to the priority placed on weed control in farm operations, the on-farm face-to-face interviews asked what had motivated producers to change their weed control methods. The most frequently mentioned reason was a worsening weed situation (30 per cent), followed by a desire to increase production (15 per cent).

Further evidence for the diversity of motivations was obtained in the on-farm interviews and interviews with key informants. Table A2.7.1 in Appendix 2 provides an extensive list of motivations ordered according to the stages in Figure 3.3, above.

The barriers that interviewees believed they faced in controlling weed fell into two groups: those that are feasibly within management control, such as lack of time, money or labour; and those that are beyond management control, such as drought, neighbours with weeds, or weeds on adjoining public land. Lack of time and lack of money were the most frequently mentioned (two thirds of interviewees). Neighbours with weeds, lack of labour and drought were mentioned by between two thirds and half of the interviewees.

Weed levels on farms represent a balance struck by managers between the barriers and difficulties they face, and how hard and how effectively they are prepared to work to overcome these barriers (Figure 3.4). The effectiveness of weed control efforts is a function of the 3Ds described in the previous section, and the motivations that influence day-to-day weed control decisions.

The data from the telephone interviews suggested that those who gave a single motivation relating to weed life cycle appear to be the better weed managers who place a higher priority on weed control. Fitting weed control in with other farm operations was associated more with sheep-wheat production than with beef cattle production, and it appears that the need to fit weed control in with other operations may result in lower priority being placed on weed control. Poorer weed management also appears to be associated with weed levels and time of year as motivations for weed control. Clearly, waiting until weed levels are high before acting is inconsistent with the 3Ds for
effective weed management (as indicated by the red cross in Figure 3.4). The association between time of year as a motivation for weed control and poorer weed management may reflect a tendency for some producers to undertake particular weed control operations routinely at a particular time of year, without paying too much attention to the life cycle stage of the weed or other factors important in the weed control decision. However, as suggested in Figure 3.4, weed control undertaken at particular times of year, with due consideration of other factors can improve the diligence of weed management efforts.

*Figure 3.4 Schematic of the relationship between motivations, barriers and the 3Ds of effective weed management.*

The findings from the telephone interviews also indicate that it is the poorer weed managers who believe they are prevented from improving weed control by factors such as lack of time, money and labour – factors that may well be within their own management control. This suggests that there will be situations where improving the standard of weed management will require first that overall farm management and
profitability are raised to higher standards. In comparison, the better weed managers appear to be more troubled by spillover effects from adjoining properties.

3.6 Extension strategies

The findings of Weed 120 (this project) and Weed 124 (the Rural Enablers’ project) both point to the critical importance of tailoring extension strategies to the weed problem on hand. This careful design of the fit between the problem and solution involves consideration of:

1. the nature of the weed and its behaviour in the agricultural production system,
2. the technical options for control,
3. the nature of weed management that is currently occurring or not occurring,
4. the reasons for ineffective weed management,
5. the capacity of farm businesses to support improved or changed weed management,
6. the distribution of costs and benefits of improved or changed weed management, and
7. the most appropriate and effective way to bring about these improvements or changes, given the incentives and disincentives for action resulting from distribution of costs and benefits.

As discussed in the Weed 124 report, various people could find they have a responsibility to undertake extension strategy design taking account of the points listed above, e.g. a national MLA/AWI funded coordinator, or a local group taking on a particular weed problem and building capacity in their locality.

The design of extension implementation, point 7 above, is dealt with in comprehensive detail in the Weed 124 report.

From the experience with this project, some observations can also be made with respect to point 6 above, however the findings from this project relate mainly to points 1 - 5 above. The following sections set out the main findings as a series of check questions and principles to be followed in developing weed extension strategies. It is assumed that assessments at a national or regional level have already been carried out to identify which weed or weeds will be the focus of extension effort.

Principle 1: Extension strategies have to be tailored to a particular weed, a particular agricultural production system, and a particular social and institutional setting.

The telephone survey showed there were marked differences in levels of awareness and knowledge about different weeds, while the workshop with researchers showed how the extension strategy to be used was critically dependent of the nature of the weed, the production system and the capacities of managers.

Check question 1: What are the key characteristics of the weed?

Knowledge of the weed life cycle, means of spread, conditions favouring or constraining reproduction and spread, and future potential are essential.
**Check question 2:** How do the weed and the production system interact?

This nature of this interaction determines how the production system might have to be modified, what new practices might be needed (which assumes these are known), and what old practices might need to be dropped.

**Principle 2:** The greater the diversity of control methods, the greater the possibility producers will find a way of controlling the weed that suits their situation.

It is important in the early stages of developing an extension strategy for a particular weed to have information on all the possible ways of controlling it. Building an extension strategy on a single control method is likely to leave the weed poorly controlled on properties where the method is not suited to the production system or the producer’s farming style.

**Check question 3:** Upon whom do the costs of not controlling the weed fall? Does weed control require collective action to be successful? Are those who will benefit from weed control the same as those who have to bear the costs of achieving control?

The answers to these questions are fundamental to specifying the institutional setting within which an extension program might sit. Parameters to be considered in defining the institutional setting include:

- the relative public and private contribution to research and extension,
- the level of involvement of industry organisations,
- the level of involvement of representatives of public environmental interests, such as environmental NGOs or government agencies with environmental responsibilities, and
- the balance between self-regulation and external monitoring and sanctions.

Further details are provided in section 3.3 and the Weed 124 report.

**Check question 4:** Does the production system affected by the weed generate returns sufficient to invest in weed control? Will the value of increased production cover the cost of weed control? If controlling the weed is not economically rational for the individual, will it spread and generate further private and public costs, such that collective control is rational, even if it is not rational for the individual?

The answers to these questions determine whether weed control can reasonably be expected to be a matter of private adoption, or whether collective action and possible public subsidy is required. Further details are provided in section 3.3.

**Check question 5:** Who believes the weed is a problem? Producers, agricultural professionals or both?
The answer to this question is critical in shaping extension strategy. If producers do not think the weed is a problem, the reasons for this have to be well understood. The findings from this project suggest that there are a number of grass weeds that are not well known to producers and which research and extension professionals believe may be reducing production. If there are practices available to control such weeds, then the first step of an extension program has to involve raising awareness and demonstrating the losses to production.

Producers may think the weed is a problem, but control is not economically rational, as mentioned in the previous check question.

**Check question 6:** Why is the weed currently a problem? Is it lack of control methods, or are the available control methods ineffective, or are the methods effective but poorly used, or are the methods effective but not being used at all?

The answer to this question is also critical in shaping extension strategy. Lacking or ineffective control methods point to the need for research before extension can be proceeded with. Poorly used methods means extension has to focus on refining existing skills, whereas methods not being used at all points to the need for a broader extension program.

**Check question 7:** If methods known to be effective are not being well used, why are they not resulting in effective weed control?

The findings from this project suggest that, where well proven effective methods of weed control exist, ineffective weed control is likely to be due to a lack of diligence in use, reliance on one or two (often herbicide-based) methods, or unplanned, reactive weed control, or some combination of the three. The design of extension strategies to improve the effectiveness of weed control requires knowledge of the contribution of each of these factors to the problem.

**Principle 3:** Each of the 3Ds of effective weed management requires its own extension approach.

Increasing diligence in application of methods with which the producer is already familiar and can use competently, requires a knowledge of what motivates producers to use the particular method for a particular weed in a timely fashion. This project suggests four motivations are fairly common among producers: those related to weed life cycle, those related to fitting in with other farm operations, those related to time of year and those related to weed levels. However, there are many more motivations and combinations of motivations and those applicable to a particular weed and method of control will need to be identified.

There are a number of simple extension messages which can remind producers to control weeds in a timely fashion:

- calendars of weed control activities directed to those who work to a fixed calendar of farm activities,
• warnings on local radio or in local newspapers about early germination, flowering or seed set directed to those who time their activities around weed life cycles,

• warnings on local radio or in local newspapers about particular weeds being present in greater densities than is immediately apparent, and

• simple hints about weed control opportunities that are generated by other farm operations (“Did you know that when you are doing X you could be doing Y to control weeds with little extra cost or effort?”)

Increasing the diversity of methods used for weed control requires the adoption of new weed control methods. Consequently, issues of trust and credibility of information and preferred ways of learning about new practices become important. The report for Weed 124 discusses the issue of trust and credibility in section A1 and A2. This project, consistent with the findings from Weed 124, has found that ‘people sources’, such as one-to-one advice, field days, workshops and discussion groups are preferred by producers to written or electronic sources. For this reason, extension approaches that build trust and credibility and use preferred modes of communication will be important for increasing the diversity of methods used in weed control.

The way in which trust and credibility are built will depend upon the institutional setting for the extension program. For example, for traditional extension by a government department, trust and credibility is built upon at least several years personal interaction with extension staff and a track record of delivering effective and successful changes to agricultural practices. For extension through an industry program, trust and credibility builds from industry organisations’ track record in promoting and defending the interests of producers. For extension through a regulatory agency, trust and credibility is built from the agency’s track record in being fair, flexible, helpful and empathetic in carrying out its regulatory mandate.

Increasing deliberation in weed control (i.e. planned, strategic, integrated methods), is likely to require an educational approach working through producer groups. This is because a planned, strategic and integrated approach to weed control requires learning about the ecology and life cycle of the weed in some detail, something which cannot be done effectively by the simple provision of information or at field days. In the last decade, there have been a number of successful group-based extension programs with a strong educational basis (e.g. BestWool, Wool for Wealth, TopCrop, TripleP, Grazing for Profit, ProGraze) and the design of educational, group-based programs for improving weed management skills should build on the experience with these programs.

**Principal 4:** Producers fall into different groups according to the level of deliberation, diversity and diligence into their weed management. Different groups need to follow different adoption paths.

The Weed 124 project report (section A1) and Appendix 1 in this report reviews some of the literature that argues for segmentation and social marketing approaches in agricultural extension. The on-farm interviews and the mail-back survey in this project support the view that there are different groups of producers with respect to how they are managing weeds and what their needs might be in improving their weed management. The nature of groups will vary from weed to weed and region to region, but there are at least two groups that will be reasonably universal, and around which extension strategies can be planned.
The first group of producers is those whose weed management is not at all effective. Their management is likely to be unplanned, reactive, based on very few methods of weed control and carried out in an ad hoc fashion. The findings from this project suggest that the best course of action to improve weed management by this group is to improve the diligence with which they tackle weed control. Weed levels are a trigger for action in this group and many may be waiting until levels are too high before taking action. In addition, many may feel that their best efforts will come to nought because of the vagaries of the weather. This is a potent justification for neglecting weed control, especially among external locus of control personality types. There are a number of ways simple extension messages can help overcome some of these barriers to diligence in weed control.

Firstly, thresholds for action may be able to be lowered with visual communications about weed density along the lines that “If [a particular weed] looks like this [picture 1] on your place, then you are spending more money than you need to. The time to act is when it looks like this [picture 2], and it’ll cost you a lot less”

Secondly, the commonsense idea that ‘a stitch in time saves nine’ or ‘one year’s seed, seven years weed’ is widely accepted among primary producers. There are a number of areas where this idea can form the basis of extension messages. These include buying clean feed and confined feeding areas during drought, on-farm quarantine measures such as vehicle washdown areas, and use of certified seed in cropping.

Thirdly, extension messages that emphasise opportunities for weed control that arise in unusual seasonal conditions can be publicised when these conditions occur.

Lastly, extension messages can emphasise that, while livestock production and cropping is never simple, producers can make their weed control simpler by establishing a routine with a few straightforward methods and following it diligently.

While regulatory approaches might be considered as a means of increasing diligence, the findings from this project suggest these can only be a measure of last resort to deal with persistent and flagrant negligence to control seriously invasive weed species.

The second, fairly universal group of producers is those who are achieving reasonable to good weed control of the main declared and broadleaf weeds through the diligent application of a small number of methods. However, they may still be losing production to lesser known weeds. It is possible that rising chemical prices, the appearance of new weeds or increasing age could result in some members of this group slipping back into the poorer weed management group. The focus for maintaining and improving the effectiveness of weed management in this group should be upon developing skills in the identification of the lesser known grass weeds, alerting them when new weed problems emerge and increasing their awareness of the advantages of newer weed control methods.

There are also other segmentations of producers that will be suitable for tailoring extension strategies. For example, the mail-back survey data showed that producers could be divided into four groups according to the weed control practices they used: a group using relatively few practices, a group using mainly mechanical methods, a group using mainly grazing management methods and a group using most methods.

*Check question 8: Is lack of time and money the real reason that producers are not controlling weeds effectively?*
Lack of time and money is likely to be volunteered by many producers as the reason they are having trouble controlling weeds. This could mean three things:

- lack of time and money is the consequence of spending available time and money on other priorities believed to be more important than weed control,
- the production system is not being managed in the most time-effective and profitable way, resulting in insufficient time and money available for weed control, or
- even with the best management possible, the production system will not provide the returns needed to invest in weed control.

The last of the three points above is dealt with under check question 4. The second point above implies that weed management extension will have to be carried out in parallel with, or after, extension and education to improve management of the production system. In relation to the first point above, other priorities may or may not be more important than weed control. If priorities relate to personal goals, then the only approach is probably one of the educational, group-based extension approaches that encourages reflection on personal goals. The Weed 124 report provides information on a number of group techniques that could be adapted to this purpose.

**Principle 5:** Gaining reasonably precise estimates of weed levels by telephone interview is not practicable.

Evaluation of the impacts of weed extension programs require measures of what has been achieved. Consistent with the concept of Bennett’s Hierarchy, the ultimate measure of impact, changes in weed levels, is the most difficult to measure. Apart from the influence of seasonal conditions on weed levels, it has been shown in this project that it is very difficult to obtain reasonable estimates of weed levels by telephone interview. However, it has also been shown that good estimates can be obtained from weeds authority staff who are familiar with weed levels in the district and the properties they visit. Consequently, the involvement of weeds authorities can assist with evaluation of extension programs, as well as with developing broad communities of practice in building local capacity.