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Increasing landholder adoption of improved surface water management practices : literature review of relevant Australian studies

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Government of Western Australia

INCREASING LANDHOLDER ADOPTION OF IMPROVED SURFACE WATER MANAGEMENT PRACTICES

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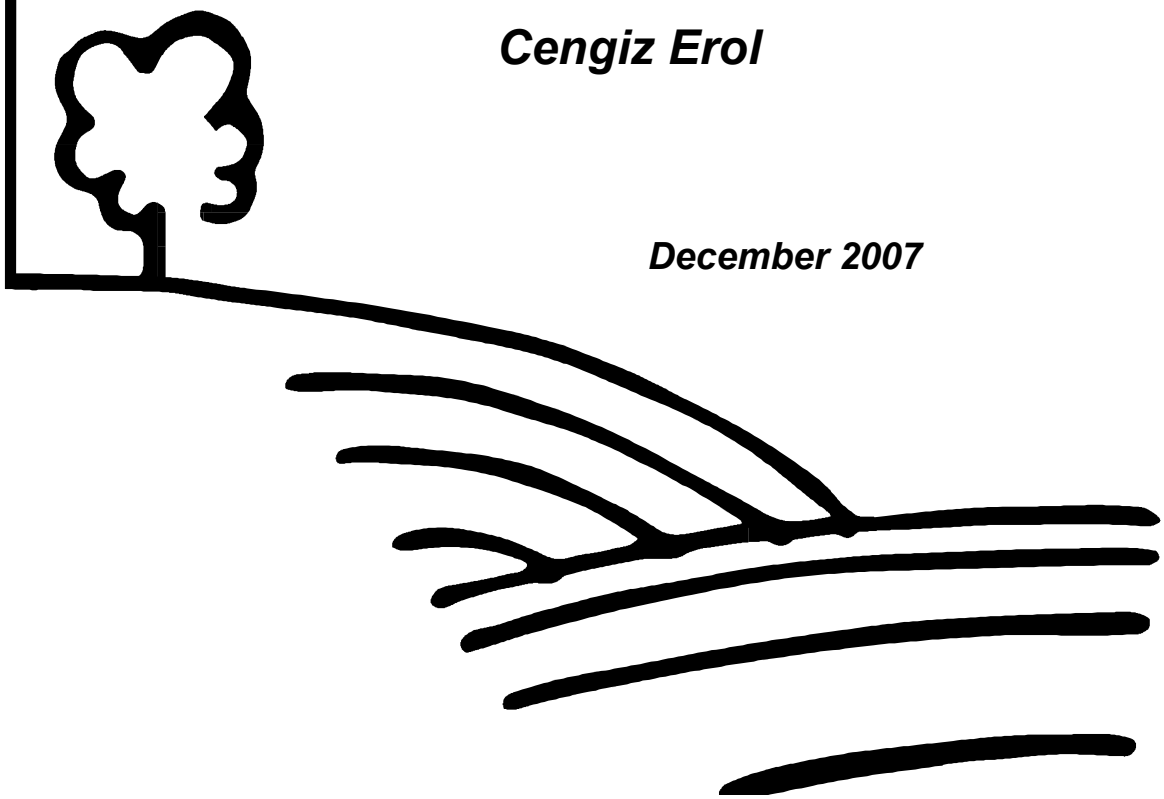

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Disclaimer:

The contents of this report were based on the best available information at the time of publication. Conditions may change over time and conclusions should be interpreted in the light of the latest information available.

Acknowledgments

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Heather Percy, Robert Rouda, James Dee, Tilwin Westrup, Theo Nabben and Martyn Keen contributed to the ideas in this report. The report was edited by Georgina Wilson (DAFWA, South Perth).

Summary

This is a review of studies related to surface water best management practices mainly in Western Australia, to identify key findings and possible barriers to adoption applicable to the South West Catchment area.

Thirteen studies were reviewed, six from Western Australia, three from Queensland, two from New South Wales and two Australia-wide general reviews.

The most frequently identified barriers to adoption were motivational, technical, financial and biophysical:

- Motivational and other barriers included lack of direction from government, the wrong extension model, lack of confidence, lack of support and cultural resistance to change.
- Technical barriers included limited knowledge, advice and information, lack of clearly written materials, lack of access to adequately skilled and trusted NRM advisers.
- Financial barriers included lack of money and incentive grants, the perception that the costs outweigh benefits, lack of equipment and time.
- Biophysical barriers included variable seasons, poor productivity (because of salinity, acidity, and lack of trace elements), poor off-farm drainage and lack of suitable productive land. These barriers are very region-specific and vary according to production system.

Future studies aimed at identifying specific barriers to adoption should pay particular attention to the specificity of biophysical barriers and their effect on land conservation management adoption.

Contents

1. Introduction

The South West Catchments Council (SWCC) commissioned the Department of Agriculture and Food (DAFWA) to increase landholder adoption of improved surface water management practices in the medium to low rainfall areas of the South West NRM Region from Boyup Brook, Darkan and Boddington east to Narrogin, Kukerin and Nyabing (see Figure 1).

The project aimed to:

- Understand the reasons why land managers resist adopting Surface Water Best Management Practices (SWBMP)
- Assess key barriers based on scale of impact and relative ease of mitigation
- Use knowledge gained to help land managers and landholder groups to implement SWBMP, with the outputs being a number of catchments and on-farm SWBMP plans, and demonstration scale on-ground works.

Experience of extension staff in the South West region suggests adoption varies with the farming system and is affected by:

- Soil and landscape factors
- Economic and time constraints and/or competing priorities
- Lack of credible advice that land managers feel they can trust
- History of previous failures due to poor design or construction.

The purpose of this review was to gain insight into documented barriers to adoption. This will guide the proposed survey of producers within the study area to ascertain local adoption barriers.

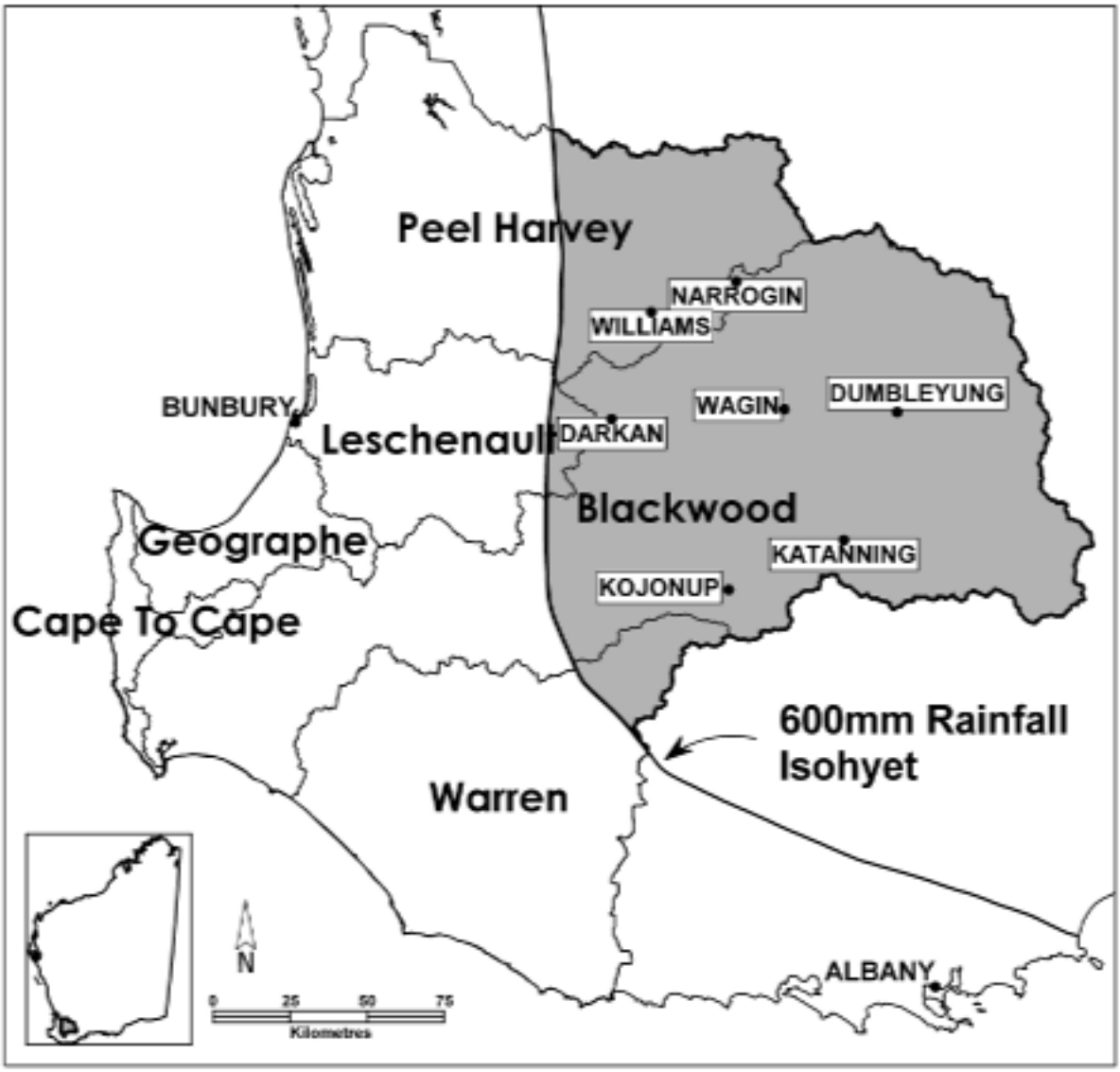

Figure 1. Map of study area and its relation to the rest of WA

2. Case studies reviewed

This review covered 13 studies that identified barriers to adoption of a range of natural resource management practices. Six studies were from Western Australia, three from Queensland and two from New South Wales, plus two general review papers.

The order of the case studies reviewed is:

- General extension and social studies on conservation and land management practices to barriers to adoption
- On-ground studies using focus groups and social marketing strategies to understand landholders' perspectives, behaviours and attitudes
- Other relevant studies mainly concentrated on barriers to adoption.

For each study, the aims, method(s) used, key findings and recommendations are documented.

The first study, 'Understanding and promoting adoption of conservation practices by rural landholders' (Pannell *et al.* 2006), is a very significant review of research on the adoption of rural innovations, interpreted "through a cross-disciplinary lens". It emphasises the multiple influences, personal, social, cultural and economic, that can affect adoption, in addition to the characteristics of the innovation itself. The full paper is highly recommended reading for anyone working in the NRM extension field.

2.1 Adoption of conservation practices by landholders

Study: Understanding and promoting adoption of conservation practices by rural landholders (Pannell *et al*. 2006).

Aim: To review and interpret research on the adoption of rural innovations using a cross-disciplinary approach to provide practical guidance for research and extension policy related to conservation practices.

Area: Australia.

Methods:

This was a review and interpretation of what was known about the determinants of adoption of new conservation and land management practices by landholders. The authors attempted to explore the relevant approaches of landholders to be able to concentrate on their concerns about adopting conservation practices.

Results:

The core theme of several decades of research and technology adoption was that landholder conservation practices were based on the expectation that the practices improved the chances of achieving goals. If the landholder did not perceive that goals were likely to be met, adoption did not follow. Goals vary widely between individual landholders depending on their circumstances and personal preferences. They may include economic, social and environmental goals. Adoption was based on subjective perceptions or expectation rather than objective truth. These perceptions depended on three broad sets of issues:

- The process of learning
- The circumstances of landholders within a social environment
- The characteristics of the practice.

Six steps in the process of learning and adopting were identified:

1. Awareness of the problem or opportunity
2. Non-trial evaluation
3. Trial evaluation
4. Adoption
5. Review and modification
6. Non-adoption or dis-adoption.

Other factors that influenced decision-making included:

- Social, cultural and personal influences
- Attributes of practices
- The effects of research and extension work.

The review noted that packaging of information affected adoption. Landholders had a range of learning styles and this influenced their preferences for information packaging, and their choice of channels for receiving that information.

Before trialling, the landholder's assessment of a practice relies strongly on information from outside. At this stage, social and information networks would be important influences. But after trialling commenced, personal experience was the main influence on future decisions.

Decisions about land management are generally made without full information. Landholders must strike a balance between the costs of acquiring additional information and the benefits of improved decision-making. Even if full information were available, there are limits to human mental capacity, so people often use rules of thumb to simplify choices. Decision-making is often a social process, involving a team and made more complex by the interplay of family members. The more complex a process, the more likely others will be drawn in.

Two broad categories of characteristics drive adoption or non-adoption: its relative advantage and trialability. Relative advantage is the perceived net benefit of adoption, and trialability is the ease to move from non-adoption to adoption via a learning phase. If a practice was not adopted long-term, it was probably because landholders were not convinced that it advanced their goals sufficiently to outweigh its cost. Boosting communication, education and persuasion activities were a common reaction but destined to fail because the innovations were not sufficiently attractive to the targeted audience.

Innovations need to be adoptable. If not, then communication and education activities will simply confirm a landholder's decision not to adopt, as well as degrade the social standing of the field agents of the organisation.

Extension providers should invest time and resources in attempting to ascertain whether an innovation was adoptable before proceeding with extension to promote its uptake.

Sometimes unattractive practices were made sufficiently attractive by providing incentive payments. However, it was important to be realistic about the potential of this approach. In some cases, the level of payment required would cost more than resulting benefits.

Identified barriers to adoption:

- Low levels of relative advantage of a new practice
- Difficulty in moving from non-adoption to adoption via a learning phase
- Extension programs fail to consider factors that lead to adoption.

Key findings:

- Adoption of conservation practices is complex and multifaceted, but well studied and understood. Reliance on any particular extension method (e.g. print, verbal presentations, group extension) will fall short of the potential impact of a diverse portfolio of extension approaches and channels.
- Rather than more research into adoption, the pressing need is to apply what is already well established in the adoption literature.
- Innovations need to be adoptable; if not, then communication and education activities will simply confirm a landholder's decision not to adopt, as well as degrade the social standing of the field agents of the organisation.
- For some issues the challenge is to develop innovations that are not only good for the environment but economically superior to the practices they are supposed to replace. If such innovations cannot be identified, there is no point in falling back on communication.
- Sometimes unattractive practices are made sufficiently attractive by financial incentives.

2.2 Soil moisture monitoring

Study: Soil moisture monitoring: state of play and barriers to adoption (Stirzaker 2006).

Aim: To understand why a logical concept such as soil moisture monitoring and associated products was only applied by one-fifth of the irrigation industry.

Area: Australia.

Methods:

Seven obstacles to adoption of irrigation and scheduling were examined through discussions with researchers and extension officers.

Results:

- Irrigators don't see the importance of scheduling and many were not convinced it was a priority; they have limited data on the water they actually used or should use; few accessible champions from whom to learn
- Entrenched resistance to change derived from inherited knowledge or the perception that the *status quo* was adequate
- Many farmers lacked confidence that investing in water monitoring tools would pay
- Implementation difficulties and structural barriers made it difficult to use monitoring tools
- The complexity of the tool concerned farmers and uncertainty about which tools were best suited to particular needs
- A perception existed that scientists were more concerned about equipment accuracy while irrigators were more concerned with economic margins
- Most scientists and advisers used inappropriate extension models to convey information to irrigators, often following the linear technology transfer approach that assumes scientists know the best technology needed to replace current methods
- The gap between scientific development and practical application has traditionally seen a failure in adoption that should be addressed by extension
- Many farmers were well informed about the benefits of soil water monitoring tools, but "other higher priorities/constraints" prevented their adoption.

The 10% increase in adoption of soil moisture monitoring tools over the past seven years is cause for optimism despite low adoption rates. This increase has captured the attention of many leading growers and is causing quantitative debate.

Recommendations:

Scientists and advisers need to understand the relationship between scientific concepts and complex production systems.

Promotion and extension of soil water monitoring tools has largely operated on a technology transfer principle to date. The on-farm situation was complex, requiring different approaches to ensure technology delivered results.

When systems are complex, management interventions were best seen as a series of experiments, rather than the application of a solution. This kind of adaptive management was occurring on farms, but was poorly understood and exploited by irrigation professionals.

Identified barriers to adoption:

- The gap between the science and practice of irrigation scheduling was considerable due to inappropriate extension
- Many irrigators were not convinced that irrigation scheduling should be a priority
- Current knowledge was seen as adequate which created resistance to change
- Lack of clear financial benefit
- Structural barriers (soil monitoring tools) that made it hard to begin to change
- Concern over the complexity of the tool and uncertainty which tools were best suited to various applications.

Key findings:

- The “learning-based” alternative should be implemented where the technology transfer approach is ineffective. The farmers’ current practices should be used to value their existing skill levels.
- The situation on-farm was complex, requiring different approaches to ensure farmers adopted new technology.

2.3 Social and economic influences on NRM decisions

Study: Understanding social and economic influences on natural resource management decision (Stanley & Clouston 2006).

Aim: To explore historical, economic and social drivers of poor natural resource management in the agricultural sector and constraints to achieving goals.

Area: Queensland.

Methods:

Analysis of landholder surveys using different methods in natural resource management regions in Queensland.

Results:

A variety of social and economic factors may interact to drive or constrain land managers from engaging in NRM. These may occur through the adoption of changed practices or involvement in NRM activities. These drivers and constraints are complex, difficult to isolate and manage. Regional NRM bodies can begin to understand local constraints by conducting regional land manager surveys and tailor their programs to fit.

Economic factors have a significant role, but a number of factors influence decision-making. Landholder surveys and other research have revealed that some social factors traditionally considered as constraints may have considerably less influence on landholder decision-making than previously thought.

Much emphasis has been placed on formal education, an ageing population, and poor NRM attitudes as barriers to adoption of new practices. There is little evidence to suggest a relationship between formal education and uptake of natural resource management practices, although participation in training courses and field days does appear to increase adoption. The age of landholders is often considered to be an indicator of willingness to change, with the assumption that younger farmers are more adaptable. Numerous studies have found no significant relationship between age and adoption rates.

The power that a community has over individuals to behave in a particular way, may also influence the willingness of landholders to adopt changed practices and innovative ideas that lie outside of the community's scope: "those who do break away from the dominant productivist paradigm risk facing social sanctions" (Richards *et al.* 2003). This can be a strong disincentive to adopting changed practices, particularly in small communities.

Lack of consultation and ownership of problems may decrease the level of engagement with NRM. Government agencies have not always successfully engaged the rural sector in decision-making surrounding NRM. This gives little credence to the value of local knowledge and the responsibility placed on the rural sector to implement Australia's NRM agenda. If decisions are made without consultation and consideration of the people who have to implement them, they may not be implemented and the NRM outcomes will not be achieved. Community representatives on regional NRM bodies may succeed in building trust and engaging communities in NRM decision-making, with the expectation that this will lead to locally accepted decisions and increased adoption of changed practices.

Access to ongoing professional advice is a constraint commonly raised by land managers. Landholders are suspicious of scientific knowledge provided by government agencies.

Managers who participate in property planning show greater capacity to adopt more sustainable practices, indicating a link between knowledge, skills and capacity to change.

The complexity of an innovation also decreased the likelihood of its adoption. As complexity increased the risk of failure was proportional to the knowledge required to understand it. Similarly, if an innovation was not compatible with existing agricultural practices, knowledge systems and social practices, it was less likely to be adopted.

A number of economic factors drive resource degradation and hinder the adoption of sustainable management practices. Broadly, these can be divided into problems arising from market failure, externalities and financial constraints.

Market failure can occur when the private sector does not supply sufficient quantity or quality of an item to meet the demands of the market. In the case of 'public good' resources which are not bought and sold it is difficult to put an economic value on them and there is little economic incentive to protect the resource.

Externalities occur when the actions of one individual impact on others and the costs are not borne solely by the perpetrator. For example, the application of fertiliser on-farm may result in nutrient runoff and pollute waterways throughout a catchment. Several of Australia's most pressing natural resource management problems are the result of externalities.

Financial constraints are reported by land managers to be important barrier to the adoption of otherwise attractive management practices. If land managers did not have sufficient resources to meet their own needs they were unlikely to invest in improved natural resource management. Land managers who felt confident about their future financial position were more likely to adopt new resource management practices.

Identified barriers to adoption:

Historical drivers and barriers

- Government policies, government advice and historical expectations saw the introduction of familiar European style farming practices unsuited to the Australian landscape.
- Economic drivers
- Market failure, externalities, financial barriers

Social drivers and barriers

- Formal education and age levels are not directly related to poor NRM attitudes
- Peer pressure, especially in small communities, may act as a barrier or driver to change
- Lack of community consultation and ownership of problems act as a barrier
- Limited access to ongoing professional advice
- If the complexity of an innovation requires upskilling, it may not be adopted.

Key findings:

- If we are serious about investing in sustainable land use practices then we need to understand the needs and expectations of people working on the land
- A variety of social and economic factors may interact to drive or constrain land managers from engaging in NRM. These drivers and constraints are complex, difficult to isolate, and difficult to manage for. Conducting regional land manager surveys allows regional NRM bodies to understand local constraints and tailor their programs to fit.

2.4 Successful adoption of conservation tillage

Study: Extension and demonstration – the final keys for successful adoption of conservation tillage (Packer *et al.* 1998).

Aim: To highlight that structured extension/demonstration efforts can get research adopted to change management systems.

Area: Southern NSW.

Methods:

Four main steps were applied to promote conservation tillage:

- Research methods were used to allow farmers to participate in on-farm trials
- This was combined with other research and practical experience of BMPs applicable to soil type, conditions and climate variations
- Training of farmers, extension professionals (government and private) and researchers ensured a coordinated approach to development and extension of the BMPs.

Results:

Farmers' knowledge about land degradation increased between 1993 and 1996 due to the National Landcare Program (NLP). Farmers reported changing behaviour due to increased knowledge and participation in extension. Surveys showed the number of cultivations before sowing reduced from 2.8 in 1993 to 2.0 in 1996 due to acceptance of conservation tillage practices. Farmers' knowledge about land degradation has increased due to NLP.

The role of succession in affecting NRM decision-making was unclear. The probability of a farm being transferred to the next generation may have encouraged long-term planning with integrated NRM. A large number of landholders in southern NSW were not changing their behaviour despite considerable effort in soil structure and conservation tillage research.

Identified barriers to adoption:

- The benefits were not well demonstrated
- There was little relevant conservation tillage research on grey cracking clay
- Difficulties of finding suitable machinery.

Key findings:

- Well structured extension/demonstration effort can promote new research and get research adopted to change management systems
- Adoption of recommended practices, and involvement and participation of landholders will help future research.

2.5 Understanding land managers' attitudes using focus groups

Study: Understanding land managers attitudes using focus groups (Finlay 2004).

Aim: To investigate the philosophy of managers towards land management and show how these attitudes are reflected.

Area: Central West of NSW.

Methods:

Focus groups were used to identify initial attitudes of land managers to adopting land stewardship. Four groups were planned and held on two successive days in two regional centres, in a non-confronting and independent location. Each session took about 1.5 hours.

The researcher introduced the proposed research and the extent of involvement sought from the five to eight participants and each group at the start of each session. An experienced landcare facilitator collected and recorded responses on:

- Practical problems such as rehabilitation costs, loss of production, reduced income, effect on landscape and aesthetics
- Environmental understanding such as environmental awareness, generational transfer, ongoing profit and viability, high management input plus the ethic to achieve it, the essentials for long-term land use productivity
- Management awareness such as holistics (i.e. good management being associated with production and income), natural systems and environmental awareness and sustainability
- Current and future accountability, and who is responsible for the management, how is government effecting their management and what value do they receive from monitoring.

Results:

The intention was to evaluate the results with a computer-based qualitative data analysis package. Due to the brevity of responses and limited number of participants, responses were assessed for common themes only.

Participants identified a strong link between good management, production and income. Formal education was considered critical to successfully identify and integrate new techniques into the production system. These techniques are aimed at improving production and deriving economic and environmental benefits. Community awareness and working with neighbours were considered important. Participants identified erosion, overploughing, excessive land clearing and wasteful irrigation as poor management practices.

Some unexpected attitudes included resistance to changing bad habits, a view that the land should be conquered rather than worked with, and refusal to look outside the square. .Inappropriate planning and land use, and lack of understanding of soils were identified as barriers to adopting appropriate management. Reading between the lines suggested that:

- Bad management is always over the fence
- Even good farmers are concerned about 'green' pasture
- Peer pressure has both negative and positive impacts
- Local ownership is important in managing public land

- Government policy has minimal impact in the paddock
- Sustainable management is associated with ethics
- Government monitoring has not led to change
- Agriculture is hell bent on fighting biodiversity rather than working with it
- The only reason for farming is capital gain (we cannot generalise this).

Factors influencing the adoption of land stewardship were:

- Education
- Economics
- Individual personality
- Financial incentives
- Technical assistance
- Sociological issues
- Regulation.

The focus groups demonstrated the benefits of gaining practical first hand responses to issues relating to land stewardship. The real difficulty was ensuring desired participation. The intent was to gain an understanding of land managers' knowledge of and attitudes towards their land. Personal beliefs are considered to play a significant role in understanding how Australian land managers might move to more environmentally sound land management. This study provided an understanding of theoretical knowledge on land stewardship, but can't confirm that land managers actually practise what they prefer.

Understanding managers' attitudes to their land and knowing why they do what they do is essential in appreciating the role of land management. The following broad areas were seen as emerging factors that require further development and understanding:

- Environmental – appreciation of sustainability and biodiversity
- Enforcement – policy and monitoring – carrot or stick
- Education – personal and professional extension – level and necessity
- Ego – individual personality – the impact on land management.

Identified barriers to adoption:

- Lack of formal education of the land managers and community awareness
- Unwillingness to change bad habits and bad management practices causing erosion include overploughing, irrigation and others
- Refusal to see outside the square
- Education, economics, personality, incentives, technical assistance, community constraints and regulation.

Key findings:

- Personal beliefs were significant in understanding how Australian land managers might move to more environmentally sound land management practices
- Managers' attitudes towards their land, and knowing why landholders do what they do, are an essential part in appreciating the role of land management in Australia.

2.6 Barriers and benefits to saltland pasture production

Study: Barriers and benefits to saltland pasture production: extension research in agriculture (Jones 2006).

Aim: This research applied the principles of social marketing to identified barriers to adoption of behaviours required for saltland production. The results were used to design a program to overcome the identifiable barriers.

Area: Zone of Ancient Drainage section of the Narrogin Advisory District, including areas in the Shires of Corrigin, Wickepin, East Brookton and East Pingelly.

Methods:

Social marketing was used to rigorously identify behaviour needed for adoption of saltland pasture production practices. Strategies to overcome the barriers to behaviour were then developed. Community Based Social Marketing (CBSM) was used to test and retest the assumptions about why people behave the way they do. The prescribed process suggested running two focus groups for each category, i.e. those who are and those who are not exhibiting a particular behaviour or practice.

Results:

It proved difficult to determine the difference between 'adopters' and 'non-adopters'. Non-adopters may be adopters at early stage, or it may have suited them to adopt only certain aspects of a practice.

The population was small, but diverse. The farmers in the focus groups and surveys were a significant portion of the target population. This affected the outcome and made it difficult to evaluate the effect of the subsequent extension program. Interpersonal relationships played a huge role in influencing behaviour, and the interaction between landholders that the focus groups provided may have assisted adoption.

The CBSM process identified the barriers, benefits, drivers and enablers to adoption and these were prioritised. This research provided an understanding of the target audience that was used to develop an effective extension program. The program ran throughout 2006, and an evaluation is being undertaken.

Note: The CBSM approach has been used internationally for motivating people to adopt sustainable lifestyle practices. It has been used most prolifically to promote energy efficiency and recycling, usually focusing on simple behaviours such as switching off lights, use of recycling bins, and mulching gardens.

Recommendations:

The farming community in the Narrogin area consists of small populations with diverse characteristics. The benefit of developing an extension plan to cater for the Narrogin community is that there are more opportunities to take advantage of closer relationships between the extension officer who implement the plan and the client and between the clients themselves. An extension program developed for larger geographic scale will be more resource efficient, but will benefit from including strategies to build networks and relationships.

Identified barriers to adoption:

- The main barrier was that the landholders' areas of saline land were too small or patchy, making adoption uneconomic
- The second barrier was lack of need for pasture
- Equipment, time and money needed for establishment
- Lack of expert advice and support for saltland production.

Key findings:

- Reducing risks of salinity can be a stronger driver for adoption than reducing the cost of production
- The influence of interpersonal relationships is significant, and has a very big impact on adoption
- Successful landholders have an attitude of learning rather than an attitude of winning
- Size of the farm is important; landholders with smaller farms have more time than the landholders with larger farms (some exceptions in special circumstances)
- Landholders' gauge of success or failure will be the outcomes that can be seen on the ground.

2.7 Landholder perspectives to aid planning for Toolibin Lake

Study: Using landholder perspectives to evaluate and improve recovery planning for Toolibin Lake in Western Australia (Munro & Moore 2005).

Aim: To Investigate landholder perceptions of land use planning undertaken in the Toolibin Lake Catchment to improve lake recovery through planning and associated activities.

Area: Toolibin Lake and its catchment in the central wheatbelt of WA.

Methods:

A sample questionnaire was mailed to selected catchment landholders, following initial contact by phone. The questionnaire was used to obtain demographic details and information on why landholders valued the lake, what conservation actions were undertaken, and the impact of Department of Environment and Conservation (DEC) subsidies.

Personal interviews were based on open-ended questions in two sections: farm management, focusing on conservation action as well as associated constraints; and their impression of the Toolibin Lake Recovery Plan, specifically its implementation strengths and weaknesses, and the quality of DEC's communication.

The quantitative data were analysed as percentages because the dataset was too small to use analytical statistics. The qualitative data were analysed using grounded theory and associated coding. Researcher-derived codes were used to synthesise and sort observations based on the responses. Themes recurring through the interviews were documented.

Results:

The Toolibin Lake Recovery Plan increased landholders' awareness of salinity and biological diversity issues and identified options for their management. More than two-thirds of landholders valued Toolibin Lake for its wildlife habitat, community value/identity, ecological significance, and productivity of surrounding agricultural land.

The networks essential for conservation actions rely on trusting relationships between individual government officers and local stakeholders, the study found.

Individual farmers were unable to judge the impact of their actions on salinity without catchment-wide monitoring and sharing of results.

The value of a focal point for community involvement was demonstrated by the extent of adoption of conservation practices and recognition of the ecological importance of Toolibin.

Farm planning was widely regarded as a conservation action. Sixty-eight per cent of landholders did not have a farm plan. Two-thirds of those with a plan developed it with help from a Community Landcare Coordinator (CLC). Landholders with a farm plan were more likely to undertake conservation actions.

The study illustrated the value of drawing on social research to assist in the complexities of recovery planning and ecological restoration.

Strengths of the recovery plan included:

- Increased community awareness
- Demonstration that government support helps adoption
- Availability of future funding.

Weakness of the recovery plan included:

- Lack of information and direction from DEC
- Variable adoption by landholders.

Recommendations:

Clearer direction and more technical information from DEC would have improved adoption.

Recovery activities requiring further attention included:

- Ongoing two-way communication between all stakeholders
- Recognition and management of the complex role of government in recovery planning
- The importance of financial incentives.

The continued need for effective interaction between government and private land owners in order to maximise conservation outcomes is evident from this study.

Identified barriers to adoption:

- Financial
- Motivational
- Logistical.

Each of these barriers has similar impact on adoption and they are very closely correlated. For example, if a landholder has a financial barrier, this stops him/her making motivational or logistic changes. Vice versa, if a landholder has no intent to change nor a logistic plan to make the changes even though he/she hasn't a financial barrier, the barrier still exists.

Key findings:

- Networking between agencies and landholders is essential for conservation action
- Social research can assist in the complexities of recovery planning and ecological restoration
- A focal point for community involvement in NRM is valuable for adoption of conservation practices and successful extension
- Effective interaction between government and landholders/managers is needed to maximise conservation outcomes.

2.8 Farmers' attitudes to land drainage

Study: Farmers' attitudes and investment intentions on land drainage in a salinising Australian landscape (Kingwell & Cook 2006).

Aim: To record landholder views and investment intentions in relation to land drainage in salt-affected areas.

Area: Avon, Yilgarn and Lockhart catchments in Western Australia's agricultural region.

Methods:

The study had three components:

- A mail-out survey with encouragement to respond
- Discussion of responses to key questions used in the survey
- Evaluation of responses using the Classification and Regression Tree (CART) statistical software package.

A postal questionnaire was sent 471 landholders after pilot-testing and revision. The sample size represented about 11% of landholders in the catchments. The questionnaire was printed in booklet form to facilitate response. It contained eight pages and took approximately 15 minutes to complete. Reply-paid envelops were used to encourage returns.

A media release was issued prior to landholders receiving the questionnaire to encourage response. This prompted media stories in rural regional newspapers. A statewide radio interview followed the questionnaire mail-out to advertise the survey and to encourage farmers to complete and return survey forms.

Results:

Survey responses and analysis were considered in two subsections:

- An overview of key descriptive statistics
- Classification and Regression Tree (CART) analysis.

There was no evidence to suggest deep open drains (DOD) were significantly more popular in any particular catchment. Other landholders and contractors were the most popular sources of information for landholders with open drains.

Landholders without open drains also accessed information sources but relied more on research publications and other media rather than on contractors' advice.

Landholders were divided in their views on disposal of drainage effluent from their properties. Landholders were asked if they should be allowed to dispose of saline/acidic water into natural drainage lines. Those who answered 'no' (58%) thought that constructing an evaporation basin costing $45,000 to retain the drainage water on the farm was an acceptable alternative. Of those respondents supporting the construction of an evaporation basin, almost a third said they would not pay for its construction.

Of the 110 respondents, only 15% thought that landholders should not be allowed to dispose of saline/acidic water into natural drainage lines and had reasons why they would be prepared to pay $45,000 to construct an evaporation basin to contain drainage waters on

their farms. Both these factors are associated with standard BMP in drainage and effluent disposal. This suggests that only 15% of respondents were in favour of applying BMPs in drainage and the other not decided yet.

The 110 respondents were represented as either drainers or non-drainers. If they had at least one open drain on their farm and/or intended to construct an open drain within the next five years, they were classified as drainers. If they had no open drain and did not intend to construct an open drain, they were classified as non-drainers.

To further investigate the nature of differences between drainers and non-drainers, respondents were grouped into those investing in open drains within five years and those not investing in open drains in the next five years. CART analysis was used to examine landholder characteristics associated with each group.

Landholders who had a large farm and spent less per hectare on salt-affected land were more likely to invest in open drains within the next five years. Those who spent more on salt-affected land, and had attended a field day on DOD were less likely to invest within next five years. Attendance at a field day on open drains appeared to act as a discouragement.

Farmers with saline land in WA were identified via mail survey. These farmers were then queried on their perceptions of deep open drains as a desirable option for salinity management. Some were strongly or weakly negative in their perception, while most had positive views. Many already had open drains or were intending to invest in an open drain.

The CART analysis revealed that adoption of open drains was influenced primarily by:

- Other farmers
- Farm size (large or small)
- Salinity expenditure
- Perceptions about open drains.

Landholders intending to invest in an open drain typically already had strong positive perceptions about them, had large properties and relied primarily on other farmers who believed their investment had been profitable, as their principal source of information.

Recommendations:

The study showed that landholders' reliance on other farmers as key sources of information could be due to limited science-based assessments of open drains, and the few economic appraisals of *in situ* open drains in the survey region. The known spatial variability in the effectiveness of open drains (Coles *et al*. 1999, Davies 2000) may lead farmers to use the experience of neighbouring landholders as the best guide about how effective an open drain may be on their own property. Other landholders may be seen as more credible and relevant sources of information compared to outside technical experts. Neighbours with open drains are likely to remain key sources of information for most landholders. This may fuel further adoption of open drains regardless of economic returns.

Identified barriers to adoption:

- Limited science-based assessments
- Lack of knowledge about safe disposal requirements
- Lack of information on the potential beneficial impacts of applying surface water best management practice
- Lack of financial incentives and trusted government adviser/advice
- Lack of direction from government bodies with vested interest in the catchment
- Unwillingness to spend additional own funds for drainage disposal.

Key findings:

- Adoption of open drains is influenced by other landholders, farm size, salinity expenditure and perceptions
- Landholders intending to invest in open drains had positive perceptions of their effectiveness
- Landholders with large properties relied primarily on others who believed their own investment in open drains had been profitable
- Neighbours with open drains were likely to remain key sources of information for most landholders and this would appear to fuel further adoption.

2.9 Torbay Catchment Focus Groups

Study: Report on Torbay Catchment Focus Groups/Community Based Social Marketing Strategy for implementing key action plans of the Torbay Catchment restoration plan - two studies reviewed jointly (Duxbury 2006).

Aim: To remove barriers to practices to meet targets for nutrient reduction.

Area: Torbay Catchment, Western Australia.

Methods:

The focus group was given one of two sets of questions based on appreciative inquiry or community-based social marketing. The variation in questions was used to test the quality of the responses.

Most participants were randomly selected from the Torbay Catchment landholder database. Initial contact was by phone using a standard introduction and short questionnaire to gather some basic information on the target behaviours. The information was also used to sort potential participants into larger and smaller landholders to attend different focus groups and to separate them according to their level of current conservation farming activities (high vs. low involvement).

Results:

An attempt was made to distinguish between adopters and non-adopters of lower nutrient loss farming systems. The resulting groups did not reflect clear differences between the systems of the farmers involved. The desirable practices included regular soil testing, using fertiliser and planting perennial pastures. Very few farmers were fully adopting these practices in most catchments.

To gain a better picture of the input from adopting landholders would require a focus group from a wider catchment, but this was beyond the scope of the project.

The focus groups provided a good opportunity for landholders to meet each other and discuss issues of common concern. The focus groups also provided feedback from a random selection of landholders, many of whom had not been in other catchment forums previously.

Recommendations:

A community-based social marketing strategy is a good starting point to encourage change. The strategy will improve over time through evaluation and implementation.

Identified barriers to adoption:

Barriers to preferred practices identified by the landholders in terms of soil testing, fertiliser application and growing perennial pastures included:

- Lack of knowledge, information and equipment needed
- Limited time and money to experiment and compare treatment to a ‘control’
- Advice from fertiliser companies sometimes contradicted landholder observations
- Seasonal variability confounds monitoring and evaluation

- Productivity improvement may be overshadowed by inherent soil problems (including acidity, trace elements).

Key findings:

- The population was small, but diverse. Landholders included in the focus groups and surveys comprised a significant portion of the target population. This affected the outcome and made it difficult to evaluate the effect of the programs in isolation.
- It was difficult to distinguish between adopters and non-adopters of lower nutrient loss farming systems as no clear differences in farming systems were detected between the landholder groups used.
- Very few landholders had fully adopted the key desirable practices to reduce nutrient use.

2.10 Social dimensions in rural land use management

Study: Social dimensions in rural land use management in the Avon River Basin - A qualitative survey based on the Theory of Planned Behaviour (Toric 2006).

Aim: To investigate farmer attitudes to a range of land use strategies on farms and identify drivers, motivators and other factors which impact on farmer decision-making or impede behaviour.

Area: West Mortlock and Upper Yilgarn Catchments, Western Australia.

Methods:

This survey collected responses of 16 farmers interviewed by telephone or mail-out survey.

Results:

Attitudes to land use practices varied depending on the practice concerned. Seeing results of a practice in the field helped reinforce and form strong opinions. Most farmers interviewed were open-minded to new technologies but needed convincing that benefits exceed costs. Landcare groups appeared to be important motivators. Information sharing may be restricted to group members so sole reliance on such groups to get the message out was unlikely to produce desired outcomes across the region.

The key factor affecting adoption of land use strategies was money. Landholders considered the benefits weren't worth the cost. Availability of written information was less important.

Recommendations:

- Provide financial incentives to increase adoption of desired land use strategies
- Better extension could be achieved by ensuring researchers and extension officers acknowledged farmers' prior knowledge and reduced reliance on written publications as a major extension strategy instrument
- Focus on practical, actionable on-ground activities and not general awareness raising
- Develop creative policies and programs that overcome multiple barriers to adoption
- Increase support to catchment, landcare and productivity groups including the provision of one-on-one assistance
- Ensure NRM advisers are adequately trained to provide specific advice, as poor advice can result in failure and future non-adoption.

Identified barriers to adoption:

- Lack of access to adequately skilled NRM advisers
- Too much dependence on written publications as extension material
- General awareness raising was a barrier if practical, actionable on-ground activities were not demonstrated
- Limited support to grass-roots organisations such as catchment groups.

Key findings:

- There was a range of beliefs and attitudes that varied according to land use strategies and between farmers
- Farmers appeared to form stronger opinions of land use strategies if they had prior experience or had seen results on other farms
- Most farmers were open-minded to new technologies but needed convincing that benefits exceeded costs
- Landcare groups appeared to be important motivators, however these may not be the best means of extensive information transfer
- A key factor was adequate resourcing; availability of written information was less important.

2.11 Management of furrow irrigation to improve efficiency

Study: Management of furrow irrigation to improve water use efficiency and sustain the groundwater resource (Klok and Ham 2004).

Aim: To improve the knowledge of the impact of water management practices including recycling, water spreading, artificial recharge and on-farm irrigation on the long-term sustainability of the Burdekin Delta groundwater system.

Area: Burdekin Delta in Queensland.

Methods:

Field studies were established on six sites representing the different soil types of the Delta compared conventional and BMP irrigation systems. The BMPs applied were site-specific and determined through consultation with Bureau of Sugar Experiment Station (BSES) extension officers and individual growers. Sites were instrumented to measure irrigation application, crop water use and the quality of drainage water.

Results:

- Irrigating to best practice guidelines reduced water application by 15% and 14% during the 2001-02 and 2002-03 irrigation seasons, respectively
- Crop production increased by 7 t/ha (5%) in 2001-02 and fell 4 t/ha (3%) in 2002-03
- The combination of reduced water and increased yield in 2001-02 resulted in a 24% increase in overall productivity
- The combination of reduced water and reduced yield in the 2002-03 season resulted in an increase in productivity of 11%
- BMP irrigation reduced deep drainage by 11% and 19% in the 2001-02 and 2002-03 seasons, equating to an average 1.8 and 1.9 ML/ha reduction in deep drainage
- BMP irrigation also reduced nitrate-nitrogen loading by 18% in 2001-02 seasons and by 39% in 2002-03.

Recommendations:

Irrigation BMPs can produce greater returns for growers with less adverse impact on the groundwater system in the delta region.

Identified barriers to adoption:

- No specific barriers to adoption were identified in this study.

Key findings:

- Maintaining current furrow irrigation practices is the most attractive option under current water pricing schedules, because it is cheapest
- Implementing centre pivot irrigation systems is the second most attractive option as it is more efficient than furrow systems
- Trickle irrigation is the least attractive to landholders due to high capital outlay.

2.12 South West Irrigation Area farm survey

Study: South West Irrigation Area farm survey (Erol 1999).

Aim: To benchmark practices and needs of irrigating landholders.

Area: Waroona, Harvey and Collie irrigation areas.

Methods:

Sixty landholders were surveyed (10% of total irrigators). The number for each district was proportional to the area and farm type (dairy, beef and/or horticulture). Landholders included a cross-section of irrigation businesses.

The questionnaire was based on existing resources, mainly following four areas:

- Characteristics of farms
- Irrigation practice and problems
- Source and use of information and advice
- Environmental issues.

Results:

- There was considerable runoff even though most of the landholders were trying to minimise runoff; a good level of awareness about runoff
- Re-use of runoff was not very common despite many landholders acknowledging the option
- Irrigation scheduling was based mainly on visual assessment
- Automated furrow irrigation was not common
- Laser grading was well-known as a practice for irrigation uniformity and pasture management
- Most landholders thought that their income could be improved by increasing pasture productivity through better irrigation and drainage management
- No dairy farmers knew how much irrigation water they used to produce a megalitre of milk.

Dairy industry:

- About 60% of farmers were operating very well (according to observation by the surveyor); some were following new technology, information and new resources to improve their farming practices
- Most farmers surveyed were unlikely to participate in a training course to improve their farming skills (lack of time and interest)
- A few had done long-term strategic planning, but most did not have a clear picture for the next five years
- Most farmers thought they had not been provided with enough simple information and resources regarding irrigation management, water-use efficiency and other farming practices.

Beef industry:

- Most beef farmers thought they were not getting good returns and lacked optimism
- Some thought they could survive without irrigation; most thought the price of water was high and indicated they should be charged a lower rate than other irrigators.

Horticulture (vineyards, citrus and vegetables):

- Growers were operating very well. Some recognised the need to improve their irrigation practices to increase productivity and quality
- Horticulturalists were less concerned about the environment than their production and industry.

Identified barriers to adoption:

- Information provided for water and fertiliser use efficiency was not clear and concise
- Information needed to be in plain English
- Landholders needed more information about salinity causes and control
- Poor off-farm drainage prevented landholders taking further surface water and irrigation management actions
- Limited information on alternative farming practices
- Dairy farmers were still coming to grips with deregulation; many expressed uncertainty.

Key findings:

No specific key findings were identified on this study.

2.13 Dairy and Lucerne Water Use Efficiency Adoption Program

Study: Dairy and Lucerne Water Use Efficiency Adoption Program (Queensland DPI 2001)

Aim: To engage farmers and develop BMPs to improve water use efficiency. The aim was to provide a framework for individual farmers to assess their irrigation systems, and compare their practice to regional benchmarks.

Area: Queensland.

Methods:

- Demonstration sites were established
- Detailed regional performance reports were prepared and used to review plan
- Liaison with several industry groups
- The project communication strategy was reviewed
- The results of the summer trials were used to develop regional criteria for BMPs related to production, management, equipment, water quality and sustainability
- An awards program was organised to recognise the best trials.

Results:

Farmers wanted to know the performance characteristics of their irrigation systems to reduce pumping costs and water loss during delivery to pasture. There was a strong demand for information on the relative efficiencies of different irrigation systems and discussions resulted in the adoption of common terminology across the industry (dollars per megalitre, tonnes of dry matter per megalitre, distribution uniformity and precipitation rate).

Recommendations:

- To strengthen the relationship between irrigation management and the overall business management on dairy farms is essential.

Identified barriers to adoption:

- Cost of installation and running pumping for irrigation
- Limited knowledge of effective irrigation and water use efficiency practices.

Key findings:

- No specific key findings were identified in this study.

3. Comparison of studies

The 13 studies are compared in Table 1. The criteria relate to the methods used and the topics covered. Each study provided useful ideas for the proposed South West NRM region survey on barriers to adoption of surface water best management practices.

Most studies identified barriers to adoption. These included landholders' perceptions and intentions to adopt new best management practices for a range of issues including irrigation, drainage, land degradation, soil monitoring, soil testing and fertiliser use. Some studies applied principles of social marketing to determine the barriers to the specific behaviours (studies 7, 8, 9, 10, 12).

The studies used community consultation, target setting, focus groups, workshops and meetings to gather information by means of social marketing, questionnaires, and phone interviews. A few studies used demonstration sites (5 and 11); half involved cost-benefit analysis; some reviewed existing research.

Table 1: Comparison of relevant studies found in literature search

Criteria	Case study number												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Quantitative		√						√					
Qualitative			√				√			√		√	
Irrigation		√	√		√				√	√	√		√
Drainage			√					√			√		
Land salinity			√				√	√	√			√	
Land degradation	√	√	√	√		√	√			√		√	√
Soil monitoring		√	√								√		
Soil testing/ fertilising			√						√		√	√	
Focus group									√	√	√	√	
Community consultation/survey	√	√		√	√	√	√	√	√	√	√	√	√
Social marketing							√	√	√	√		√	
Workshops/meetings		√	√	√	√	√	√	√	√		√	√	√
Demonstration site					√						√		
Economics (cost-benefit)	√	√	√	√	√				√		√		
Targets set			√		√		√	√	√		√	√	
Questionnaire			√				√	√	√			√	√
Phone interview			√				√	√				√	

4. Recommendations for South West NRM Region

Experience of extension staff in the South West shows that adoption of surface water best management practice varies with the farming system. The main barriers encountered are landscape and soil factors, economic factors, lack of credible advice and knowledge, poor design and construction and previous failures.

The following recommendations from this review are relevant to future extension actions in the South West NRM region:

- Networks for action rely on trusting relationships between individual government officers and local stakeholders to maximise conservation outcomes.
- Better extension could be achieved by ensuring that researchers and extension officers acknowledged farmers' prior knowledge and reduced the reliance on written publications as major extension strategy instruments.
- Need to focus on practical, actionable on-ground activities and not raising awareness generally.
- Develop creative policies, programs and projects that overcome multiple barriers to adoption.
- Increase support to catchment, landcare and productivity groups including one-on-one assistance.
- Ensure NRM advisers are adequately trained to provide specific advice. Poor advice can result in failure and future non-adoption.
- The challenge for scientist and advisers is to understand the relationship between scientific concepts and complex production systems.
- Financial incentives (grants) are needed to increase adoption of desired land use strategies.
- Adequate resourcing is vital.

5. Conclusion

Thirteen studies from across Australia that dealt with the barriers to land conservation management adoption were reviewed. The most commonly cited barriers are presented in Table 2. The most common barriers were motivational in nature, followed by technical, financial and lastly, biophysical.

It is worth noting that the biophysical barriers were only identified in those studies conducted in Western Australia. Biophysical barriers include high seasonal variability, low levels of productivity, poor off-farm drainage and lack of suitable productive land. Such barriers are highly region-specific and vary with the production system.

Future studies aimed at identifying specific barriers to adoption should pay particular attention to the specificity of biophysical barriers and their effect on land conservation management adoption.

Table 2: Occurrence of most common barriers to adoption

Barriers to adoption	**Case study number**													
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***Total***
Financial	√	√		√					√	√			√	6
Technical		√	√	√	√	√			√	√		√	√	9
Biophysical			√	√		√								3
Motivational	√	√	√	√	√	√	√	√	√			√	√	11

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