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Partnerships and Understanding Towards Targeted Implementation – PUTTI

Identifying factors influencing land management practice in the Lachlan Catchment

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July 2008

Australian Government

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Central West catchment management authority

Water for a Healthy Country Flagship Report series ISSN: 1835-095X

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Citation: Bates, L. E., Bishop, B. J., Dzidic, P. L., Green, M. J., Leviston, Z., Nicol, S. C., Price, J & Tucker, D. I. (2008) . Partnerships and Understanding Towards Targeted Implementation: Identifying factors influencing land management practice in the Lachlan Catchment. CSIRO: Water for a Healthy Country National Research Flagship

Cover Photograph:

Description: Sheep in the Mandagery sub-catchment, NSW
Photographer: Jennifer Price

ACKNOWLEDGEMENTS

We would like to acknowledge the generosity of the Lachlan catchment community for their participation in our research and on-going interest in the PUTTI project. The support and assistance of our research partners, the Lachlan Catchment Management Authority and the Central West Catchment Management Authority (CMA), is highly appreciated. We would like to specifically acknowledge those staff members of the Lachlan CMA who gave up their time to aid in the validation of the land management practice variable, as well as Kate Lorimer-Ward and Mike Chambers for ongoing communication and assistance.

The PUTTI project is a collaborative research initiative between the CSIRO and nominated NSW Catchment Management Authorities. The project is focussed on dryland farming and is funded by the Australian Government's National Action Plan for Salinity and Water Quality/National Heritage Trust Program (NAP/NHT) and CSIRO.

As all authors made a significant contribution to the formulation of this report, the authorship is presented alphabetically. We also wish to thank Murni Greenhill, Alison Browne, Kim Alexander, Alex Fry, Catherine Johnston, Wendy McIntyre, Natasha Porter and Simon Russell for their contributions to the PUTTI project.

EXECUTIVE SUMMARY

The Partnerships and Understanding Towards Targeted Implementation (PUTTI) research project (PUTTI) is funded by the Australian Government's National Action Plan for Salinity and Water Quality/National Heritage Trust Program and CSIRO. The research is a collaboration between the Lachlan and Central West Catchment Management Authorities (CMAs), landholders, the broader Lachlan and Central West catchment communities and researchers at the CSIRO.

The PUTTI research project aims to progress knowledge of the features and context of land management practice at a farm level, so that catchment management can better reflect and address the drivers of decision-making at the individual property level. The project uses qualitative and quantitative behavioural science methodologies to identify and elaborate the drivers, the context in which decisions are made and the most effective strategic intervention points to effect change in land management practice.

Past experience has shown that best practice land management as identified by Catchment Management Authorities and government agencies does not always mesh well with what landholders think is best for their farms or lifestyles (Barr & Cary 2000; Curtis & Byron 2002). It is well known that farming practice can be more than just an economic activity. It is underpinned by experience, local understanding, local knowledge about the environment shared by landholders and others in the community, and a set of beliefs, values and attitudes that are specific to individual landholders.

As part of the first phase of the PUTTI project, work was conducted in the Central West Catchment of New South Wales where several indicators of desirable land management practice were identified (Porter et al. 2007). In this phase of the project, the research extends into the Humbug and Mandagery sub-catchments within the Lachlan CMA in New South Wales and adopts the same analytical framework of qualitative and quantitative behavioural science methodologies as used in phase one of the project.

In the Lachlan study areas, the qualitative study identified issues and trends relating to the following:

- current farming practice, including land, stock and risk management;
- community and social interaction circumstances of rural townships and communities including rural decline, structural change, social cohesion, generational change and rural depression;
- specific information networks; and
- farmer attitudes towards the CMA, government and funding programs.

It is clear that the issues facing rural communities in the Lachlan study areas need to be seen as a threat not only to the economy and the environment, but also to the well-being of individual farmers and rural communities at large.

Following the qualitative study, a hypothetical model of the key factors that influence land management practice was developed for the Lachlan. A large-scale telephone survey of landholders in the Humbug and Mandagery sub-catchments and adjacent areas was conducted to test the model. The results from the survey indicated large differences in levels of trust and influence between sources of information – most notably, agronomists and other farmers were seen as more trustworthy and influential than the local CMA. Adding to the richness of the results, a number of significant differences were also identified when performing group comparisons based on key characteristics of respondents such as age group, sub-catchment area, agricultural qualifications, farm size, involvement in community groups and whether they had a written farm plan.

An initial exploratory model to predict land management practice containing all the hypothesised variables was developed using Structural Equation Modelling. The fully elaborated hypothetical model was reduced by an analytical process that removed all non-significant relationship pathways to the dependent variable (land management practice). The resultant simplified model accounted for 35% of the variance in land management practice and overall, goodness of fit indices were excellent. The amount of variance explained is good given the diversity among dryland farmers and the motivations influencing the way they manage their properties that emerged from the qualitative research.

The model provided a set of conditions that lead directly to an increased likelihood of undertaking desirable land management practice. These included increased trust in and influence of outside sources, high internal locus of control, a formal property plan (created with the assistance of a professional), high environmental values as related to the biosphere and low environmental values as they relate to egoistic factors. The qualitative study, survey and predictive model of land management practice together identify areas where interventions might occur.

A number of key findings relating to the way dryland farming communities operate at individual and local levels have emerged from the research conducted to date. These have significant implications for the design and implementation of strategies aimed at encouraging the adoption of improved land management practice.

- Local community structure is an important aspect of information dissemination, particularly the informal information pathways within and between families and with other farmers in the community
- CMA targets and recommendations have filtered into the farming communities via informal information networks.
- Farming is perceived as risky, particularly in the short term. There is a degree of apprehension in some farming circles in instigating change in farming practices and an aversion to risk taking. Change is only likely to occur if there is evidence in the community that apparent risk and perceived benefit is manageable and that in the long term, potential benefits will outweigh potential costs.
- It is necessary to develop change strategies that compliment or 'fit into' the way that farming communities currently change. Doing so reduces the anxiety or confrontation associated with introducing new farming technologies or practices.

Overall, the most effective means of creating sustainable change within a community is to support and supplement existing resources and harness these in a way that is acceptable to the local community – particularly in terms of ensuring community ownership and a process of change that complies with the community's value system.

The research findings inform the following recommendations with regard to the incentive programs developed by the CMAs as these are the primary mechanisms utilised by the regional bodies to engage landholders and influence the way they manage their properties.

1. **That consideration be given to modifying CMA incentive funding mechanisms and application formats.** There is currently too much paperwork required for the incentive program. Application forms could be rationalised
2. **Improve communication about CMA incentive funding mechanisms.** A variety of strategies may be necessary to communicate information about incentive programs, particularly those aimed towards the majority of land-managers that are not yet engaged in CMA sponsored activities
3. **Increase collaboration between CMAs regarding the focus of incentive funding.** Each CMA is perceived to maintain a focus on different specific issues relating to land management practice. While this may be entirely appropriate given the assessments

made through the prioritisation processes undertaken by the CMA's, the prioritisation process itself does not appear to have been communicated to landholders.

4. **Package incentive programs to suit differing landholder intentions and skills.** The incentive programs could be designed to recognise and capitalise on individual differences between farmers with regards to the following: existing skill base; landholder intentions or focus (e.g. expansion, diversification, downsizing); and, farm type and size (so that smaller properties, or those engaged in niche industries, are also considered).
5. **Ensure that incentive funding appeals to a broad range of motivations.** Just as the incentive program should be appropriate for a range of stages in farm development, so incentive funding should cater for lifestyle and other personal priorities. This may be achieved by emphasising some of the more pragmatic benefits that Catchment Action Plans (CAP) target might deliver to the landholder.
6. **Make the CAP document more accessible.** The current CAP document is too long, too technical and provides no guidelines as to what the high order strategies mean on ground.
7. **Recognise and leverage the value of the CMA as a resource in itself.** Landholders benefit from friendships and informal associations with CMA staff. They recognise the value of property visits and on ground consultations by experienced CMA staff.
8. **Reinforce the message that behaviour change takes time.** The critical nature of informal information networks should be acknowledged.
9. **Use informal networks as a mentoring opportunity.** The utility and value in informal information networks were consistently reported and marks the potential for pre-existing social structures to be opportunistically utilised.

The recommendations provide a framework for considering how change can be targeted in the Lachlan and Central West catchments. While it is recognised that there are constant and substantive resourcing issues associated with implementing some of these recommendations, proposed elements of a change program are specified. It is suggested that the practice of co operative learning is implemented where less demands are placed on land managers and current social change mechanisms are supported and enhanced.

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1. INTRODUCTION

Traditional agricultural production techniques impact natural resource conditions and are not sustainable in the longer term. However, the adoption of alternative approaches requires landholders to change land management practice in an environment of high uncertainty. While the support and cooperation of the agricultural community is essential to implement change, matching landholder and broader catchment management priorities is an issue facing Catchment Management Authorities (CMAs) throughout New South Wales (NSW). Effective catchment management requires both local knowledge and scientific understanding of the biophysical, social and economic features of an area. CMAs are required to formulate targets for natural resource management in their region as part of their Catchment Action Plans (CAPs). Target areas include soil, water, vegetation, biodiversity and salinity. The targets in these areas have historically been based on the CMA's considerations of 'good' farm management practice. To encourage landholders to assist in meeting these management targets, incentive programs have been designed which offer financial assistance for eligible landholders. Without the integration of local and scientific knowledge, however, catchment management initiatives can be limited in their effectiveness.

Effective implementation of CAPs (including uptake of incentive programs) is essential for all CMAs, as these plans are designed to ensure natural resources are maintained and improved for the whole community. This can only be effectively achieved by working with the community to identify *their* priorities for *their* properties and *their* regions and understanding what factors affect the way landholders manage their farms – i.e. what matters to them and what influences their farm management decisions. The Partnerships and Understanding Towards Targeted Implementation (PUTTI) project is focussed on addressing these issues in dryland farming systems so that substantive progress can be made in sustainable land and water management. It is partly funded by the Australian Government's National Action Plan for Salinity and Water Quality/National Heritage Trust Program. It is a collaborative project between the Lachlan and Central West Catchment Management Authorities, landholders, the broader community and researchers at the CSIRO.

The ultimate aim of the PUTTI research is to create and facilitate a genuine partnership between catchment managers, scientists and the catchment community to address natural resource management challenges. The project is developing and implementing an ongoing program to support and encourage change and build mutual trust between community members, scientists and decision-makers.

The first phase of the PUTTI project took place in the NSW Central West catchment (see Appendix A for an overview). A hypothesised model of land management practice was explored during this phase. The model was based on a number of international and local studies in conjunction with face to face interviews. Previous studies indicate that conservation-related land management practices are influenced, at least in part, by factors such as age, financial concern, degradation of property (Crase and Mayberry, 2002), environmental concern, farm size and formal farm planning (Cary, Webb and Barr, 2002). The hypothesised model provided initial insights into factors that influence 'desirable' land management practice. Following analysis of the survey results from the sub-catchments studied in the Central West region, a number of social-psychological factors were identified as having significant impact on land management behaviours at this stage in the research. These factors are shown in the preliminary model (see Figure 12 in Appendix A).

The findings from the first phase contributed to the design and development of this second phase of PUTTI. The current research was undertaken in the Lachlan catchment area, specifically the Humbug and Mandagery sub-catchments and areas immediately adjacent to these sub-catchments. The focus is on dryland farming and is comprised of the following three stages.

Stage 1: Qualitative Research

Semi-structured interviews in the Humbug and Mandagery sub-catchment communities to identify landholders' attitudes, beliefs and values relating to farming practices and decision-making.

Stage 2: Community Survey

A comprehensive survey of landholders in the Humbug and Mandagery sub-catchments to further identify what drives farming practices and decision-making on landholders' properties.

Stage 3: Partnered Change

Having identified the major drivers in Stage 2, a Change Program will be developed in partnership with the community, followed by implementation in the Humbug and Mandagery sub-catchments. The program will focus on addressing the key aspects that underpin land management decisions and practices to encourage the uptake of approaches that lead to better environmental outcomes at the local and regional scale.

2. PUTTI PHASE TWO – LACHLAN CMA

2.1. Study Area

The second phase of the PUTTI project specifically focused on the Humbug and Mandagery sub-catchments, located in the Lachlan catchment. The Lachlan catchment was selected as the next study area by the PUTTI Coaching Committee in accordance with the original project proposal. The Lachlan CMA adjoins the Central West, and the Mandagery and Bell (Central West) sub-catchments share a common boundary. The Lachlan catchment covers an area of approximately 84,700km^2 and has a population of 106,000 (Lachlan Catchment Management Authority, 2006). Figure 1 shows the Lachlan catchment, highlighting the Humbug and Mandagery sub-catchment boundaries and major urban settlements. Major townships in the Mandagery sub-catchment include Manildra, Cudal and Eugowra, with Cargo located on the boundary. The townships of Parkes, Forbes and Canowindra are in close proximity to the Mandagery in adjoining sub-catchments. Ungarie, located between Lake Cargelligo and West Wyalong, is the main township in the Humbug sub-catchment. The Humbug and Mandagery Creeks are tributaries of the Lachlan River and flow though the centre of each sub-catchment respectively. Participants in the survey were drawn principally from the two sub-catchments. To obtain the desired number of respondents for the survey, it was necessary to extend the sampling boundaries beyond the sub-catchment borders, particularly in the Humbug sub-catchment, and sample from adjacent areas with consistent landscapes.

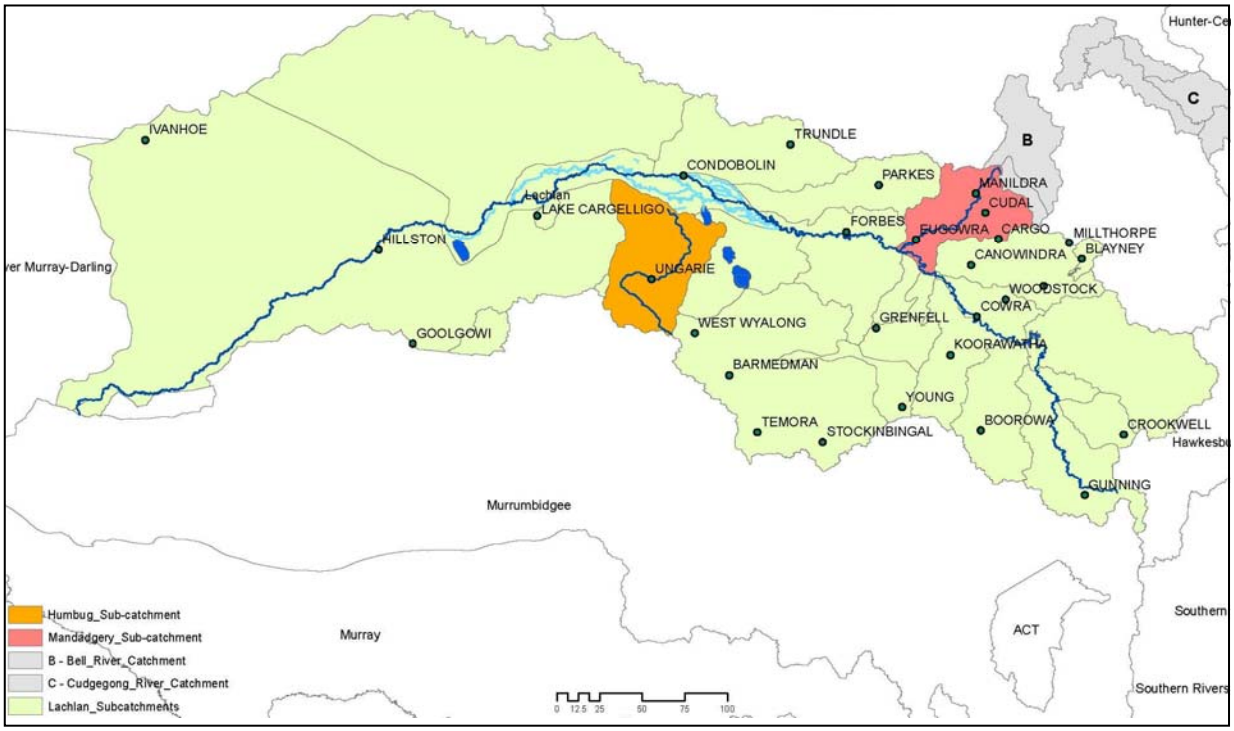

Figure 1 NSW Lachlan Catchment Management Authority boundary – Mandagery and Humbug sub-catchments

2.2. Research Context

The Humbug and Mandagery sub-catchments display many similarities in terms of land management practice, values, and attitudes (Lachlan Catchment Management Authority, 2006). A current distinction between the two relates to the severity of drought impacts on the land, and the flow-on impacts to the community. The sub-catchments are characterised by different physiographic and hydroclimatic conditions (topography, soil type, rainfall, hydrological systems and so on) which affect land use patterns. The Humbug sub-catchment

has historically received less rainfall and has less fertile soil than the Mandagery, and subsequently has been less able to ‘carry the drought’.

The proximity of the Mandagery sub-catchment to the prosperous regional centre of Orange ensures that capital and vibrancy are injected into the area. The areas surrounding Orange have attracted interest from Sydney investors and have benefited from the resultant high land-values. Orange is rapidly growing with increased subdivision and hobby or lifestyle farms. Despite devastating drought impacts, high land values have enabled landholders in the Mandagery to retain the option of selling their properties at relatively good prices. Humbug landholders do not have this option.

3. ANALYTICAL APPROACHES – QUALITATIVE RESEARCH

Qualitative research was undertaken in the Lachlan catchment in order to inform successive stages of the PUTTI project and provide an understanding of the current environmental and social context within the study areas. The qualitative research stage involved collection and analysis of qualitative data from a range of land-managers and people involved in agribusiness within the Lachlan catchment.

This phase of the PUTTI project was designed to deliver the following:

- provide an indication of the range of land management practices, issues, hopes, concerns and influences across the study area to inform later stages of the research;
- provide the project team with first hand experience of the catchment and sub-catchment communities;
- inform the development of a questionnaire for a community survey;
- contribute to the development of a project communication plan;
- contribute to the development and implementation of the change program; and
- act as an ongoing reference source for the project.

3.1. Methodology

The Humbug and Mandagery sub-catchments were selected as focal study sites for investigation through discussions held with the Lachlan Catchment Management Authority. The qualitative research in these sub-catchments involved semi-structured conversational interviews with a range of land-managers (including lifestyle farmers on hobby-blocks) and agronomists or people involved in agribusiness. These people were identified through lists supplied by the Lachlan CMA and additional nominations from landholders and other sources.[1]

Project team members telephoned individuals to describe the project, invite participation and organise an interview time. Confirmation letters were sent to each participant, along with a project information sheet (Appendix B). A total of 61 participants (25 from the Humbug and 36 from the Mandagery) were involved in the qualitative face to face interviews conducted over two weeks in October and November 2007. Project team members conducted the interviews in pairs at the participants' place of residence or workplace.

Detailed notes were taken by the researchers during the qualitative interviews in order to document the participants' responses. The contextual data gathered from qualitative interviews was transcribed and then analysed using NVivo software (Richards, 1998; Richards, 2005) to extract themes and better understand complex relationships within the sub-catchments. The following questions were addressed in the interviews:

1. What farmers do on their farms and why, inclusive of the following:
    a. activities and tools that are important for the operation of the property;
    b. general changes in farming in the district over time; and
    c. key elements of a well managed farm and sustainable land management practice.

[1] Information collected in the course of our research is totally confidential. During analysis data is coded and numeric identifiers are assigned to respondents. To preserve confidentiality, actual respondent details are not stored within the same dataset.

2. Important issues in the catchment and in the community.
3. How individual farmers see themselves influencing and being impacted upon by the broader catchment.
4. Barriers and pressures that landholders feel.
5. Social networks and sources of land-management information.
6. Perceptions of and attitudes towards the Lachlan CMA, Catchment Action Plan and Incentive Funding initiatives.
7. What the future holds for themselves and their community.

3.2. Qualitative Research Results

The following results are organised into sections that correspond with the emergent themes of the interviews.

3.2.1. Farming Practices

Farming activities in the Lachlan catchment were characterised as 'mixed farming' – a combination of cropping and grazing. Other common land uses included sub-division for lifestyle blocks and viticulture. There was significantly less land-use diversification evident in the Humbug, where land management was largely restricted to mixed farming. In the Mandagery, farming activities were commonly referred to as 'enterprises', particularly by the farmers on larger properties. This emphasis was not evident in the Humbug, where the focus was on drought survival rather than business. It was a widely held view that farming in the Lachlan catchment was shifting towards increased cropping, depending on the type of land available, as participants felt that sheep and cattle were contributing to environmental degradation and exacerbating drought impacts.

It was widely held that farming attitudes had changed for the better with a strong shift towards conservation farming and genuine commitment to leaving the land in better condition than it was found.

Land management

Participants had varied interpretations as to what constituted 'good' land management practice. Typically, it was defined by participants as stubble retention, direct drilling, minimum tillage and, to a lesser degree, fencing, tree planting and rotational grazing. These practices were thought to be inter-related, often used in conjunction with each other, and their use was perceived by some as being related to the availability of Lachlan CMA incentive funding. Holistic farming and conservation farming were buzz words in the Mandagery.

The environmental benefits of good land management practice were often viewed as secondary to the economic benefits and increased efficiency that such practices provide. Conservation farming techniques were thought to be less time-consuming and, aside from the purchase of specific machinery, to have less ongoing input costs (such as petrol, chemicals/ fertilisers). As such many land managers were adopting environmentally sensitive practices in order to maximise productivity rather than to contribute to conservation. Furthermore, it was suggested that environmentally favourable land management practice were especially important during droughts as input costs were generally lower, while in 'good-times' these practices were not as productive. Within the Humbug however, conservation farming techniques were generally perceived as 'luxury activities' where realistic engagement and investment in such practices were thought of as only truly feasible 'post-drought'.

Efficiency was often seen as representing sustainability, with connections being made by some participants between the economic benefits of operating efficiently and the environmental benefits of minimal land disturbance. In this sense economics and environment were viewed by some as inseparable, particularly by those who were proponents of more sustainable practices. For some land managers, however, sustainable practices were still perceived as being at the expense of immediate productivity or short-term profits. Difference of opinion about sustainability and profitability appeared to be one of the central tensions in the Lachlan area.

Farmers indicated that retaining the stubble improves soil health and structure by building biomass, increasing nutrients and reducing wind erosion. While farmers were aware of the importance of maintaining the soil, it was considered that stubble is easier to retain when crops are smaller due to less rainfall. Most farmers saw themselves as looking after the soil and felt that erosion was not as significant as it had been in the 1940s and 1960s. Many farmers were testing their soil or moving into that technology, although in some cases soil testing had ceased or reduced due to the drought and was seen as a major expense. Interestingly, many noted that new landholders from Sydney were undertaking poor land management activities due to inexperience.

There were suggestions that some farmers may state they are implementing 'good' land management practices but are not implementing the techniques correctly. This was due either to barriers or to numerous and conflicting information sources. The barriers included reduced financial resources (particularly due to loss of productive land resulting from the drought, increased input costs and reduced commodity prices), increased regulations, less acquirement of land due to high land values, reduced time, and an ageing population who are less likely to uptake new technologies and ideas.

Farming in the Lachlan catchment (and more generally) was perceived as becoming an increasingly risky activity. Many people commented that a land-manager's level of skill is irrelevant if there is no rain. Farm viability was viewed as being affected by external factors such as weather conditions, changing world markets and increased regulation. The uncontrollable nature of these factors was viewed as potentially disempowering.

Participants identified numerous barriers to sustainable land management practice, including the following:

- dwindling financial resources to invest in sustainable practices and efficient machinery as a result of
    - prolonged drought and reduced farm productivity,
    - reduced commodity prices and down turn in the wool-market, and
    - increased input costs (chemicals, labour, occupational health and safety requirements, licenses, petrol, agronomy advice, disease audits and rates);
- increased regulations, licenses and paperwork which was perceived as costly and time consuming;
- high land values limiting farmers' ability to purchase sufficient land to make a living and cover costs of more efficient machinery;
- reduced time available for farming activities due to
    - many land managers having to source additional off-farm income
    - difficulties employing farm labour because of inability to compete with the mines in the area and declines in rural population (particularly the loss of young people); and

- an ageing population which was perceived as more traditional and set in their ways; less technologically savvy; less likely to have extended information networks; and not as physically capable or as likely to set long-term goals and plans.

Stock management

Many farmers were deciding to de-stock in order to reduce environmental impacts, through increased ground cover, retention of native vegetation and top-soil, and reduced soil compaction and erosion. De-stocking was seen as a way to reduce the costs associated with buying feed to cover the 'feed-gap' – where the stock has to be hand-fed because there is no pasture left. Climatic pressures, the low comparative profitability of wool markets and the amount of work required (particularly for breeding stock) were also factors contributing to the de-stocking trend.

Managing stock on increasingly marginal land meant that many farmers were engaging in feed-lotting and drought-lotting activities. Landholders indicated that these activities were a method for fattening-up stock by keeping them in a small contained area and hand feeding, enabling the stock to conserve energy that would be used to forage for food. Reduced stock movement during the driest part of the year was also thought to minimise environmental damage. There was a distinction between the Humbug and Mandagery regarding the terminology used for this practice. Farmers in the Humbug were reluctant to use the term "drought-lotting" as they felt it implied that they were struggling due to the drought, whereas farmers in the Mandagery used the term more freely.

Another trend reported in the Lachlan catchment involved farmers investing in stock that are easily tradable units, rather than investing in breeding stock, so that they can be off-loaded quickly in order to adapt to context. Farmers gave examples of fattening lambs to trade for meat (such as Dorper sheep) rather than breeding sheep for wool (traditionally Merino sheep). Trading stock was perceived as a strategy to cope with severe weather conditions and was explained in terms of managing risk; if financial or weather conditions worsen, land-managers involved in fat-lamb production can adapt by selling their trading stock, whereas breeding stock was perceived as harder to sell as it represents an investment in an uncertain future. With many farmers turning to fat-lamb production and the trend away from traditional farming, some farmers suggested that it would be sensible to remain with Merino's, as the price on the wool market could improve as supply decreases.

Risk management

Many noted that farm success was related to the land-manager's ability to appraise and manage risk. Agronomists noted that successful farmers were those that adopted a business model and evenly distributed their risks. Those farmers who had not adapted to climate risks (through diversifying land-use or adopting sustainable practices) were seen as more severely impacted by drought conditions. Farm diversification was often viewed with mixed feelings and as a 'vicious cycle', as those needing to diversify activities were often the worst affected by the drought and therefore had less capital to be able to do so. Overall, farmers tended to agree that 'one good season' would be the key to their survival.

3.2.2. Community and social interaction

Rural decline

A dominant theme arising from the interviews was that rural communities are suffering and that townships are in decline; this was particularly the case in the Humbug. Participants had a perception that the size of the population in the rural areas of the Lachlan catchment was

decreasing, with some estimating that the population had halved (or more) in their lifetimes and was also ageing. Participants, particularly those in the Humbug, identified a range of services in the community that had been impacted by this trend, including shops, banks and healthcare. A growing trend towards the centralisation of services to larger towns, as directed by government funding, was also reported. The perceived reduction in population may be related in part to the reduced productivity of the land and the need for farmers to 'get big or get out'. The perceived reduction in rural population contrasts with the rapid growth observed in some urban centres within the area, such as Orange.

Structural change

Large properties were seen as vital in generating adequate produce and income and to offset ever increasing input costs: labour, machinery, chemicals, licensing, rents, rates and so on. There was a perceived increase in big-business investment in the Lachlan catchment, with numerous properties being acquired for large-scale commercial farming. Investors who did not relocate to the rural areas they had invested in were frequently termed "Pitt Street Farmers" – a pejorative term referring historically to business people with high disposable incomes working in the Sydney CBD.

Many participants in the Mandagery cited difficulty acquiring more property due to the increased land values around Orange. Land managers in the Mandagery noted that it would be more sensible to sell their land, as land values were seen as inflated in terms of the relative profitability the land itself could generate through farming. One farmer asserted that he was making more profit off the interest accumulated on the proceeds from land that he had sold than he had made when farming that land. However, this high land value was also seen as a 'false asset' due to difficulties in competing with other land uses and accessing government drought assistance.

Increased subdivision and creation of smaller farms for hobby or lifestyle purposes was viewed as reducing the amount of agricultural land available and altering the community dynamic significantly. Hobby or lifestyle farmers were less evident in the Humbug than in the Mandagery, where subdivision is becoming increasingly common.

Social cohesion

Involvement and participation in local communities in both sub-catchments appeared to be irregular, with a number of people reporting that there had been a decrease in social interaction during their time in the area. Participants suggested that this was related to emotional states and fatigue brought about by ongoing difficulties associated with the drought. Roger Barker's (1968) seminal work on rural community resources showed that 'undermanned' communities are at risk. Many farmers noted that they have limited spare time as they now perform tasks that were previously outsourced because labour is unaffordable and unavailable due to the reduction in population. Many community groups were thought to suffer from increased litigation risk and insurance costs, making some groups non-viable. This has had a negative impact on community halls, sporting clubs, and community fetes. While both formal and informal social processes were stressed, there was an expressed desire to maintain and support social interaction.

Reduced participation in community groups, particularly Landcare, was seen as being especially evident amongst young people. Younger farmers indicated that organised community groups and networks were less appealing than informal ones, as membership in these formal groups was actually perceived as an indication of loneliness. Younger people preferred attending field days and training courses to benefit from informal social interaction within the more formal settings. Having a chat and getting to know the other people at courses was thought to be just as useful as the information being taught.

Generational change

A number of younger people felt frustrated that they were not able to create positive change due to strong family influences and conservatism. There were suggestions that generational transfer is occurring too late in many farms. This was seen as limiting the learning experience of new farmers in economic and land management. This also led to a perceived limitation of uptake of innovation and technology; an area viewed as being driven by younger people. Reference was made to young people's energy, passion, enthusiasm and the way in which they viewed sustainability and environmental conservation as normal and expected aspirations. The succession planning process was viewed by some as especially time consuming and painful. Many older farmers have their assets, superannuation and retirement fund tied up within the farm and are reluctant or unable to hand over the property to their children. Participants noted that in previous years a farm could support more than one family but, because of changing social expectations regarding family living arrangements and reduced farm productivity, this was viewed as no longer possible.

Some young people noted that they felt they were being forced out of farming as high land-values were preventing them from purchasing their own property. In cases where they did purchase a property, concern was expressed that the 'credit culture' meant young farmers were steadily working up significant debt. Participants expressed concern that the next generation of farmers (aged 25 to 40) faced an uncertain future. Many families were actively dissuading their children from returning to the farm due to greater opportunities and secure incomes available in the cities and in the mining industry; however, many farmers were regretful that their children would not continue the family legacy.

Rural depression

The amount of on-farm contracting work available in the catchment (such as shearing, cropping, fencing and bailing) has significantly reduced due to the continuing drought and the dwindling financial resources of farmers. This has led to people increasingly seeking off-farm employment. Many participants indicated that wives were now predominately working in towns and becoming the main providers for the family. This was perceived as impacting on community function and as difficult for husbands, who had to 'swallow their pride'.

Depression was an issue raised by participants, thought to be caused by the drought. There was discussion of suicides, and thoughts that a farm is not a good place for people to be when they are under stress, as it is lonely and isolated from other people. The mental states of land managers were seen by some to affect the productivity of the farm, as depressed people may have reduced motivation and fewer emotional resources to draw on when managing their farms. Lacking control over conditions on the farm was seen as very hard to deal with. Regardless of the land-managers' level of skill, crops were failing and stock were suffering. Many farmers felt that there was simply nothing they could do.

The loss of sense of control over one's destiny has been related to poor psychological well-being. Duram (1997) investigated the link between personal characteristics of US farmers and whether they practiced conventional or alternative techniques of land management. In a series of in depth and lengthy (lasting between 4 and 16 hours) qualitative interviews with 11 farmers, Duram identified 'locus of control' (see glossary) as a key point of difference. To corroborate this, Duram developed a series of 12 continuous scales measuring levels of proactiveness versus reactiveness. Duram found that alternative farmers scored toward the proactive side and that conventional farmers scored toward the reactive side. It is clear that locus of control needs to be considered in this research.

3.2.3. Information and Influence

Most of the farmers interviewed stated that they obtained information by word-of-mouth and informal discussions within the community. Field days, the Conservation Farming Association, CSIRO and agronomy professionals were all mentioned as sources of information; it was also noted that information networks often extended interstate and overseas. The CMA was mentioned as a source of information by a few respondents.

Agronomists were preferred to agribusiness consultants (suppliers) as a source of information, as they were seen as being more impartial; however, due to the financial impacts of the prolonged drought most land managers were resorting to the 'free' agronomy advice offered by agribusinesses. Good advice was seen as expensive and one-on-one advice increasingly difficult to access. There was a perception held by some that many consultants were either failed farmers or lacked experience. In the Mandagery there was a common perception that older agronomists in the Department of Primary Industries (DPI) were more credible. Interestingly, it was noted that many of the agribusinesses were acting as 'counsellors' during the times of drought, with farmers feeling this was a 'safe' environment to discuss problems.

The strong focus on minimum till, direct drilling and stubble retention in the Lachlan catchment was perceived by some participants as being related to the availability of incentive funding in the Lachlan CMA, i.e. for machinery conversion to direct drill.

3.2.4. Attitudes towards CMA, government and funding

Many of the positive changes in land management practice were seen by some as facilitated by the Lachlan CMA. Adoption of conservation farming techniques in the catchment such as direct drill and minimum till was discussed in relation to the courses offered by the CMA. 'Holistic Farming' was seen as becoming a buzz word in the Mandagery after farmers attended Holistic Farming courses funded by the CMA.

There were suggestions that CMA incentive funding was going to the big farms rather than to the farmers in need. Participants noted that there was a lot of paperwork required to receive funding and that the corporate famers were able to employ accountants and lawyers to fill out the forms. These perceived funding issues led to feelings of inequity and resentment amongst the smaller farmers. Confusion and frustration over funding was also mentioned by farmers in regard to catchment specific targets. Many were aware of incentives available in other catchments but were unable to apply for such grants or carry out the activities on their own properties because of CMA boundary issues. It was also noted that funding cycles would be of more benefit to farmers if they became synchronised with farming and weather cycles.

Personal contact or relationships with CMA employees was seen as invaluable, particularly in terms of finding out what funding was available and using the 'right words' when completing application forms. CMA attendance at social and field days was well received and many people commented that their attitudes towards the Lachlan CMA had greatly improved because of the 'feet-on-the-ground' approach. Some saw the CMA as becoming more professional with the so-called 'dead wood' being removed and young and enthusiastic people being employed. Despite many positive attitudes towards the CMA, it was mentioned that there was an apparent lack of contact between local agronomists and consultants and the CMA.

When asked about the Catchment Action Plan and the CMA incentive program, there was a general lack of awareness amongst farmers. This highlighted the lack of translation of CMA rhetoric or jargon into every-day farming language, and it was suggested that people may have been accessing funds without actually filling out applications themselves. It was

suggested that the CAP was focused on ‘being seen to do the right thing’ but that it wasn’t specific at a farm level.

There was an evident lack of trust in government, banks and other organisations. Government handouts were seen as needing to be directed more towards improving commodity prices. Governments were perceived as being unresponsive to local contexts and of lacking understanding of rural conditions. Different government departments and organisations were seen to be caught up in red tape, depleting resources that should be made available for farmers and causing confusion. Banks were seen as being irresponsible by lending money which could not be repaid. The issue of farmers being unable to fulfil contracts that they had signed was mentioned frequently, with reference to the larger economic forces at play that farmers cannot contend with.

3.3. Summary and Implications

Overall, it appears that rural communities have been experiencing cascading impacts. While the impacts are detailed here separately, they are interrelated and experienced together. For example, rising petrol, pesticide and labour prices are embedded in the drought and create greater stress than either of the factors taken separately. The issues facing rural communities need to be seen as a threat not only to the economy and the environment, but also the well-being of individual farmers and rural communities at large. Qualitative investigations undertaken in the Lachlan area provided some further insight into land management practice, and in light of these interviews an enhanced focus on the following was deemed appropriate for further stages of research:

- the extent to which individuals believe that they can control events that affect them i.e. locus of control;
- environmental values and attitudes towards land stewardship;
- risk perceptions and risk management in agriculture;
- optimism, motivation and future orientation; and
- personal contacts between CMA staff and land-managers.

4. ANALYTICAL APPROACHES – BEHAVIOURAL MODELLING

The aim of the modelling stage of the current PUTTI research in the Lachlan is to validate and refine the model of land management practice developed for the Central West (Appendix A), and assess whether the revised model has more general applicability across other catchment areas in NSW. The hypothesised model was based on the following factors:

- results from qualitative interviews in the Lachlan;
- results from the Central West phase of the PUTTI project (Appendix A); and
- results from previous studies of a similar nature, including previous research carried out by the Australian Research Centre for Water in Society (ARCWIS).

4.1. Description of hypothetical model

As indicated above, our research has identified a number of variables thought to influence the likelihood that landholders will engage in good land management practice. It represents a refinement of the model developed for the Central West based on the qualitative research conducted in the Lachlan. In order to describe the structure of the hypothesised relationship between variables such as landholder characteristics, their values and beliefs and their actual land management practice, an investigative (or hypothetical) model was constructed. Figure 2 details the hypothetical model (intended to be exploratory in nature), comprised of 19 variables.[2]

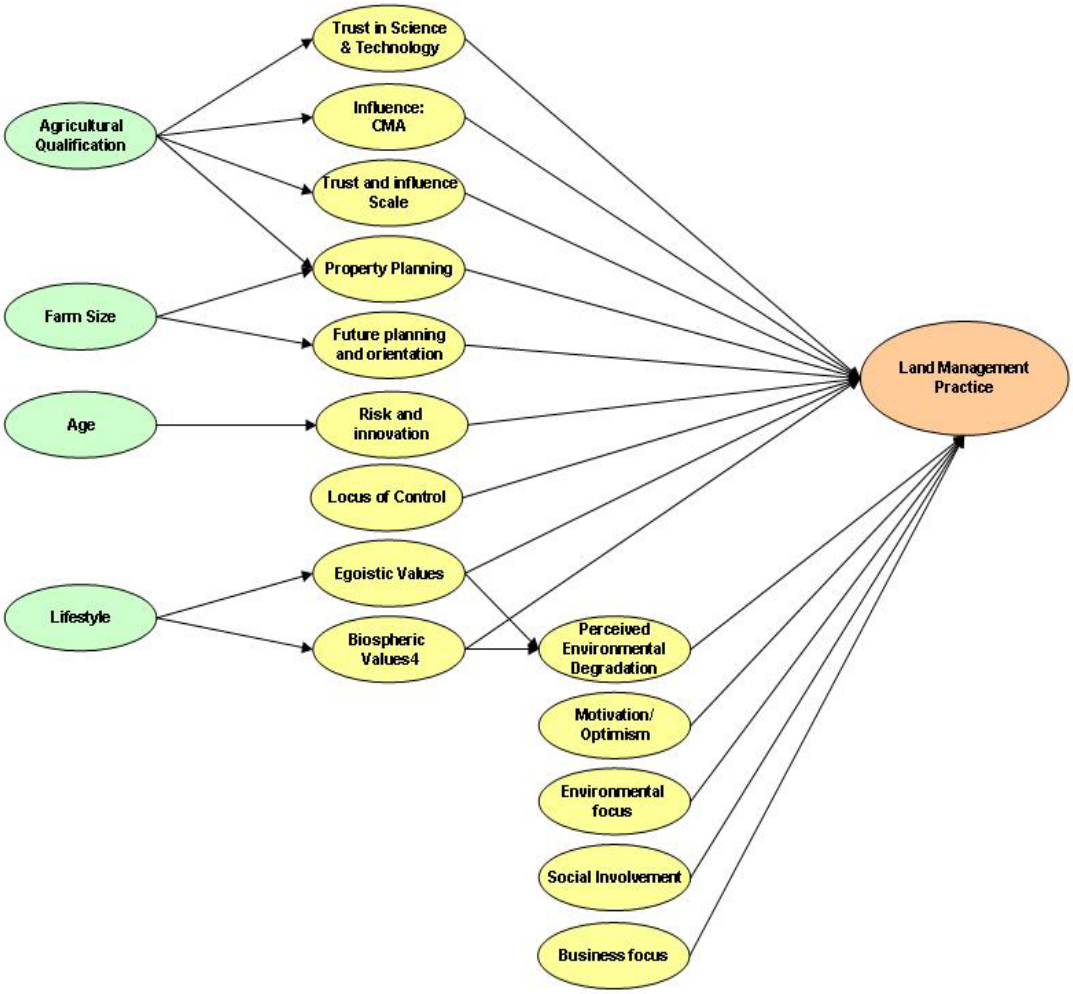

Figure 2 Hypothetical model of factors influencing land management practice

[2] In Figure 2, the different colours are used to illustrate the differentiation between preliminary variables (green), moderating or secondary variables (yellow), and dependent variables (orange).

All potential relationships between variables were included for examination, with the expectation that some of these relationships would not reach statistical significance. The following sections provide a summary of the components of the hypothetical model. The abbreviated model component variable names as they appear in Figure 8 are provided in italics in the sections below. Not all variables listed appear in the estimated model as described in section 6.4.

Land Management Practice

The land management practice variable is the outcome construct of interest in the PUTTI project. In this model it is comprised of participant responses to a number of land management items, and focuses on the following areas of interest: weed control; stock management (where applicable); native vegetation management; perennial pasture management; and soil management and testing. For each participant, an overall land management score was calculated using responses to questions relating to each of these areas (*BEHAVFIN*). Members of the Lachlan CMA were instrumental in helping to understand how the responses to each of these land management measures could be evaluated and quantified validly. Collaboration with the CMA is explained in more detail later in the report.

Agricultural Qualifications

The agricultural qualifications component of the model refers to any formal qualifications that respondents have that are relevant to land management and farming.

Farm Size

The farm size component of the model refers to the size of the respondents' farm in hectares.

Age

The age component of the model refers to respondents' age in years.

Lifestyle

The lifestyle component of the model refers to the extent to which respondents indicate that they are farming for the lifestyle as opposed to a business venture. Consequently, higher scores in this variable indicate that a respondent is farming more for the lifestyle it represents than for business purposes.

Trust in Science and Technology

The science and technology component of the model refers to respondents' beliefs that science and technology can provide effective solutions to land management issues.

Influence: CMA

This component refers to the perception of CMA influence over on-farm activities and the amount of contact respondents have with the CMA.

Trust and Influence Scale

The trust and influence component of the model indicates how much trust respondents have in information provided by various organisations, businesses and institutions, and how much these various sources of information influence what they do on their farm (*TINF3, TINF4, TINF8 & TINF10)*.

Property Planning

Refers to whether respondents have a written property plan, and whether this plan was created with the aid of a professional (*FarmPlan)*.

Future Planning and Orientation

The future planning and orientation component refers to how much emphasis the respondent places on planning for the future, and how much considerations of future outcomes influence their current activities.

Locus of Control

The locus of control component refers to the extent to which respondents indicate that the management of their farm is either within their control, or outside of their control and impinged upon by external factors (*Att23r, Att21r & Att24)*.

Risk and Innovation

The risk and innovation component of the model refers to the level of risk people are willing to take in the management of their property. The innovator component of the model measures the extent to which respondents report they enjoy trying new things and being innovative in the way they manage their farm.

Egoistic Environmental Values

This refers to concern for the environment as it relates to self and family (*ENVAL9, ENVAL6 & ENVAL12)*.

Biospheric Environmental Values

Respondents' value of the environment as it relates to concern for the biosphere (*ENVAL3, ENVAL1 & ENVAL2)*.

Perceived Environmental Condition

The perceived environmental condition component of the model refers to respondents' perception of the condition of their property and the region as a whole. It covers perceptions of water quality, soil health, weed presence and erosion.

Motivation/Optimism

The motivation/optimism component of the model refers to the level of confidence held by respondents regarding the future of the community and the future of their property.

Environmental Focus

Environmental focus refers to the extent to which the management of property is focused on environmental benefits.

Social Involvement

The social involvement component identifies the extent to which respondents have interaction with others in their community.

Business Focus

The extent to which management of property is focused on business gains over environmental.

5. TESTING THE MODEL

5.1. Methodology

A survey instrument designed specifically to test the hypothetical model was developed based on previous research and knowledge of the study area. Data was collected by a trained team of field interviewers who conducted the telephone survey with dryland farmers in the Humbug and Mandagery sub-catchment areas of the Lachlan Catchment. The sample size (300 landholders in total) allows for comparative analysis between sub-catchments and satisfies the minimum sample size requirements for Structural Equation Modelling to be effectively undertaken.

5.1.1. The questionnaire

As a result of findings during the first phase of the study in the Central West, amendments to the questionnaire were made. These changes were designed to ensure that the dependent variable (land management behaviour) was measured more accurately. The changes in the Lachlan behavioural questionnaire included alteration of the key land management questions to include more of the participants' rationale for undertaking certain practices. This was done by including a number of open ended questions for each of the separate management behaviours, asking participants to explain *why* a specific practice was undertaken. The resultant survey was more open-ended and participant-led. In addition, it contained additional items to measure new variables identified in the Lachlan qualitative interviews. The questionnaire was pre-tested with a number of landholders in the Lachlan study area before it was finalised and implemented.

The questionnaire was designed to measure each of the variables contained in the hypothetical model. In summary, the questionnaire covered the following areas:

- background information relating to farming and property details – including farming activities, property size, years in farming, and property ownership;
- socio-demographic information;
- trust in and influence of sources of information and advice;
- individuals' role in and views of the community;
- a series of attitudinal statements;
- the existence of farm plans; and
- a series of questions regarding land management practice.

5.1.2. Respondents and refusal rates

Landholders were randomly selected from telephone lists for both the Humbug and Mandagery sub-catchments and adjacent areas. In total, 300 landholders were surveyed – 130 (43.3%) from the Humbug sub-catchment and 170 (56.6%) from the Mandagery sub-catchment.

Interviewers were directed to ask to speak to the principal decision-maker for the property (this may have been the owner or farm manager). Interviewers were further instructed to contact each property on the lists at least five times, at different times of the day and across different days, before the property could be classified as a 'non-contact'.

Table 1 depicts the refusal details over the two sub-catchments as a whole, which gives a combined refusal rate of 40.7%. The refusal rates for the Humbug and Mandagery sub-

catchments were 38.4% and 42.4% respectively, which indicates good involvement in the project, and comparable to refusal rates for the Central West CMA (Porter et al, 2007).[3]

Table 1 Refusal details

Reason	Humbug	Mandagery	TOTAL
Not Interested	36	51	87
Too Busy	23	35	58
Elderly/Too Old	15	23	38
Ill/Sick	1	0	1
Hung Up	6	15	21
Aborted	0	1	1
TOTAL	81	125	206

5.2. Collaboration with the CMA in determining the behavioural measure

In order to maximise the validity of the land management practice variable, members of the project team met with a number of representatives from the Lachlan CMA to discuss how best to categorise and assign numeric value to survey responses. A workshop was held over the course of a day with eight CMA representatives. Each of the land management practice responses was examined and quantified according to whether it conformed to desirable management practices, and also weighted in accordance with how important the CMA believed certain areas of practice to be - that is, all criteria of land management practice were weighted by several CMA staff. Consensus was reached with the quantification and weighting of each practice; where consensus was not immediately achieved, further discussion and deliberation occurred until consensus occurred. The resulting quantified and scaled measurement items allowed an individual land management score to be calculated and assigned to all survey respondents.

[3] Research conducted as part of PUTTI program in Central West Catchment Aug-Sept 2007 yielded refusal rates of 42% for the Cudgegong sub-catchment and 39% for the Bell sub-catchment.

6. SURVEY RESULTS AND ANALYSIS

Preliminary analyses to establish frequencies and scale suitability were undertaken using correlation, analysis of variance (ANOVA), cross-tabulation and reliability analysis. This was followed by an investigation of the causal relationships between the components of the hypothesised model using the robust maximum likelihood estimation method in LISREL 8.72 (Joreskorg, Sorbom, du Toit & du Toit, 2000).

For the preliminary analyses, and to ensure robustness of results, a significance level of $p < .01$ was applied. Differences labelled 'significant' in the results section refer to *statistical* significance at this .01 level. The number of respondents answering a question is shown and denoted as 'n' and/or as a percentage of the whole sample. For a number of open-ended questions, more than one answer was allowed; hence percentages do not always add up to 100%. Results of open-ended questions are presented with the number (denoted as "n") of times this response was offered and as a percentage of the number of people responding.

6.1. Preliminary analyses

6.1.1. Background farming information

A series of questions was asked to collect general information regarding respondents' properties.

Types of farming activities

Respondents were asked to nominate the main farming activities carried out on their property (or properties) as well as the main focus of their farming activities. As can be seen in Table 2, the main farming activities in the two sub-catchments were broad acre cropping (72.3%), sheep (61.0%) and cattle (40.7%).

Table 2 Main farming activities undertaken by respondents

Farming Activities	Humbug		Mandagery		Total	
	n (130)	% of cases	n (170)	% of cases	n (300)	% of cases
Broad acre crops	117	90.0	100	58.8	217	72.3
Sheep	98	75.4	85	50.0	183	61.0
Cattle	41	31.5	81	47.6	122	40.7
Fat-lambs	28	21.5	61	35.9	89	29.7
Pasture crops	7	5.4	27	15.9	34	11.3

Most respondents (n=247) were engaged in more than one farming activity on their property (e.g. cattle and sheep farming, cattle farming and broad acre crops).

As can be seen in Table 3, the main focus of farming activities for most respondents (68.5%) was ongoing farm maintenance and management. Almost one-third of respondents had a

primary focus on activities that were outside the scope of 'business as usual', concentrating on such things as expansion (10.1%), downsizing (6.0%) and diversification (4.0%). Responses indicated higher relative proportions of people focusing on expansion in the Humbug (14.0%) than in the Mandagery (7.1%).

Table 3 The main focus of respondents' farming activities

Main focus of farming	Mandagery		Humbug		Total	
	n (129)	%	n (169)	%	n (298)	%
Ongoing farm maintenance/ management	83	64.3	121	71.6	204	68.5
Expansion/ consolidation/ land acquisition	18	14.0	12	7.1	30	10.1
Downsizing- subdivision/ leasing land	4	3.1	14	8.3	18	6.0
Diversification	5	3.9	7	4.1	12	4.0
Impact management- drought/ flood	8	6.2	3	1.8	11	3.7
Selling-up/ retiring	2	1.6	7	4.1	9	3.0
Developing low input agriculture/ cutting costs	6	4.7	0	0.0	6	2.0
Other	2	1.6	3	1.8	5	1.7
Property improvement	1	0.8	2	1.2	3	1.0
Total	129	100.0	169	100.0	298	100.0

Years in dryland farming

The length of time respondents had been dryland farming in the area ranged from one to 80 years, with the average being a length of 29.2 years. Over a third of respondents had been farming for between 16 and 30 years (see Table 4).

Table 4 Years respondents had been dryland farming

Years	n (300)	%
0-15	71.0	23.7
16-30	101.0	33.7
31-45	87.0	29.0
46+	41.0	13.7

The length of time respondents' families had been farming in the area ranged from two to 200 years, with an average length of 69.4 years (see Table 5).

Table 5 Length of time respondents' families had been farming in the area

Years	n (300)	%
0-24	61.0	20.3
25-49	43.0	14.3
50-74	40.0	13.3
75-99	61.0	20.3
100+	95.0	31.7

Farm size and number of properties

Respondents were asked about the size of their farm and the number of properties involved. They were also asked about how many properties they actively managed which were under agricultural production. The average farm size across the two sub-catchments was 1431.1 hectares (ha). Within the specific sub-catchments, the average property size in the Humbug was 2440.1 ha, substantially larger than the Mandagery (659.5 ha, see Table 6). Almost half of the respondents (41.3%) had properties over 1000 ha. It should be noted that there was a substantially larger degree of variation in land sizes among properties in the Humbug than among properties in the Mandagery.

Table 6 Farm sizes for Humbug and Mandagery sub-catchment respondents

Farm size (ha)	Humbug		Mandagery		Total	
	n (130)	%	n (170)	%	n (300)	%
0-99	8	6.2	37	21.8	45	15.0
100-399	14	10.8	54	31.8	68	22.7
400-999	12	9.2	51	30.0	63	21.0
1000-2999	59	45.4	22	12.9	81	27.0
3000+	37	28.5	6	3.5	43	14.3

Farm ownership

The majority of respondents (55.7%) had only one property and actively managed only one property under agricultural production (52.7%). On average, respondents had 2.0 properties and managed 2.1 properties (see Appendix C for full details). The amount of respondents with between 2 and 4 properties was 37.3%.

6.1.2. Socio-demographics

Respondents were asked a number of socio-demographic questions relating to age, gender and agricultural qualifications.

Age

Most respondents were aged between 45 and 54 years in both the Humbug and Mandagery sub-catchments. More than two-thirds of all respondents fell into the 35 to 64 age bracket (see Table 7). However, the Humbug sub-catchment had a higher proportion of respondents aged less than 45 years (34.6%) when compared with the Mandagery (26.5%).

Table 7 Details of respondents' age

Age category	Humbug		Mandagery		Total	
	n (130)	%	n (170)	%	n (300)	%
Less than 24 years	2	1.5	1	0.6	3	1.0
25 to 34 years	11	8.5	9	5.3	20	6.7
35 to 44 years	32	24.6	35	20.6	67	22.3
45 to 54 years	34	26.2	43	25.3	77	25.7
55 to 64 years	32	24.6	43	25.3	75	25.0
65 to 74 years	15	11.5	34	20.0	49	16.3
More than 75 years	4	3.1	5	2.9	9	3.0

Agricultural qualifications

Over a third of participants reported having formal agricultural qualifications (31.7%). Of those with formal agricultural qualifications, most qualifications were procured through TAFE (41.1%), with 19.6% of qualifications being from University, and 39.3% from other institutions.

Gender

The majority of respondents were male (74.3%). This was similar for both sub-catchments, with 73.8% male participants in the Mandagery, and 74.7% in the Humbug.

6.1.3. Property planning

The majority of participants (73.3%) stated that they did not have a written property plan. Of the 26.7% who had a written plan, just over half (52.5%) had their farm plan created with assistance from a professional. A larger proportion of Mandagery respondents stated that they had written farm plans (28.2%) relative to Humbug respondents (24.6%). This finding is consistent with qualitative data from the scoping activities which indicated that farmers found it harder to adhere to farm plans in more adverse climatic conditions.

Of the 220 people who stated that they did not have a written property plan, a wide variety of responses were given for what they used instead. The most frequent responses are presented in Table 8. A full list of responses is presented in Appendix C.

Table 8 Responses for what was used in lieu of a written property plan

What do you use instead of a property plan?	Responses	%
Common sense / own brain / own knowledge	105	47.9
Experience	40	18.3
Consultation/ discussion (inc. family, other farmers, employees)	35	16.0
Adapt daily	27	12.3
Adapt according to weather conditions	24	11.0
Continue practices undertaken in the past	21	9.6
Annual calendar / seasonal calendar	18	8.2
Written diary records	15	6.8
Unwritten goals/ future plans	12	5.5
Mapping (computer assisted/ aerial/ overlays)	12	5.5
Knowledge from other farmers	7	3.2
Instinct	7	3.2

6.1.4. Decision making

CMA assistance

Respondents were asked if they knew anyone who worked for the CMA and if the CMA had assisted them with their agricultural practices. Almost half of the respondents (44.7%) knew someone in the CMA. Of those who knew someone in the CMA, over half (51.1%) stated that the CMA had assisted them with agricultural practices. Roughly the same proportion of Mandagery respondents (44.7%) knew someone in the CMA compared to Humbug respondents (44.6%); however of these respondents, a greater proportion from Humbug (55.9%) indicated that they had received assistance from someone in the CMA compared to Mandagery (47.4%).

6.1.5. Sources of information

Trust in sources of information

Participants were asked how much they would trust information from a range of sources, on a scale from 1 (no trust) through to 5 (complete trust).

Over half of the respondents (62.3%) strongly trusted information from agronomists regarding farming practices, along with other farmers (56.5%), field days (54.2%), and the Kondinin group (50.4%). Over a quarter of respondents felt little or no trust in information provided by the CMA (27.4%), Agribusiness (25.8%) and Landcare (25.0%). A full list of responses is presented in Appendix C.

Figure 3 demonstrates that the most trusted source of information reported by respondents was other farmers (mean=3.63), with the CMA being the least trusted overall (mean=2.96).

The most commonly identified other sources of information included the Central West Farming System group (n=16, mean = 3.88), The Land publication (n=11, mean=3.55), the Internet (n=7, mean=3.71) and the Rural Press (n=7, mean=2.86).

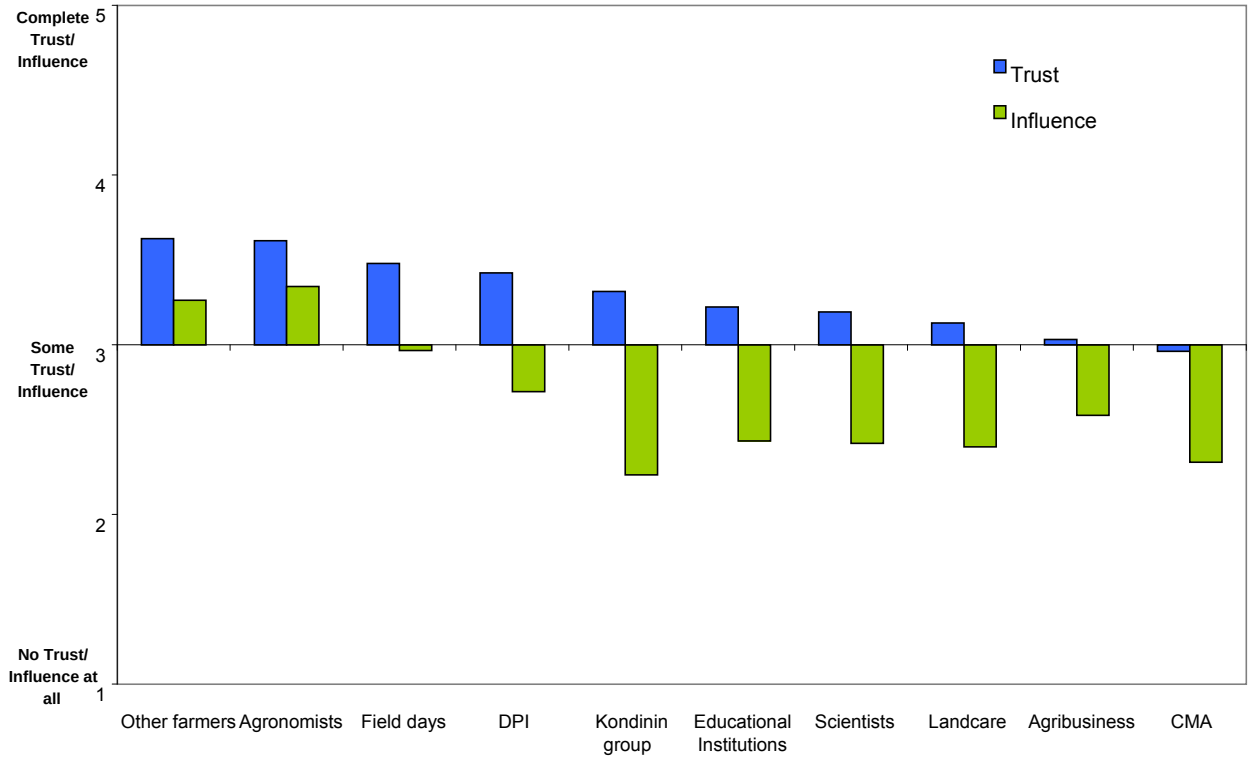

Figure 3 Mean trust and influence ratings

Influence of information sources

Respondents rated how much influence each of the information sources listed in Figure 3 had on their farm management using a five-point scale (*1 = no influence* to *5 = significant influence)*. A full list of responses is presented in Appendix C.

Over half of the respondents reported that agronomists strongly influenced their farming practices (52.2%), while nearly half (44.3%) were strongly influenced by other farmers. Over half of the respondents felt that their farming practices were influenced little or not at all by the Kondinin group (58.35%), CMA (55.8%), Landcare (54.0%), Scientists (51.7%) and Educational institutions (51.5%).

The most common other sources of information nominated by respondents included the Central West Farming Systems group (n=15, mean=3.47); The Land (n=11, mean=3.27); the Internet (n=7, mean=3.00); and the Rural Press (n=7, mean=2.86).

Interestingly, for all sources except for other farmers and agronomists, irrespective of trust levels, participants did not feel any other groups influenced their farm management (see Figure 3).

Courses attended

Respondents were asked if they had attended any agricultural courses recently, and if so if the courses had helped them to better understand their properties. Respondents were also

asked if the course(s) had made a difference to what they did on their property.

Over a third (35.3%) of respondents had recently attended at least one agricultural course. Of these, the majority (77.1%) felt that the course had helped them better understand their property. Further, most respondents (69.8%) that had attended a course recently also felt that it had made a difference to what they did on their property. The most common differences noted by participants are detailed in Table 9. A full list of responses is presented in Appendix C.

Table 9 Common impacts that agricultural courses have made to respondents' property management

Difference made by agricultural course	Responses	%
Improved safety awareness and practice	13	11.6
Improved soil condition	12	10.7
More sustainable land use	11	9.8
Improved pastures/ pasture input	10	8.9
Improved fertiliser knowledge (inputs/ types/ results)	9	8.0
Generally improved farm planning and management	8	7.1
More profitable land use	7	6.3
Better understanding of stock food quality / quantity	6	5.4
Putting drought lotting into practice	4	3.6
Improved native vegetation management	4	3.6

Agronomy advice

Most respondents (69.3%) indicated that they consulted an agronomist for land management advice. A relatively high proportion of Humbug respondents (76.3%), relative to those in the Mandagery (64.1%), consulted an agronomist. Less than one-quarter (24.6%) of those who had consulted an agronomist paid for the service. This may indicate that agronomy advice is being sought from agronomists employed at rural supply stores who do not charge for their services.

6.1.6. Social norm

Questions were asked to identify whether respondents were influenced by other people's views, and whether they perceived that they influenced others in the community. Respondents were firstly asked to rate on a five-point scale how similar their own views were to others in the community (1 = *not at all similar* through to 5 = *extremely similar*). Respondents were then asked to rate how much they valued the views of other farmers (1 = *no value at all* to 5 = *immense value*). The results are provided in Table 10.

Table 10 Summary of responses to social norm indicators

How similar are your views to others in the community?		How much do you value the views of other farmers?	
	% (n=300)		% (n=300)
1- Not at all similar	3.0	**1- No value at all**	0.3
2	12.3	**2- Little value**	5.3
3- Somewhat similar	39.7	**3- Some value**	35.3
4	32.0	**4- A lot of value**	47.7
5- Extremely similar	13.0	**5- Immense value**	11.3

The majority of respondents felt that their views were at least somewhat similar to others in their community (84.7%), and that the views of other farmers had at least some value to them (94.3%).

Table 11 Summary of respondents' perceived influence

How much do people come to you for agricultural advice?		How much influence do you have on other farmers' agricultural practices?	
	% (n=300)		% (n=300)
1- Never	10.0	**1- No influence**	18.7
2- Rarely	31.1	**2**	27.0
3- Sometimes	44.1	**3- Some influence**	44.3
4- Often	13.7	**4**	8.3
5- All the time	1.0	**5- Significant influence**	1.7

Almost a third of participants thought that others came to them for advice *never* or *rarely* (31.1%), while more than half believed that people came to them *sometimes* or *often* (57.8%). Just over half of the respondents believed they had some level of influence over other famers' practice (54.3%), while 45.7% did not feel they influenced other farmers (see Table 11).

6.1.7. Perceived environmental condition

Respondents rated the environmental condition of their district, as well as their particular property, in relation to soil health, water quality, erosion and weeds. A full table of responses is available in Appendix C.

Figure 4 Mean perceived environmental conditions: Humbug and Mandagery

Figure 4 shows that mean ratings of the broader district's soil health (3.43), weeds (2.80), water quality (3.45) and erosion (3.42), indicated an overall perception of *fair conditions.* On average, respondents rated the conditions of their property conditions as *fair* to *good* for all aspects*.* Individual properties were rated to be in significantly better condition than the district.

Respondents in the Humbug sub-catchment rated district conditions lower than did Mandagery respondents in all aspects of the environment under consideration. Humbug respondents also reported lower mean ratings of property conditions in terms of soil health, water quality and erosion.

6.1.8. Attitudinal statements

A series of attitudinal statements, which later formed the scales used in this study, was presented to respondents. These forty-six attitudinal statements were developed through analysis of the qualitative research in the Lachlan and past ARCWIS research (see Section 4.1). Scale development was further informed by a review of relevant literature on assessing environmental values (see Schultz, 2000 for a review), locus of control (Rotter, 1966; Marsh and Richards, 1986; Nuthall, 2006; Paulhus and Van Selst, 1990; McNairn and Mitchell, 1992; Stayner, 1997) and risk and innovation (Bard and Barry, 2000; Pennings and Garcia, 2001).

Nine scales were created from the attitude statements by conducting a principal components factor analysis.

Factor analysis involves reducing multiple variables (in this case attitudinal statements) to factors, which can be thought of as representing underlying constructs. This involves examination of the mathematical patterns of relationships among the attitudinal statements. Those statements that are inter-related to each other (or correlated) were thought to measure the same underlying construct. One factor may be comprised of several variables which are inter-related. The nine main factors extracted informed the construction of the nine scales presented in the passages below.

Social involvement scale

The social involvement scale assessed respondents' level of community involvement through responses to three statements. The following statement is representative of those in the scale: "*There are a lot of people in the community I can talk to"*. Respondents used a 5-point scale ranging from *strongly disagree* (1) through to *strongly agree* (5) to respond to the statements. The scale was considered to be statistically reliable (Cronbach's alpha value=0.74 – see Acronyms, Abbreviations and Definitions section for a definition of Cronbach's alpha).

Optimism scale

Respondents' optimism regarding the future was assessed through responses to two attitudinal items. The following item is representative of those in the scale: "*How confident are you that the community will be doing well in 10 years?"*. Participants responded to items using a 5-point scale ranging from *not at all confident* (1) through to *extremely confident* (5). The scale was found to be approaching statistical reliability (Cronbach's alpha value=0.56 – while this is below the recommended level for statistical reliability, as the scale items had been abstracted to apply to an agricultural context, the Cronbach's alpha score was deemed acceptable).

Risk and innovation scale

Respondents' innovativeness and attitude towards risk was assessed through responses to six attitudinal statements. The following item is representative of those in the scale: "*I am willing to take higher than average risks in order to get higher financial returns"*. Participants responded to statements using a 5-point scale ranging from *strongly disagree* (1) through to *strongly agree* (5). The scale was found to be statistically reliable (Cronbach's alpha=0.68).

Locus of control scale

Respondents' locus of control was assessed through responses to three attitudinal statements. The following item is representative of those in the scale: "*The success of the farm is mostly determined by factors outside of my control"*. Locus of control is a robust and replicated construct in the literature that identifies the degree to which an individual feels that they are personally in control of their own affairs rather than being controlled by external factors (McKnight and Sutton, 1994).

Participants responded to statements using a 5-point scale ranging from *strongly disagree* (1) through to *strongly agree* (5). The locus of control scale was found to be approaching statistical reliability (Cronbach's alpha=0.55 – again, while this is below the recommended level for statistical reliability, as the scale items had been abstracted to apply to an agricultural context, the Cronbach's alpha score was deemed acceptable).

Value of science and technology scale

The value respondents place on science and technology was assessed through responses to four attitudinal statements using a five-point scale ranging from 1 = *strongly disagree* through to 5 = *strongly agree*. The following item is representative of those in the scale: "*I trust*

technology to provide answers to land management issues". The value of science and technology scale was found to be statistically reliable (Cronbach's alpha=0.58).

Planning and goal orientation scale

Respondents' orientation towards planning and goal attainment was assessed by eliciting their responses to five attitudinal statements using a five-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The following item is representative of those in the scale: "*When I know there is work to be done I don't get easily distracted".* The planning and goal orientation scale was found to be statistically reliable (Cronbach's alpha=0.57).

Environmental stewardship scale

Respondents' orientation towards environmental stewardship, or commitment towards conservation of the land, was assessed through responses to two attitudinal statements, using a five-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The following item is representative of those in the scale: "*It is important to leave the land better than you found it".* The environmental stewardship scale was found to be statistically reliable (Cronbach's alpha=0.74).

Environmental values scales

People tend to have different environmental values. Research literature identifies several distinct types of environmental values (for example see Schultz, 2000). People may be concerned about environmental problems because of the impacts on

- aspects of the natural and physical environment (plants and animals) – termed 'biospheric' environmental values, as well as
- themselves and their family – termed 'egoistic' environmental values.

Biospheric values scale

Respondents were asked about their level of concern about environmental problems because of the impacts on native animals and plants. The value they place in aspects of the 'biosphere' was assessed using a five-point scale 1= *not at all concerned* to 5 = *extremely concerned*. The biospheric values scale was found to be statistically reliable (Cronbach's alpha=0.86) and consisted of three items.

Egoistic values scale

Respondents were asked about their level of concern regarding environmental problems because of the impacts on themselves and their families. The value they place in the human welfare, or instrumental usage of the environment was assessed using a five-point scale ranging from 1 = *not at all concerned* to 5 = *extremely concerned*. The egoistic values scale was found to be statistically reliable (Cronbach's alpha=0.92) and consisted of nine items.

Residual statements

Of the original forty-six attitudinal statements, nine did not load satisfactorily on a factor. As such, they were not included in the aforementioned nine scales. These items are presented in Table 12.

Table 12 Residual statements

	Strongly disagree (%)	Mildly disagree (%)	Unsure (%)	Mildly agree (%)	Strongly agree (%)	Mean	Std. Dev.
It is important to run a farm as a business enterprise* (n=299)	0.3	2.7	6.0	36.8	54.2	4.42	0.75
I really value the lifestyle that farming provides me (n=299)	2.3	5.0	8.4	37.8	46.5	4.21	0.96
The primary objective on a farm is to maximise productivity* (n =299)	3.0	18.1	17.4	46.5	15.1	3.53	1.05
For most farmers who can't make a go of it you usually find that unwise decisions played a big part in it (n=299)	4.3	20.4	22.1	41.5	11.7	3.36	1.07
The decisions I make on my property are based primarily on how it affects my lifestyle (n=300)	7.3	28.0	20.7	32.3	11.7	3.13	1.16
Managing a successful farm is a matter of hard work and luck has little or nothing to do with it (n=300)	7.7	30.0	25.7	24.7	12.0	3.03	1.16
I am confident that my family will be farming in this area in 20 years (n=299)	28.4	18.7	15.1	26.4	11.4	2.74	1.41
Making a living from my farm now is more important than worrying about the farm's long-term future* (n=300)	18.0	37.3	20.0	19.3	5.3	2.57	1.15
People have the right to change the natural environment to suit their needs* (n=299)	21.1	35.8	22.7	15.7	4.7	2.47	1.13

* Indicates a reversely worded item

6.1.9. Land management practice

A series of questions was asked relating to five areas of land management practice common to dryland farming. These practices were identified as contributing to good land management during the qualitative phase of the study and reviews of past research. The areas of land management explored were soil management, perennial pasture management, native vegetation management, weed management and stock management (where applicable to respondents).

Respondents were asked not only what practices they undertook, but also for the reasons they managed their properties in this way.

Soil management

This section relates to the management of soil on the respondent's property. Respondents were firstly asked a series of questions about soil testing.

Of the 300 respondents, 154 (51.3%) reported undertaking regular soil testing on their properties. Of the 154, the majority reported testing for pH levels (n=79), nitrogen (n=59), phosphorus (n=48) or trace elements (n=29). A full table of responses is available in Appendix C.

Respondents were also asked how often they tested their soil. The majority tested annually (n=72) (see Table 13).

Table 13 Frequency of soil testing

Frequency	n (154)	%
Annually	72	46.8
Once every two years	20	13.0
Every three years	13	8.4
Annually on a rotational basis	11	7.1
When paddock is cropped / put into pasture	7	4.5
Every five years	6	3.9
Twice a year	4	2.6
Every three-five years	4	2.6
Annually on fresh paddocks	4	2.6
Every two-three years	3	1.9
Every five-ten years	3	1.9
Every one-two years	3	1.9
Every one-two years on a rotational basis	2	1.3
More than twice a year	1	0.6
Every year before the drought	1	0.6

Respondents were asked how the results of soil tests influenced what they did on their properties. Most commonly, respondents used the results of soil tests to better understand fertiliser requirements, including the type of fertilizer to use, the amount, and where and when to apply it (n=90). Other common responses included understanding soil nutrient levels and requirements (n=44), pasture requirements (n=36), and to inform farm management and methods (n=15).

Respondents were asked to indicate whether there were any barriers preventing them from undertaking soil management on their properties. Most respondents stated that there were no barriers (n=147), with other common responses including financial constraints (n=92), weather constraints (n=37) and time constraints (n=13). Some respondents felt that soil tests were not needed (n=27) (see Appendix C for a full list).

Perennial pasture management

This section relates to perennial pasture management on the respondent's property. Respondents were asked a series of questions about setting aside land for perennial pastures. The majority of respondents (n=237; 79%) indicated that they had land under perennial pastures.

There were relatively low proportions of respondents in the Humbug (60%) with land under perennial pasture when compared to Mandagery (93.5%).

For those with perennial pastures, the most common pastures planted were Lucerne (n=146), native grasses/clovers (type unspecified; n=70) and Phalaris (n=67). A full table of responses is available in Appendix C.

Most respondents stated that they had perennial pastures for the purpose of feed or stock pastures (n=181), with other reasons including soil health and productivity (n=37), and nitrogen fixation (n=21). A full table of responses is available in Appendix C.

Respondents were asked to indicate whether there were any barriers preventing them from undertaking perennial pasture management on their properties. Most respondents cited weather conditions (n=169) and financial constraints (n=40) as the main barriers. Sixty three participants stated there were no barriers. A full table of responses is available in Appendix C.

Native vegetation management

This section relates to native vegetation management on the respondents' property. The majority of respondents (71.2%) indicated that native vegetation was part of their property planning. A relatively higher proportion of Mandagery respondents (78.1%) indicated that native vegetation was part of their property management when compared with Humbug respondents (62.3%).

The type of native vegetation existing on properties varied, with the main vegetation types unspecified grasses and clovers (n=73), eucalypts (n=69), kurrajongs (n=53) and unspecified tree varieties (n=46). A full table of responses is available in Appendix C.

When asked why native vegetation management was a part of property planning, the most common responses were for shade or shelter (n=99), for biodiversity (n=50), because the vegetation was already there or the area was uncultivated (n=42), or to maintain soil health (n=41). A full table of responses is available in Appendix C.

The main barriers to native vegetation management included weather conditions (n=46) and financial constraints (n=30). One hundred and seventy respondents indicated that there were no barriers.

Weed Management

Respondents were asked a number of questions about weed management on their properties. Almost half of all respondents (42.3%) indicated that weed management was a large focus in their property management, with a further 52.7% indicating weed management

accounted for at least *some* of their focus and only 5% for whom it constituted little or no focus.

A large number of weed management techniques were being employed by respondents, with the most popular methods being boom spraying (n=204) and spot spraying (n=178). Grazing (n=74) and hoeing (n=56) were also popular. A full table of responses is available in Appendix C.

By far the most popular reason for employing a particular weed management technique was its efficiency (n=170), with price (n=40) and reducing chemical reliance (n=25) also popular reasons. A full table of responses is available in Appendix C.

When asked about barriers to integrated weed management, again participants stated that cost (n=53) and weather conditions (n=32) were most pertinent. One hundred and forty three respondents indicated that there were no barriers to integrated weed management.

Stock Management

For those who had stock on their properties, a series of questions were asked in relation to their stock management.

Of the 287 participants with some level of stock, 81.2% indicated that they had taken action to minimise the environmental impact of stock on their land. A relatively high proportion of Mandagery respondents with stock (83.6%) indicated that they had taken action to minimise the environmental impact of stock on their land compared to Humbug respondents (77.9%). These actions included reducing/controlling stock numbers (n=106), stock rotation (n=92) and fencing off natives vegetation and waterways (n=52) (see Appendix C).

When asked how their actions had reduced the impact of stock on the land, the most common responses were the reduction of soil degradation (n=138), retention of groundcover (n=73) and not overgrazing (n=34) (see Appendix C).

When asked about barriers to the reduction of stock impact, 142 respondents stated that there were no barriers, while weather conditions (n=77) and cost (n=31) were the most frequently cited barriers.

6.1.10. Future involvement

As a final question, participants were asked if they were interested in being involved in future stages of the project. The majority (87.3%) were willing to remain involved.

6.2. Group comparisons

Statistical analyses were performed to identify any differences in responses to particular questions based on key characteristics of the respondents. These included the respondents' age group, sub-catchment area, agricultural qualifications, farm size, involvement in community groups and whether they had a written farm plan. A number of significant differences were identified. These are reported in the following section.

6.2.1. Differences between age groups

Statistically significant differences ($p<.01$) based on age group were identified for the following questions:

- *I am confident that my family will be farming in this area in 20 years;*
    - Farmers under the age of 24 were more confident than farmers aged between 45 and 64.
    - Farmers aged between 35 and 44 years were more confident than those aged between 45 to 64 years.
- *How would you rate the environmental condition of your district as it relates to soil health;*
    - Farmers aged between 25 and 34 years reported the district soil health to be more degraded than did those aged between 45 and 74 years.
    - Farmers aged between 35 and 44 years reported the district soil health to be more degraded than did those aged between 55 and 74 years.
- *How would you rate the environmental condition of your property as it relates to water quality;*
    - Farmers aged between 25 and 34 years reported water quality on their property to be more degraded than did those aged between 65 and 74 years.
    - Farmers aged between 35 and 44 years reported water quality on their property to be more degraded than did those aged between 55 and 64 years.
    - Farmers aged between 55 and 64 years reported water quality on their property to be more degraded than did those aged between 45 and 54 and 65 and 74 years.
- *How would you rate the environmental condition of your district as it relates to erosion;*
    - Farmers aged between 25 and 34 years reported more erosion in the district than did farmers aged between 65 and 74 years.
    - Farmers aged between 45 and 54 years reported more erosion in the district than did farmers aged 65 years and over.

6.2.2. Differences based on gender

The following statistically significant differences (*p <.01)* based on gender were identified:

- Males (mean=3.42) reported having significantly more trust in the Kondinin Group than did females (mean=2.95).
- Males (mean=3.86) rated the water quality on their property significantly higher than did females (mean=3.52).
- Females (mean=3.58) reported their property to be in significantly worse condition in relation to erosion than did males (mean=3.99).

6.2.3. Differences between sub-catchments

The following statistically significant differences (*p <.01)* based on sub-catchments were identified:

- Farmers in the Humbug sub-catchment (mean=3.43) had significantly more trust in the Kondinin Group than did those in the Mandagery (mean= 3.20).
- Farmers in the Humbug sub-catchment (mean=2.78) believed that ‘making a living now’ was more important than worrying about the farm’s long-term future (Mandagery; mean=2.41).

- Farmers in the Humbug sub-catchment (mean=4.05) scored significantly higher on the item '*when I know there is work to be done I don't get easily distracted*'' (Mandagery; mean=3.74).
- Farmers in the Mandagery sub-catchment (mean=3.46) were significantly more optimistic that the community would be doing well in 10 years than were those in the Humbug (mean=2.98).
- Farmers in the Mandagery sub-catchment (mean=3.50) were more concerned about environmental impacts on animals than those in the Humbug (mean=3.12).
- Farmers in the Mandagery sub-catchment (mean=3.75) were more concerned about environmental impacts on birds than were farmers in the Humbug (mean=3.38).
- Farmers in the Mandagery sub-catchment (mean=3.83) were more concerned about possible environmental impacts on personal health than were farmers in the Humbug (mean=3.43).

6.2.4. Differences based on agricultural qualifications

- Farmers with formal agricultural qualifications (mean=3.68) scored significantly lower than those without (mean=4.01) on the item '*when I know there is work to be done I don't get easily distracted'.*

6.2.5. Differences based on written farm plans

- A number of statistically significant differences (*p <.01)* were identified based on written farm planning. Those farmers who had written farm plans
    - had more trust in the Kondinin group than those without (means=3.64 and 3.17 respectively),
    - were more influenced by agronomists than those without (means=3.65 and 3.23 respectively),
    - were more influenced by the Kondinin group than those without (means=2.56 and 2.10 respectively),
    - were more concerned about environmental impacts on plants than those without (means=3.79 and 3.35 respectively),
    - consulted agronomists more often (means=3.65 and 3.35 respectively),
    - scored higher on measures of risk and innovation than those without (means=3.37 and 3.08 respectively),
    - had more of an internal locus of control than those without (means=3.65 and 3.20 respectively),
    - were more socially involved than those without (means=3.94 and 3.60 respectively),
    - were more optimistic than those without (means=3.70 and 3.38 respectively), and
    - were more concerned about environmental impacts because of consequences to humans than those without (means=4.03 and 3.67 respectively).
- Those farmers who did not have written farm plans
    - scored significantly higher on the item '*even without the drought making plans for more than the next season is a waste of time*' than those with written plans (means=1.94 and 1.50 respectively).

6.2.6. Differences based on farm size

Statistically significant differences (*p <.01)* based on farm size were identified for the following questions:

- *Trust in the Kondinin group for information of agricultural management;*
    - Those with farm sizes in excess of 1000 ha trusted the Kondinin group significantly more than those with 41 and 400 ha.
    - Those with farm sizes between 401 and 1000 ha trusted the Kondinin group significantly more than those with 101 to 400 ha.
- *Influence of agronomists;*
    - Those with properties in excess of 401 ha were influenced by agronomists significantly more than those with 101 to 400 ha.
- *Influence of Kondinin group;*
    - Those with properties in excess of 400 ha were influenced by the Kondinin group significantly more than those with properties between 40 and 101 ha.
    - Properties in excess of 1000 ha were influenced by the Kondinin group more than those up to 400 ha.
- *I am confident that my family will be farming in this area in 20 years;*
    - Those with properties in excess of 1000 ha were more confident than those with under 40 ha and also those with properties between 101 and 400 ha.
- *How confident are you that your property will be successfully farmed in 10 years time;*
    - Those with properties in excess of 1000 ha were more confident than those with up to 40 ha.
    - Those with properties between 41 and 100 ha were less confident than those with over 100 ha.
- *Do you consult an agronomist to help you with any of your farming activities;*
    - Those with properties in excess of 1000 ha were less likely to consult an agronomist than those with under 100 ha.
    - Those with between 41 and 400 ha were more likely to consult an agronomist than those with over 400 ha.

6.3. Comparisons between survey results in the Central West and Lachlan sub-catchments [4]

The Central West survey was administered in early 2007 and the Lachlan survey in early 2008. While there were different conditions evident, particularly with reference to the severity of the drought, it is possible to make some comparative comments based on the data collected in the two regions.

[4] There were a number of differences between the survey administered to those in the Lachlan sub-catchments to that administered in the Central West sub-catchments. The reason for these changes was threefold: (i) a range of differing contextual issues existing between the two catchments (and time periods) as identified in the Lachlan qualitative interviews; (ii) the adaptation of several measurement items based on responses to the Central West questionnaire; and (iii) different foci attendant with each stage of the PUTTI project (e.g. Social Network Analysis questions were not required for this component of the 3-year project). Accordingly, this section is comprised of only those questions common to both questionnaires.

6.3.1. Demographics

Age

As can be seen in Table 14, the range of ages represented in the Central West sub-catchments and the Lachlan sub-catchments were very similar.

Table 14 Age group comparison of Central West and Lachlan sub-catchment respondents

	Central West catchment (%)	Lachlan catchment (%)
Less than 24	1.5	1.0
25 to 34 years	6.4	6.7
35 to 44 years	16.7	22.3
45 to 54 years	25.3	25.7
55 to 64 years	28.5	25.0
65 to 74 years	17.7	16.3
More than 75 years	3.9	3.0

Farming activities

The main farming activities for respondents from both the Central West catchment and the Lachlan catchment indicated greater proportion of crop farmers among the Lachlan respondents, and a greater emphasis on cattle farming among Central West respondents.

Table 15 summarises average property size and the length of time spent farming in the area. Respondents from the Lachlan catchment had, on average, spent slightly longer in the area, and had substantially bigger properties, due predominantly to large properties in the Humbug.[5]

Table 15 Farming demographics - comparison of Central West and Lachlan sub-catchment respondents

	Central West catchment	Lachlan catchment
Average property size (ha)	577.0	1431.1
Average length of time farming in area (yrs)	22.3	29.2
Average length of time family has farmed in area (yrs)	59.3	69.4

[5] Property sizes for the Humbug sub-catchment respondents averaged 2440 ha.

Property and farm planning

As can be seen in Table 16, formal property planning rates between Central West and Lachlan respondents were similar.

Table 16 Property planning rates for Central West and Lachlan sub-catchment respondents

	Central West catchment (%)	Lachlan catchment (%)
Respondents with written property plan	29.7	26.7
Respondents with professionally assisted property plans	15.2	14.0

Stated reasons for not having a farm plan were similar between the two catchments, with *reliance on one's own experience and knowledge*, *responding to current weather conditions*, *adapting daily* and *taking advice from family members* the most common responses in both catchments.

6.3.2. Attitudinal variables

Trust in information

A comparison of responses to trust in the information provided by a range of sources yielded a high degree of similarity between the two catchments (see Figure 5). Overall, Lachlan respondents' trust ratings were slightly lower than the ratings of Central West respondents. An exception to this trend is the respective ratings for the CMA.

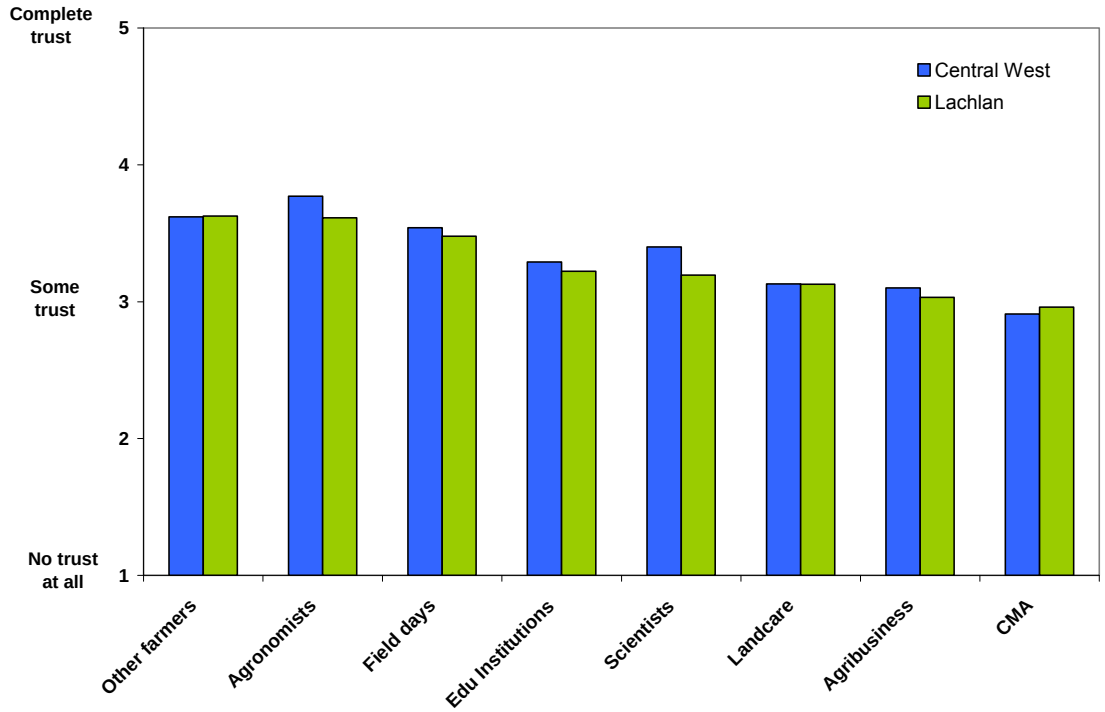

Figure 5 Comparison of trust ratings between Central West and Lachlan sub-catchment respondents

Influence of information

While a comparison of responses to the influence of information provided by a range of sources yielded high degrees of similarity (see Figure 6), Lachlan respondents rated the influence of several information sources notably lower than did Central West respondents; specifically, *Educational Institutions* and *Scientists*.

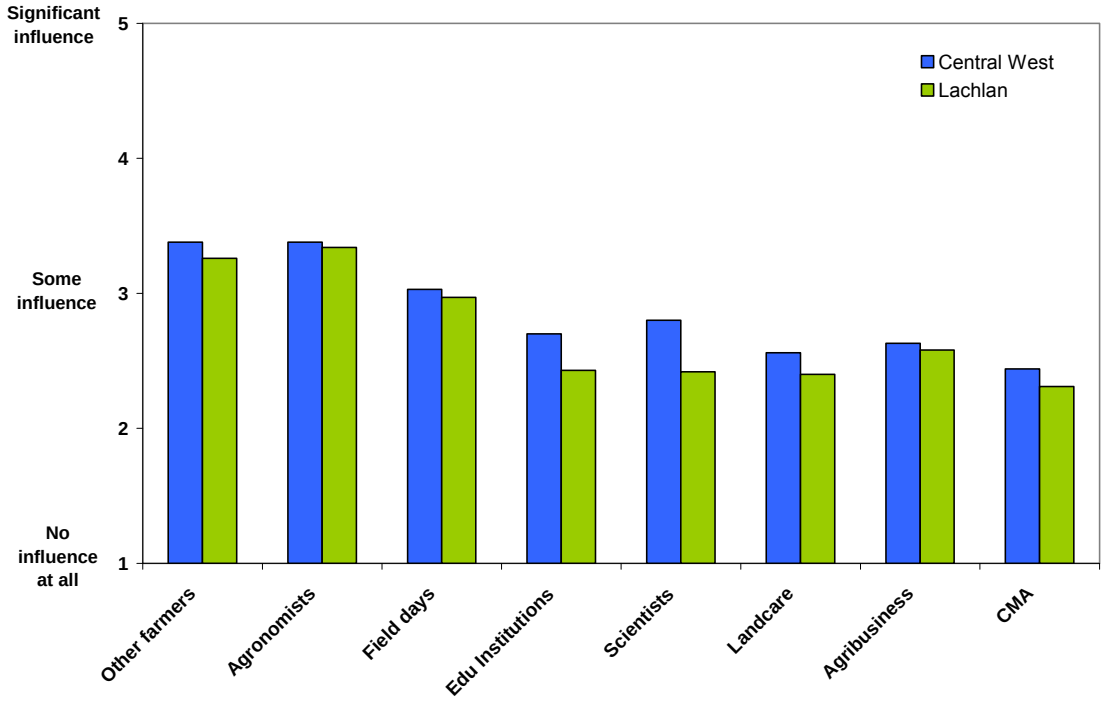

Figure 6 Comparison of influence ratings between Central West and Lachlan sub-catchment respondents

Social norm

Respondents in both the Central West catchment and the Lachlan catchment were asked to rate on a five-point scale how much they valued the views of other farmers in their community. A comparison of responses is presented in Table 17.

Table 17 Comparison of Central West and Lachlan sub-catchment respondents' value ratings of other farmers' views

	Central West catchment (%)	Lachlan catchment (%)
1 – no value at all	0.7	0.3
2 – little value	2.3	5.3
3 – some value	31.0	35.3
4 – a lot of value	45.9	47.7
5 – immense value	20.1	11.3
Mean rating	*3.83*	*4.00*

Again, responses in both catchments were similar, with both sets of respondents indicating a high valuation of other farmers' views.

Perceived environmental condition

Both Central West and Lachlan catchment respondents were asked to rate the environmental condition of their district and property in relation to a number of issues or characteristics (erosion, water quality, soil heath and weeds). A comparison of ratings is presented in Figure 7.

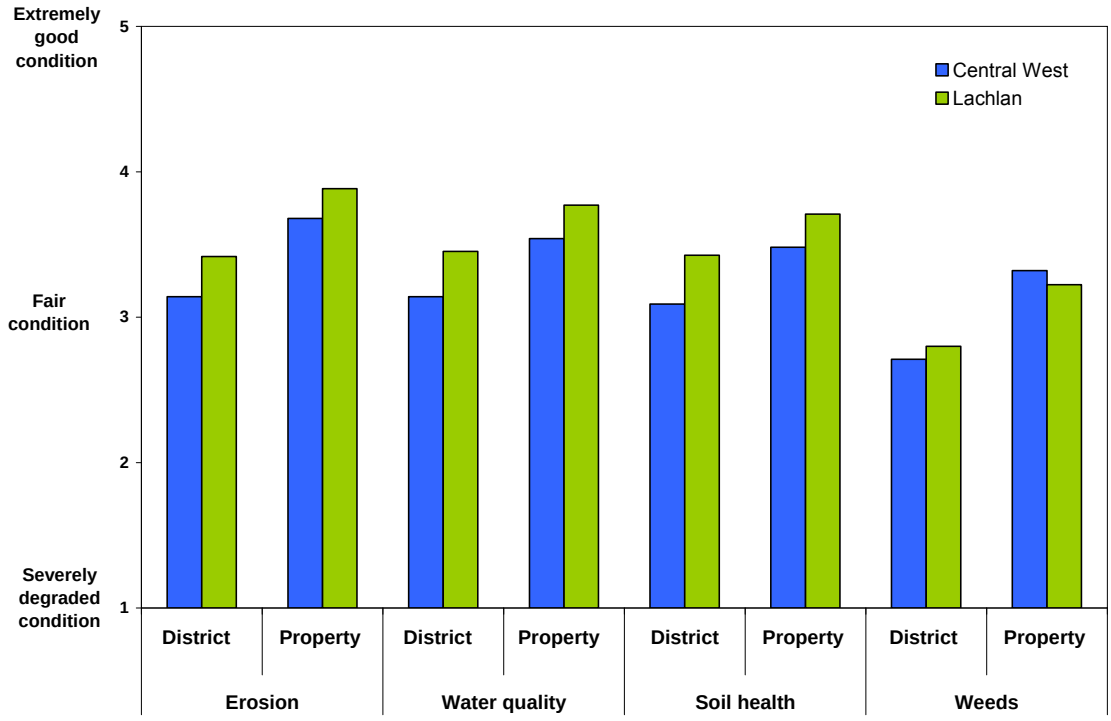

Figure 7 Comparison of perceived environmental conditions between Central West and Lachlan sub-catchment respondents

Figure 7 shows that respondents from the Lachlan catchment consistently rated environmental conditions for both their property and district higher than did respondents from the Central West catchment. The exception to this trend is the ratings given to weeds on respondents' properties, with Central West respondents rating conditions better than did Lachlan respondents.

6.3.3. Land Management Practice

Soil testing

Respondents in both the Central West catchment and Lachlan catchment were asked how frequently they tested their soil. Responses are outlined in Table 18.

Table 18 Comparison of frequency of soil testing between Central West and Lachlan sub-catchment respondents

Frequency	Central West catchment (%)	Lachlan catchment (%)
More than once a year	7.1	3.2
Every one to two years	38.2	64.8
Every two to three years	26.0	14.9
Every three to five years	26.8	14.9
Less than every five years	1.9	1.9

As Table 18 demonstrates, rates of soil testing were more frequent in the Lachlan catchment than in the Central West catchment.

Perennial pasture management

Respondents in both the Central West catchment and Lachlan catchment were asked whether any of their land was set aside for perennial pastures. Responses are outlined in Table 19.

Table 19 Comparison of Central West and Lachlan sub-catchment respondents' perennial pasture management

Land set aside for perennials?	Central West catchment (%)	Lachlan catchment (%)
Yes	79.9	79.0
No	20.1	21.0

As Table 19 demonstrates, rates of land being set aside for perennial pasture were similar for the two catchments.

6.4. Predicting land management practice in the Lachlan sub-catchments

An initial exploratory model to predict land management practice containing all the hypothesised variables was developed using Structural Equation Modelling. The analytical technique utilised was Maximum Likelihood Estimation, a statistically efficient method using all available information (Diamontopolous and Siguaw, 2000) using LISREL 8.72 software (Joreskog, Sorbom, du Toit and du Toit, 2008). As an initial step, all non-significant relationship pathways to the dependent variable (land management practice) were removed.[6] The variables removed during this initial step were as follows:

- Agricultural qualifications
- Farm size

[6] Note that non-significance here does not necessarily imply non-importance. It means simply that, *relative to the other variables in the model*, these variables did not contribute significantly (in a statistical sense) to improving the model's predictive power.

- Age
- Lifestyle
- Trust in science and technology
- Influence of the CMA
- Future planning and orientation
- Risk and innovation
- Motivation/Optimism
- Environmental focus
- Social involvement
- Business focus
- Perceived environmental degradation

The resultant estimated model can be seen in Figure 8 which shows the relationships between the latent variables (shown in the model as ellipses) and their respective indicators (shown in the model as rectangles). The model schematic reveals how well the indicators measure the latent variables. For example, *ATT24* is one of three attitudinal statements intended to measure Locus of Control. The value of the co-efficient on the path indicates how well the statement (*ATT24*) actually measures the concept of Locus of Control. Coefficients on these paths can range from -1.0 (i.e. a strong *negative* relationship between the latent variable and the indicator) to +1.0 (i.e. a strong *positive* relationship between the latent variable and the indicator). Each of the indicators included in the model were sufficiently reliable measures of the latent construct they were designed to represent (as demonstrated by the Cronbach's alpha scores of the scales presented in Section 6.1.7).

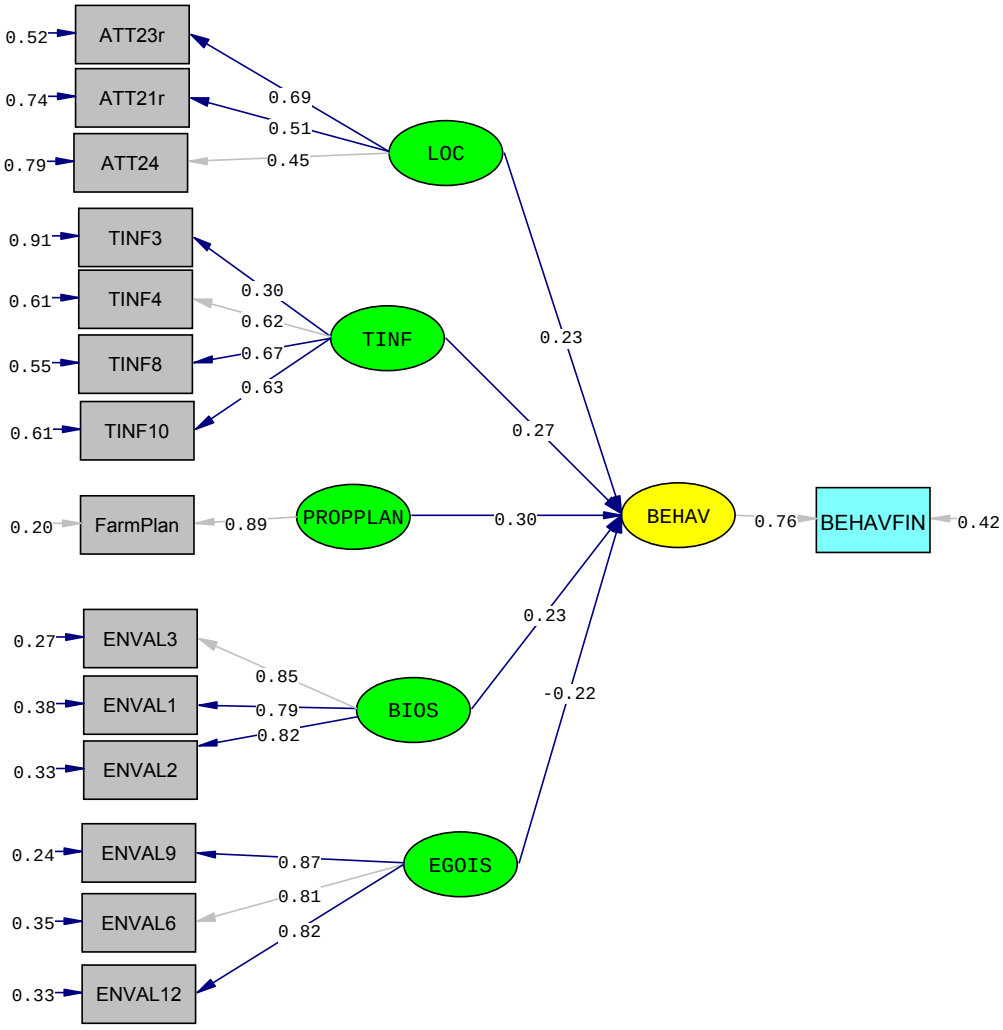

Figure 8 Estimated model predicting land management practice [7]

Table 20 shows the variable names as they appear in the Estimated Model (Figure 8) and the corresponding model component names. Descriptions of the model component variable names can be found in Section 4.1.

[7] Variable labels in the Estimated Structural Equation Model (Figure 8) are as they appear in Lisrel 8.72, and differ from the descriptive labels in the hypothetical model (Figure 2) and simplified model (see Figure 9).

Table 20 Variable names and descriptive labels for the Estimated Structural Equation Model (Figure 8)

Estimated Structural Equation Variable Name	Model Component Name
LOC	Locus of control—sense of being in control over decisions
TINF	Trust and influence scale
PROPPLAN	Property planning
BIOS	Biospheric environmental values – concern for environment as it effects native plants and animals
EGOIS	Egoistic environmental values – concern for the environment as it affects family and self
BEHAV	Land management practice

Figure 9 shows a simplified version of the behavioural model, showing statistically significant pathways and their respective strengths. Again, the coefficients between variables can range from -1 (a strong *negative* relationship) to +1 (a strong *positive* relationship). All of the variables contributed significantly and were of equivalent value.

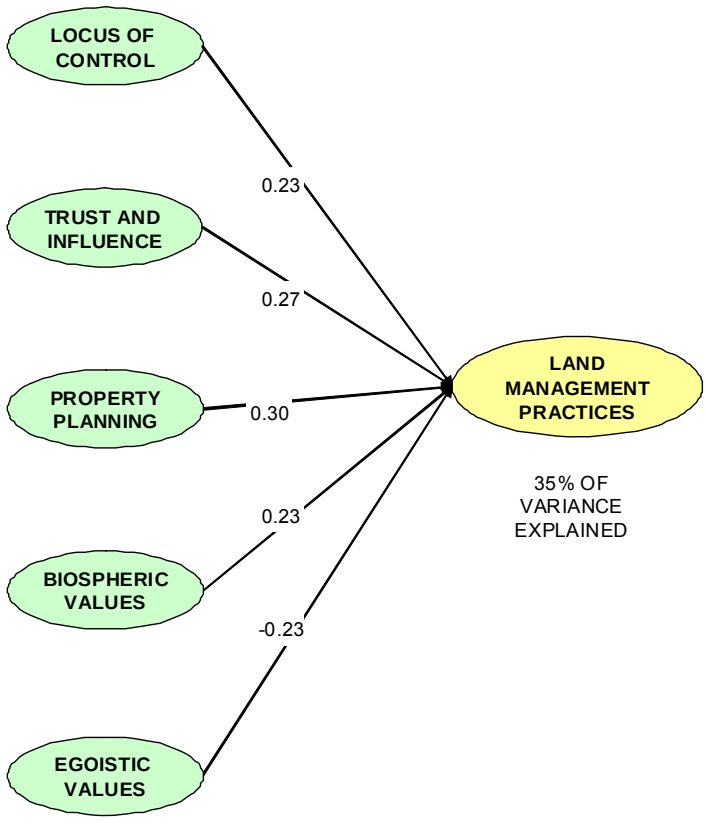

Figure 9 Simplified model of land management practice

The relationships shown in Figure 9 can be described as follows:

The following conditions lead to an increased likelihood of undertaking desirable land management practice:

- Increased trust in and influence of outside sources such as other farmers, scientists, field days and the Department of Primary Industries;
- Having an internal locus of control – the sense of being able to determine one's own actions;
- Having a formal property plan, created with the assistance of a professional;
- High biospheric environmental values - a value system that conveys concern for the physical and naturally occurring environment (such as native animals, birds and plants); and
- Low egoistic environmental values - a value system that conveys secondary or reduced concern about the impacts of environmental problems on family and self.

The model (Figure 9) accounted for 35% of the variance in land management practice and overall, goodness of fit indices were excellent (see Table 21). For an explanation of the Model Fit Indices, refer to the Glossary.

Table 21 Model fit indices for initial structural equation model

Fit Statistics	Obtained Value	Recommended Value
Chi-square (df)	88.61 (91), p=.17	$p > .05$
CFI	0.99	≥ .90
GFI	0.95	≥ .90
RMSEA	0.02	≤ .08

7. DISCUSSION

7.1. Preliminary results

A variety of dryland agriculturalists participated in the study, with a good mix of croppers, sheep and cattle farmers. Similarly, respondents represented a diversity of property sizes and on-farm experience.

While most respondents indicated that their main farming focus was ongoing maintenance and management, almost one-third were primarily focussed on matters outside of 'business as usual', such as expansion, downsizing or diversification. This indicates considerable variation in the current priorities of landholders and suggests that a 'one-size-fits-all' approach to incentive funding might not always be suitably aligned with the main concerns of landholders. Further, qualitative results indicate that the incentive funding offered by a neighbouring CMA might be regarded by some individuals as more relevant and appealing relative to their circumstances. Funding initiatives and programs that are flexible enough to address the express concerns of landholders may have higher subscription rates and be more successful. For example, a landholder who is downsizing is less likely to view a machinery conversion incentive as relevant, but is likely to need access to other types of incentive funding; while someone undertaking expansion activities may find the machinery conversion funding attractive.

Qualitative results indicate that formal written plans were difficult to follow or maintain in situations of drought because of the need for land-managers to react to extreme and unpredictable environmental conditions. This may explain in part why only a small number of respondents claimed to have formal property plans. Survey results reveal that a variety of methods, such as relying on existing knowledge and discussions with other farmers, were used in place of a formal property plan. The lack of more widespread use of formal property plans to achieve goals may indicate the impact of an increasing burden of paperwork involved and the lack of on-ground help available to prepare such a plan. Encouraging farmers who have experience in the preparation of formal property plans to share their knowledge with other farmers could be a mechanism to foster behavioural change.

7.1.1. Trust and influence

The survey reveals both low levels of trust in information from the CMA, and a minimal influence of this information on land management practice. Qualitative research participants indicated that the CMA was often viewed as a regulatory body, a perception which negatively influenced people's level of trust. Further, the qualitative research revealed some confusion as to how the CAP and its targets had been developed. Some participants questioned whether there was strong evidence demonstrating the benefits and utility of practice encouraged by the CMA.

By contrast, respondents showed relatively high levels of trust and influence relating to other farmers and agronomists. In fact, almost all respondents felt that other farmers' views held at least some value, again highlighting the importance and potential effectiveness of farmer-to-farmer communication and learning.

Overall, the results for trust and influence are consistent with findings from Stage 1 of the PUTTI program undertaken in the Central West catchment, suggesting that the findings are indicative of widespread attitudes. Mistrust and low levels of influence appear to be problematic for CMAs irrespective of locale. While trust in and influence of information from CMAs was low, almost half the respondents reported knowing someone in the CMA. Of these respondents, over half felt that their relationship with CMA staff had informed their agricultural practices. These findings suggest that existing relationships between the CMA and the community need to be promoted and fostered. Future communication strategies that

focus on face to face interactions and on-ground assistance to help increase trust and influence could also be developed.

Another interesting finding concerns the relatively high trust, but relatively small influence of information presented at field days. One possible explanation for this discrepancy could be that people are most likely to attend field days hosted by farmers they already know and trust. However, other factors are likely to influence or inhibit their uptake of practices promoted during these events.

While only a third of respondents had recently attended an agricultural course, the majority of these respondents reported that they found the course helpful and that it had changed the way they do things on their property. While this is a promising sign, it may be that these courses are not attracting some landholders because their current priorities rule out attending or because their properties are at a stage that is not compatible with the course on offer.

7.1.2. Optimism, locus of control and risk

Results concerning levels of optimism appear mixed. Almost half of the respondents felt that their family would be not be farming in the area in 20 years time. This perhaps reflects a sense of despondency regarding their current circumstances and a perceived lack of ability to influence their future. Both issues emerged in the qualitative research phase. It appears also that this is more than simply a pre-occupation with short-term goals. Over half of the respondents disagreed with the statement that making a living from their farm now was more important than worrying about the farm's long-term future. However, respondents expressed moderate confidence that their own properties and the wider community itself would be doing well in a decade's time (though it should be noted this confidence was more marked in the Mandagery than in the Humbug). While respondents appear unsure of their own long-term (20 year) future in the area, their moderate expression of optimism for the nearer term (10 year) future suggests that people believe there are actions that can be taken to secure the future viability of farms and the community. Individual landholders feel unable to undertake personal actions to secure their longer term future in the region.

Attitudes towards risk also yielded mixed results. While there was widespread acceptance of the concept that one has to be prepared to try new things in farming to get ahead, responses to other questions suggested a far more cautious attitude toward innovative production methods. Responses to risk statements suggest that, while their may be some 'in principle' support for alternative land management techniques, their uptake and practice will take time and effort to establish in an atmosphere of risk aversion and hesitant receptivity.

7.1.3. Land management practice

The open-ended questionnaire items, along with qualitative results, reveal that land-managers are undertaking desirable land-management practice for a variety of reasons. In addition to explicit ecological motivations, a combination of pragmatism, self-interest and business motivation appear to drive the uptake of many land management practices that have positive environmental outcomes. For example, the most common response given by respondents for having native vegetation on their properties, was 'for shade or shelter'. In such instances, improved environmental conditions may be a secondary effect arising from more practical and immediate drivers.

7.2. Modelling land management behaviour

The social and psychological drivers identified during this stage of the PUTTI project were able to predict 35% of the variance in the land management practice of landholders. Given the diversity in farming activities and the biophysical differences in these sub-catchments, the

variance explained is substantial. It represents a significant refinement in the predictive ability of the model from Stage 1 of the PUTTI project.

This research has indicated a profile of a land manager whose attributes, values and reported behaviours support sustainable land management practices. The key features of these land managers are as follows:

- Having a written property plan – particularly plans created with the aid of a professional/consultant;
- Seeing themselves as being in control of their circumstances (having an internal locus of control);
- Having trust in and being influenced by their peers and informed groups (such as other farmers, scientists, agronomists, Department of Primary Industry);
- Possessing a value system that conveys concern for the physical and naturally occurring environment (such as native animals, birds and plants); and, interestingly,
- Possessing a value system that conveys secondary or reduced concern about the impacts of environmental problems on family and self.

The findings highlight the importance of having formal property planning. While this is encouraging, it should be kept in mind that individual personality differences are likely to contribute to the likelihood that people will use a property plan. Methods to encourage property planning need to take into account these individual differences.

Findings from qualitative research suggest that the components of 'locus of control' and 'trust in and influence of sources of information' variables are interrelated. Results imply that people require self-confidence to take on new ideas, and that the impetus to try something new is largely reliant on strength of belief in one's self. This is consistent with Duram (1997), who states that the breadth and range of sources of information and views on agriculture can act to narrow or expand a farmer's theoretical, or perceived, range of choices. Discounting different sources of information can restrict one's perceived choices, leading to a sense of lack of control over one's circumstances.

The modelling indicates that egoistic values are negatively related to sustainable land management practices. Egoistic environmental values are characterised by concern over how environmental sustainability potentially impacts on the individual and their family. This may reflect the underlying tension between environmentally sustainable practices and those which are socially and economically sustainable in terms of family livelihoods and community cohesion. The concept of attending to the more immediate and primary human needs (such as procuring sufficient food, water and safety for one's family) before other imperatives (such as self-development and fulfilment) is robust and widely supported in social science literature (e.g. Maslow's Hierarchy of Needs; see Mischel, Shoda & Ayduk, 2007)

In order to encourage more environmentally sustainable practices it may be necessary to consider the social sustainability of farming families and communities. Landholders must be able to satisfy basic needs for themselves and their families before they can entertain less pressing needs, such as feelings of self-worth and the formation of positive identities. It may be more important for landholders to be a good parent or good community member than it is to be a 'good' farmer, as these things satisfy immediate needs for security and belongingness rather than less tangible needs for self-fulfilment.

8. RECOMMENDATIONS

The systematic behavioural research activities in the Lachlan, including the qualitative interviews, the behavioural survey and analysis and resultant model of land management practice, provide a rich conceptualisation of the nature of dryland farming in the study area and the constraints under which individuals and the broader community operate. The following recommendations are made as a result of the major findings in this report and the subsequent discussion with the Lachlan CMA and the project Coaching Committee.

8.1. Key research findings informing the recommendations

1. Local community structure is an important aspect of information dissemination, particularly the informal information pathways within and between families and with other farmers in the community. Data from the qualitative interviews conveyed the critical role that peer based learning currently plays within the catchment. For instance, farmers commented on the value and importance of engaging with other farmers in the region for advice about issues such as farm management. Survey findings confirmed this assertion where respondents reported the greatest degree of trust in other farmers. Further, other farmers and agronomists were the most influential sources of information. The role that farmers serve for each other exemplifies a vital pathway in which information flows. Informal interaction such as conversations at the local pub or at field days not only provides farmers with a support system, but also a sounding board to discuss their agricultural practices.

2. CMA targets and recommendations have filtered into the farming communities via informal information networks. Conversations and interactions within the community are creating informal learning structures where farmers are learning from each other about sustainable land management. However, the information exchange has yet to translate into significant behavioural change. This highlights the need to recognise that change takes time, particularly during times of adversity, and to support and develop these interactions in the future.

3. Farming is perceived as risky, particularly in the short term. There is a degree of apprehension in some farming circles in instigating change in farming practices and an aversion to risk taking. A pre-disposition to risk taking behaviour, however, may not account significantly for the uptake of desirable land management practice. It was commonly reported that some farmers watch and learn from other farmers prior to making a change to their own farming practices. Hence, it appears that modelling of sustainable practices by other farmers in their community may provide a means of reassurance for them to contemplate a change in their own behaviour. This process reduces the anxieties or risks that might be associated with changing from their current or traditional farming activities. Field days and demonstration sites provide useful ways of introducing and promoting innovative methods; adoption at the farm scale is the goal. Landholders need to be convinced that a change (a potential risk) to their current farming practices will provide benefit on their property. Some have a mindset consistent with the expression ‘if it ain’t broke, don’t fix it’. Change is only likely to occur if there is evidence in the community that apparent risk and perceived benefit is manageable and that in the long term, potential benefits will outweigh potential costs.

4. It is necessary to develop change strategies that compliment or ‘fit into’ the way that farming communities currently change. Doing so reduces the anxiety or confrontation associated with introducing new farming technologies or practices. Such principles need to recognise that nothing is sustainable if it is imposed. Even if a target is consistent with the local farming culture, farmers will still vary in their ability, capacity and environmental

awareness. The heterogeneity in the farming community in terms of their needs and their environmental awareness means that targeted activities will need to be multilevel.

With these research messages in mind, it is necessary to recognise the complexity of the current farming context when considering the on ground implications. In particular, that farming is inherently risky and becoming increasingly so – drought conditions, climate variability and downward trending market prices are overt examples of the issues facing the farming community. Furthermore, in some areas of the catchment, such as the Mandagery, farming may be more often thought of as a business enterprise, while in other areas, like the Humbug, a family farming paradigm might be more apparent. This distinction is significant and introduces an additional layer of complexity when considering change.

The most effective means of creating sustainable change within a community is to support and supplement existing resources and harness these in a way that is acceptable to the local community – particularly in terms of ensuring community ownership and a process of change that complies with the community's value system.

8.2. Recommendations

1. **That consideration be given to modifying CMA incentive funding mechanisms and application formats.** There is currently too much paperwork required for the incentive program. Application forms could be rationalised. It may be beneficial to direct efforts into building the capacity of farmers to complete the necessary paperwork, or into developing and supporting services that provide this function for farmers. The current funding mechanisms, including application forms, may inadvertently be a disempowering process for some farmers who find the additional burden of paperwork stressful and detracting from core-business activities; find the rhetoric used confusing and often only relevant to people with university backgrounds; and who find that the process of 'jumping through hoops' further undermines their autonomy and dwindling level of control over their own circumstances. As such, the empowerment potential of receiving incentive funding is potentially undermined by the process of applying for it. Furthermore, there are equity considerations associated with the level of education that the current application forms are directed towards, as those who most need the support are often unable to 'use the right words' to secure funding.

2. **Improve communication about CMA incentive funding mechanisms.** Consideration should also be given to the way in which the CMA communicates their funding incentives. Some farmers are not aware of the opportunities available until it is too late. Also, there may be a false assumption that landholders are aware of the process that is required. Therefore, a variety of strategies may be necessary to communicate information about incentive programs, particularly those aimed towards the majority of land-managers that are not yet engaged in CMA sponsored activities. CMA communications could also be mindful of the variety of reasons farmers undertake desirable land management practices, and attempt to appeal to different people on different levels. This may involve emphasising the pragmatic or economic benefits of environmentally focused land management practices. For instance, it may be beneficial to encourage retention of native vegetation to provide shelter and shade for stock, as an additional (and for some, more important) benefit on top of the environmental outcomes.

3. **Increase collaboration between CMAs regarding the focus of incentive funding.** Each CMA is perceived to maintain a focus on different specific issues relating to land management practice. While this may be entirely appropriate given the assessments made through the prioritisation processes undertaken by the CMA's, the prioritisation process itself does not appear to have been communicated to landholders. Some land managers feel that the specific focus and incentive programs of the CMA in which they are located is not as relevant to their individual circumstances as the focus of their

neighbouring CMA. This is a source of frustration for some and regarded as further evidence of bureaucratic 'red-tape'. Increased dialogue between CMAs regarding the loosening of artificial boundaries between catchments may be beneficial. Likewise, addressing the confusion associated with geographic targeting of incentive programs may also be of use.

4. **Package incentive programs to suit differing landholder intentions and skills.** The incentive programs could be designed to recognise and capitalise on individual differences between farmers with regards to the following: existing skill base; landholder intentions or focus (e.g. expansion, diversification, downsizing); and, farm type and size (so that smaller properties, or those engaged in niche industries, are also considered). The incentive program could be specifically tailored to cater for the differences and designed to introduce change incrementally. A 'one size fits all' approach to incentive funding acts as a barrier to adoption. The types of funding available could be more clearly signposted so that landholders can identify where they are on the path, or continuum, of farm development, and then decide on the appropriate incentive funding to apply for and the degree of personal investment to make. This may involve breaking down incentives according to property size and type, landholder focus and so on. By acknowledging farmers' pre-existing skills the CMA may be better able to enable them to be their own agents of change.

5. **Ensure that incentive funding appeals to a broad range of motivations.** Just as the incentive program should be appropriate for a range of stages in farm development, so incentive funding should cater for lifestyle and other personal priorities. This may be achieved by emphasising some of the more pragmatic benefits that CAP targets might deliver to the landholder.

6. **Make the CAP document more accessible.** The current CAP document is too long, too technical and provides no guidelines as to what the high order strategies mean on ground. A more easily understood or summary version is required that identifies and describes the issues at the local or property level.

7. **Recognise and leverage the value of the CMA as a resource in itself.** Landholders benefit from friendships and informal associations with CMA staff. They recognise the value of property visits and on ground consultations by experienced CMA staff. While recognising that the CMA staff are under considerable pressure, there may be ways of capitalising on the high regard that landholders have for them. Conversely, they are less inclined to listen to inexperienced staff members. It is acknowledged that this may be problematic from a resourcing viewpoint.

8. **Reinforce the message that behaviour change takes time.** The critical nature of informal information networks should be acknowledged. More use can be made of these informal networks to disseminate the CMAs messages and programs, and to support, encourage and recognise incremental positive change.

9. **Use informal networks as a mentoring opportunity.** The utility and value in informal information networks were consistently reported and marks the potential for pre-existing social structures to be opportunistically utilised.

9. FUTURE DIRECTIONS

The recommendations provide a framework for considering how change can be targeted in the Lachlan and Central West catchments. It is recognised that there are constant and substantive resourcing issues associated with implementing some of these recommendations. Adopting a social learning program, such as The SLIM[8] program (see below), has potential for creating change. It involves recognition of the interdependencies of human and ecological systems, complexity of natural and human systems, and uncertainty and social controversy of interventions. This model requires good local knowledge, transparency and trust of agencies and government. All of this requires close working partnerships between communities and agencies in which all partners are treated with respect and awareness that their constraints and opportunities need to be addressed equally. With this supposition in mind, two possible and complimentary models of change are discussed.

9.1. Social learning

Social Learning Theory has been growing in adoption, particularly within natural resource settings, and capitalises on the complexity of managing people and resources simultaneously and holistically. This move towards holistic approaches is due in part to a paradigmatic shift in government and community recognition of the role that people play in, firstly, the emergence of natural resource issues, and secondly, in response to what people can do to address these issues. This represents a shift from hard to soft systems thinking in how we conceptualise natural resource issues (Blackmore, 2007).

A central tenant of the approach is creating an environment for change that is non-confrontational, non-coercive, reflective and responsive to the participants. This is becoming increasingly important, particularly in natural resource management as we move towards an approach that is not theory and/or practice, but *praxis* – a combination of both. Significantly, social learning is not a process of people imitating each other; rather, it is a collective learning process through concerted action (Ison, Roling & Watson, 2007).

There has been wide spread application of the principles of Social Learning Theory in the development of management plans and strategies. Its underpinnings are steeped in a myriad of theoretical perspectives regarding knowledge, learning and the process of knowing (Blackmore, 2007) which date back to the 1940s, demonstrating its robustness. A widely recognised international example of its adoption is in the SLIM Project (Social Learning for Integrated Management and Sustainable Management of Water at the Catchment Scale). The SLIM team have drawn on individual and international examples of programs that capitalise on people teaching each other. An example from a Western Australian Landcare Group conveyed how significant the *process* of learning was to the overall outcome (Ison, Roling & Watson, 2007; Blackmore, 2007; Ison, Steyaert, Roggero, Hubert, & Jiggins, 2004).

9.2. Cooperative learning

Cooperative Learning approaches are based on the principles that through supporting our peers we are also supported, and that learning from our peers makes for a more contextually appropriate and responsive forum. Significantly, there is recognition of a common problem, and an exchange of mutual support and experiential knowledge which is mutually beneficial (Lawrence, 2001). Consequently, as peers work together, the knowledge base of the community grows.

[8] SLIM refers to the Social Learning for Integrated Management program (Ison, Steyaert, Roggero, Hubert and Jiggins, 2004).

Planned change can only be effective if new demands are not placed on farming communities; rather, change needs to be integrated into the lifestyles and demands of farmers. An effective way this can be achieved is through using pre-existing social processes and resources. Furthermore, enhancing and supporting current social change mechanisms within the farming community makes for a less confronting means of introducing new farming technologies or practices. This is important as many farmers are conservative in their farming practice, risk averse and often have few resources and time to create change. Cooperative Learning provides a potential space for change within the farming community to occur.

There is an opportunity for the CMA to capitalise on pre-existing informal information networks by using these flows as a way of communicating and reinforcing Catchment Targets articulated at the local level. The behavioural modelling presented in this report has provided a means of recognising landholders who are most likely to be 'sustainable' land managers. The attributes associated with the profile suggest that such farmers are most likely to be the first in the catchment to adopt sustainable farming practices – based on their internal locus of control, and pro-environmental value system. This poses a potential avenue for actively engaging and encouraging willing farmers as mentors in cooperative learning.

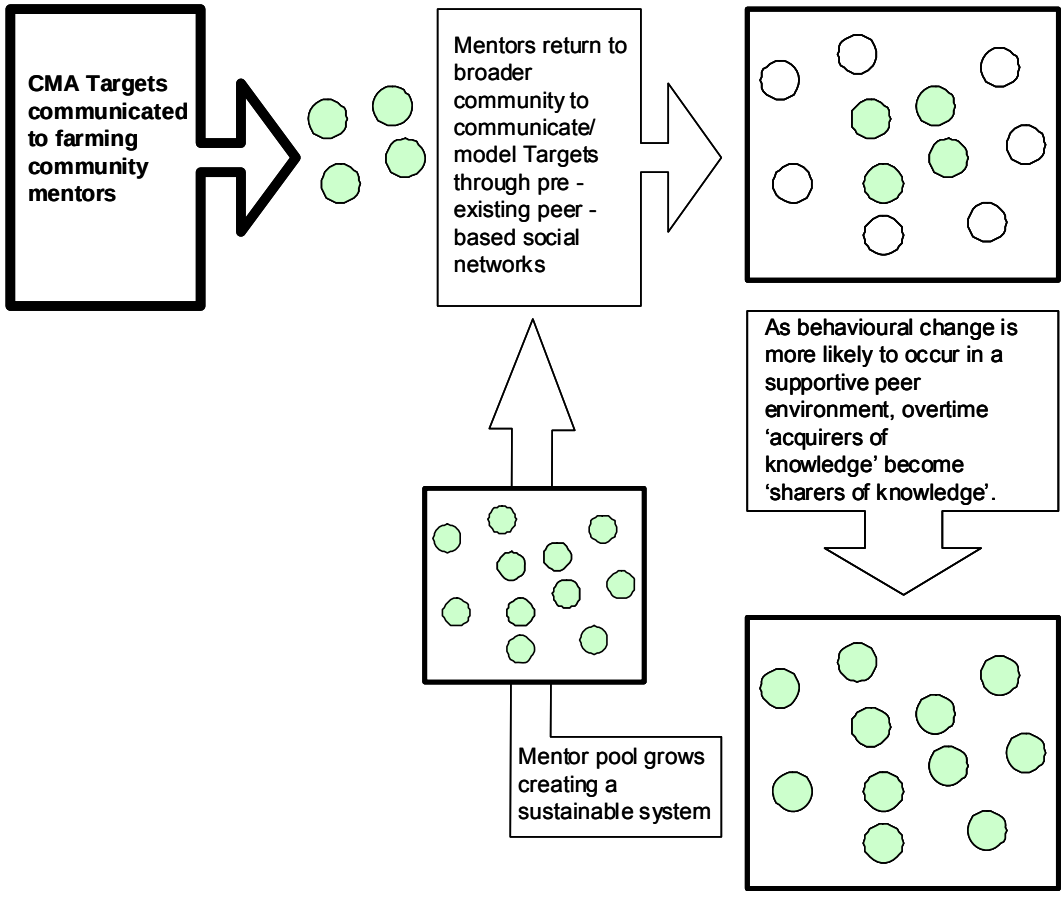

Figure 10 Cooperative Learning Model

Thus, while the CMA provide the initial direction in terms of targets for the catchment to 'Sustainable Land Managers', the relationships that emerge between farmers and the CMA are mutually supportive and engaging (see Figure 10). The impacts of such engagement are seen in an increased sense of value and purpose, increased sense of social support, a shift from passive to active participation and ability to engage in change (Lawrence, 2001). These internal processes also make for a sustainable mutual learning space whereby farmers can move from being the 'acquirers of knowledge' to becoming 'sharers of knowledge'. In time, this makes for a sustainable knowledge exchange system, and a more resilient, engaged and adaptive community.

APPENDIX A

OVERVIEW OF PUTTI PHASE 1: CENTRAL WEST NSW

Overview of Past Research (Central West Phase)

The first phase of the 'Partnerships and Understanding Towards Targeted Implementation' (PUTTI) project commenced in the Central West Catchment of NSW in June 2006 (Figure 11). This research comprised of three stages:

1. *Scoping Study* - interviews were conducted with landholders/ agribusiness to understand attitudes, beliefs and values relating to farming practices and decision-making.
2. *Community Survey* - a survey of landholders was conducted to further clarify/ identify factors driving farming practices and decision-making.
3. *Partnered Change* - a change program will be developed in 2008, in partnership with the Bell and Cudgegong communities, that addresses the drivers identified in Stages 1 and 2.

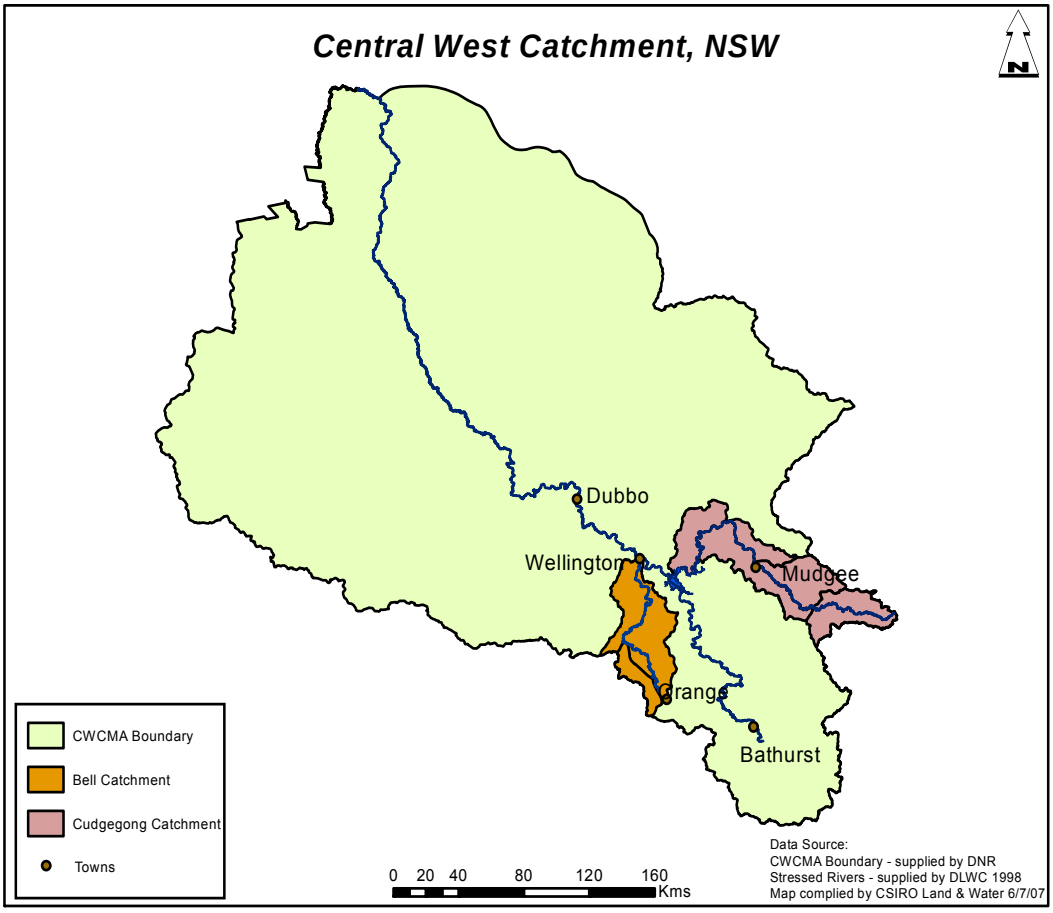

Figure 11 Bell and Cudgegong sub-catchments of the Central West Catchment

Overall, this research aimed to further our understanding of the features and context of land management practices at a farm based level, so that catchment management can better reflect and address the drivers of decision-making at the individual property level. A hypothetical model of decision-making in regards to land management practice was developed and tested through 79 face-to-face scoping interviews and delivery of a telephone survey to 407 landholders in the Bell and Cudgegong sub-catchments of the Central West

Catchment, New South Wales. The resultant Central West model of factors influencing land management practice was developed from the analysis of survey results and is presented in Figure 12.

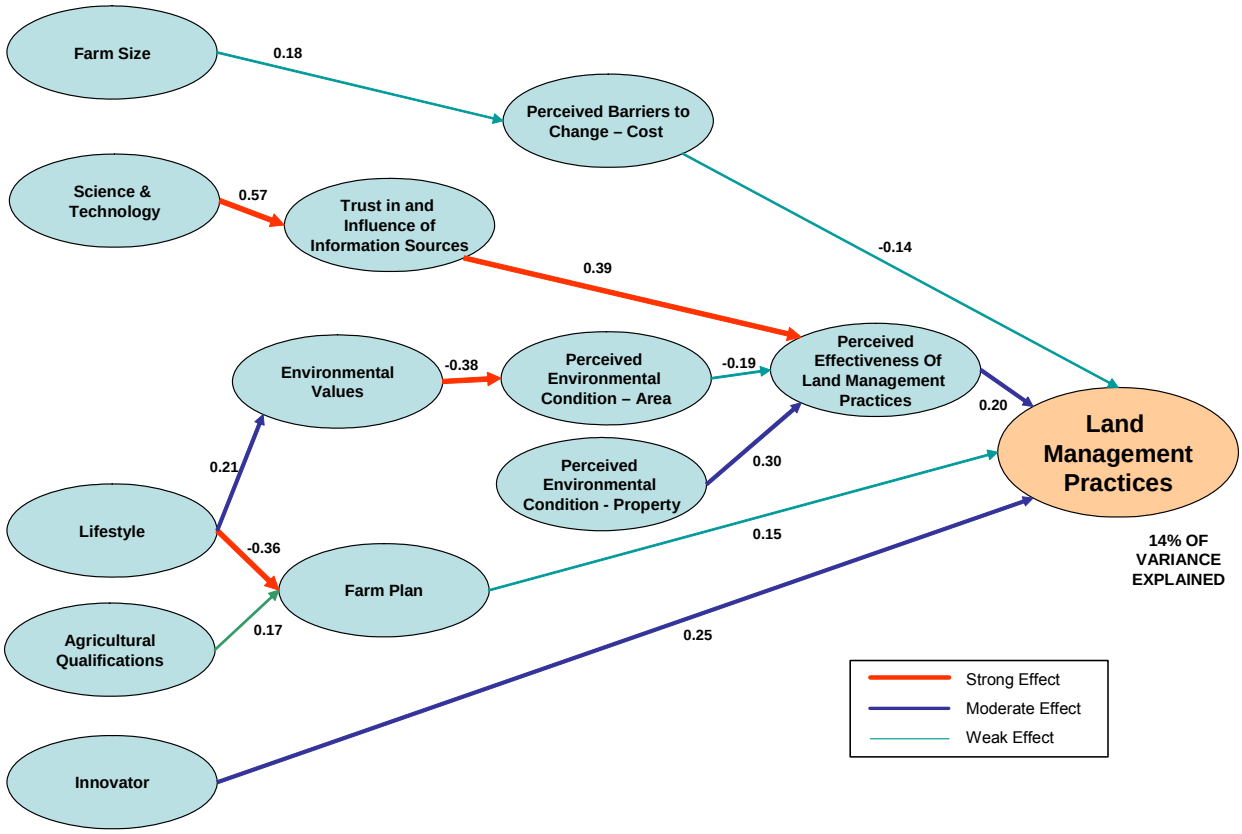

Figure 12 Resultant Central West Model for Land Management Practice

The findings suggested that there are several determinants of whether a range of desirable land management practices are likely to be undertaken, including the following:

- the reported level of innovation with which farm management is approached;
- the level to which financial cost is seen as a barrier to certain practices;
- whether properties are operating under a formal written farm plan; and
- the perceived effectiveness of specific land management practices.

Other influences on land management practices included considerations of lifestyle, environmental values, attitudes towards science and technology, the presence of agricultural qualifications and perceptions of the environmental condition of both individual properties and the surrounding area. Conversely, levels of engagement with the community, succession planning and social influences were found to have relatively little influence over land management practice.

There were several other findings that were of interest. Firstly, large differences in trust levels for sources of information were revealed – most notably, high levels of trust in agronomists and other farmers, and relatively low levels of trust in the local CMA. Also, there were very few differences in responses between the two sub-catchment areas. This consistency suggests that the findings of the Central West study could be generalised to the larger dryland farming population.

The following recommendations resulted from the first phase of the PUTTI project:

- refinement of survey measures for future surveys;
- to develop a greater understanding of Farm Plans;
- to develop an understanding of trust to better utilise currently trusted sources of information and to build trust in key organisations where it is lacking;
- to develop an understanding of the components that make up an innovator to better focus incentive and communication programs;
- to develop a communication program to address attitudinal change; and
- to investigate ways to better focus the Incentives Programs to meet the needs of both the CMA and the farmers.

In conclusion, it was noted that in order to achieve these recommendations, the Project Team and the CMA should work together, as progress made on all of the above recommendations will provide valuable information to develop appropriate directions.

APPENDIX B

PROJECT INFORMATION SHEET USED FOR THE PUTTI PROGRAM

Communities working together for sustainable landscapes

PUTTI is a three-year collaborative project between Catchment Management Authorities (CMAs), landholders, the broader community and researchers at the CSIRO. The project started in July 2006 in the Central West catchment area where we continue to work. Now, in our second year, we are extending into the Lachlan region with a focus on the Mandagery and Humbug sub-catchments. During our third year, we will broaden out into another catchment with significant areas of dryland farming.

The aim of the project is to work together to reach a better match between landholder and broader catchment management priorities. Current catchment management targets are formulated on the basis of the authority's considerations of "good" farm management practices. However, farming practice is underpinned by experience, local understanding and local knowledge about the environment that is shared by landholders and others in the community. It comes from many years of living and working in the area.

The Catchment Management Authority offers a range of incentives through investment programmes to help landholders and others meet the targets outlined in the Catchment Action Plan. Examples of investment programmes include perennial pasture establishment, conservation farming machinery conversions, and erosion control. However, these programmes may not mesh well with what landholders think is best for their farms. Therefore "good" land use practices at the catchment level will need to include what is also good for the farm.

Because many factors affect the way landholders manage their farms, we would like to better-understand what matters to them and what influences their farm management decisions. We aim to use what we learn to improve the exchange of information between landholders, others in the community, catchment managers and researchers to take full advantage of all types of information and ensure it is useful. This project will firstly be seeking input from landholders about:

- what works well on their farms
- how their farms affect the local environment (and vice versa), both locally and at a regional scale
- what they need to know and what they want others to know
- how current incentive programmes can be improved.

We expect that this project will help make land management targets more achievable, and help guide scientists and catchment managers to improve the usefulness and delivery of information.

APPENDIX C
ADDITIONAL RESULTS

Table 22 Farm ownership and management

Number of properties	How many properties do you have? (n = 300)	(%)	How many properties do you actively manage under agricultural production? (n = 300)	(%)
0	/	/	1	0.3
1	167	55.7	158	52.7
2	61	20.3	56	18.7
3	34	11.3	40	13.3
4	17	5.7	18	6.0
5	9	3.0	15	5.0
6	4	1.3	4	1.3
7	5	1.7	6	2.0
8	2	0.7	1	0.3
12	1	0.3	1	0.3
	Mean = 2.0	*Std. dev. = 1.5*	*Mean = 2.1*	*Std. dev. = 1.6*

Table 23 Responses for what was used in lieu of a written property plan

What do you use instead of a property plan	Responses	Percentage of respondents
Common sense / own brain / own knowledge	105	47.9
Experience	40	18.3
Consultation/ discussion (inc. family, other farmers, employees)	35	16.0
Adapt daily - it changes	27	12.3
Adapt according to weather conditions	24	11.0
Continue practices undertaken in the past	21	9.6
Annual calendar / seasonal calendar	18	8.2
Written diary records	15	6.8
Unwritten goals/ future plans	12	5.5
Mapping (computer assisted/ aerial/ overlays)	12	5.5
Knowledge from other farmers	7	3.2
Instinct	7	3.2
Crop rotation history	5	2.3
Observation	5	2.3
Drought ruined plan	4	1.8
Own budgets / financial records	3	1.4
No insecticides / herbicides	3	1.4
No time for a written property plan / no need	2	0.9
Refer to journals	1	0.5
Guess work	1	0.5
Land use to suit the market	1	0.5
Photographs	1	0.5
Luck	1	0.5
Survival	1	0.5
	351	**160.3**

Table 24 Common impacts that agricultural courses have made to respondents' property management

Difference made by agricultural course	Responses	%
Improved safety awareness/ practices (OHS & Chemical course)	13	11.6
Improved soil condition (better practices, less disturbance, increased soil knowledge)	12	10.7
More sustainable landuse / Holistic approach	11	9.8
Improved pastures/ pasture input	10	8.9
Improved fertiliser knowledge (inputs/ types/ results)	9	8.0
Generally improved farm planning and management	8	7.1
More profitable land use	7	6.3
Better understanding of stock food quality / quantity	6	5.4
Putting drought lotting into practice	4	3.6
Improved native vegetation management	4	3.6
Stock rotation for better breeding	3	2.7
More efficient product selection	3	2.7
Use of direct drilling	3	2.7
Stubble retention	3	2.7
Selling stock earlier	2	1.8
Access to new technology	2	1.8
Knowledge in wool classing	2	1.8
Retaining weeds/ less weed control	2	1.8
Knowledge about growing vines	1	0.9
Grazing for Profit: better insight into land management	1	0.9
Invested in more equipment	1	0.9
Larger paddocks resulted in fitter stock	1	0.9
Different mix of stock	1	0.9
Received funding	1	0.9
Eroded areas fenced off	1	0.9
Change in farm output	1	0.9
Total	**112**	**100**

Table 25 Trust in sources of information

	No trust at all		Some trust		Complete trust	Mean	Std. Dev.
	(%)	(%)	(%)	(%)	(%)		
Other farmers (n=299)	1.3	8.0	34.1	39.8	16.7	3.63	0.90
Agronomists (n=297)	3.4	8.1	26.3	48.5	13.8	3.61	0.94
Field days (n=297)	3.0	11.1	31.6	43.4	10.8	3.48	0.93
DPI (n=298)	4.0	6.7	41.6	38.3	9.4	3.42	0.90
Kondinin group (n=246)	11.8	11.0	26.8	35.0	15.4	3.31	1.21
Edu Institutions (n=292)	5.5	10.6	46.6	30.8	6.5	3.22	0.92
Scientists (n=294)	5.4	16.3	39.8	30.3	8.2	3.19	0.99
Landcare (n=288)	9.0	16.0	35.4	32.3	7.3	3.13	1.06
Agribusiness (n=295)	5.8	20.0	44.4	25.1	4.7	3.03	0.93
CMA (n=281)	12.5	14.9	40.6	28.1	3.9	2.96	1.04

Table 26 Influence of information sources

	No influence		Some influence		Significant influence	Mean	Std. Dev.
	(%)	(%)	(%)	(%)	(%)		
Agronomists (n=295)	10.8	10.2	26.8	38.3	13.9	3.34	1.17
Other farmers (n=298)	7.0	13.8	34.9	34.6	9.7	3.26	1.04
Field days (n=295)	10.8	20.0	38.0	24.1	7.1	2.97	1.08
DPI (n=296)	16.2	22.6	37.5	19.9	3.7	2.72	1.07
Agribusiness (n=295)	18.6	27.5	33.9	16.9	3.1	2.58	1.07
Edu Institutions (n=291)	23.4	28.2	33.0	12.7	2.7	2.43	1.07
Scientists (n=294)	27.6	24.1	30.3	15.0	3.1	2.42	1.13
Landcare (n=289)	28.0	26.0	26.6	17.0	2.4	2.40	1.14
CMA (n=283)	31.4	24.4	27.6	15.2	1.4	2.31	1.11
Kondinin group (n=266)	38.0	20.3	24.8	14.3	2.6	2.23	1.18

Table 27 Perceived environmental condition

	Severely degraded condition		Fair condition		Extremely good condition	Mean	Std. Dev.
	(%)	(%)	(%)	(%)	(%)		
Soil Health							
District (n=300)	2.7	6.7	42.7	41.3	6.7	3.43	0.82
Property (n=300)	0.3	4.7	31.3	51.0	12.7	3.71	0.76
Weeds							
District (n=300)	7.3	28.7	41.7	21.3	1.0	2.80	0.89
Property (n=300)	3.7	17.7	36.7	36.7	5.3	3.22	0.93
Water Quality							
District (n=299)	3.3	10.7	35.8	37.8	12.4	3.45	0.96
Property (n=300)	2.3	5.3	24.3	49.0	19.0	3.77	0.90
Erosion							
District (n=300)	3.3	11.7	33.7	42.7	8.7	3.42	0.92
Property (n=300)	1.0	7.0	21.0	44.7	26.3	3.88	0.91

Table 28 Soil test responses

	N	%
Acidity/pH	79	20.7
Nitrogen	59	15.5
Phosphorous	48	12.6
Trace Elements	29	7.6
Sulphur	17	4.5
Nutrients (macro/micro)	17	4.5
Organic carbon	15	3.9
Fertiliser/Fertility requirements	14	3.7
General soil test e.g. health/quality/structure	12	3.1
Aluminium	11	2.9
Minerals	9	2.4
Phosphate	9	2.4
Potassium	8	2.1
Lime	6	1.6
Full soil test	5	1.3
Deficiencies	4	1.0
Don't know	4	1.0
Calcium	3	0.8
Magnesium	3	0.8
Salinity/Electrical conductivity	3	0.8
Cation Exchange	3	0.8
Sodium	3	0.8
Zinc	2	0.5
Super-phosphate	2	0.5
Wheat Diseases	2	0.5
Iron	2	0.5
Weeds	2	0.5
Hard pan in soil	1	0.3
Shallow soil test	1	0.3
Carbon dioxide	1	0.3
Nitrates	1	0.3
Deep Probe	1	0.3
Microbes	1	0.3
Cadmium	1	0.3
Tissue test for plants	1	0.3
Filtration rates	1	0.3
Moisture	1	0.3
Total	**381**	**100**

Table 29 Influence of soil test results on property

	n	%
Fertiliser requirements/application e.g. type, amount, where, when	90	42.5
Soil nutrient levels/requirements e.g. nitrogen, phosphorus, lime	44	20.8
Pasture requirements e.g. what to plant, when, timing	36	17.0
Inform farm management/methods	15	7.1
Act on advice/confirm actions/guide behaviour	7	3.3
They don't /very little	5	2.4
Inform crop rotation	4	1.9
Grazing decisions	2	0.9
Counter-act acidity	1	0.5
Agronomist acts appropriately	1	0.5
Micro and macro needs	1	0.5
Determines the cost of growing things	1	0.5
Weed control	1	0.5
Whether to top dress or not	1	0.5
Amelioration rate	1	0.5
Informs productive grass management	1	0.5
Dictates stocking rates	1	0.5
Total	**212**	**100.0**

Table 30 Barriers to soil testing

	N	%
No barriers	147	42.4
Cost- tests uneconomical/limited income available	92	26.5
Weather conditions- seasons/drought	37	10.7
Not required/not needed	27	7.8
Time constraints- time spent waiting for results	13	3.7
Ineffective- don't trust accuracy/low paddock variability	9	2.6
Use knowledge/experience instead	7	2.0
Availability of people to do testing/access to agronomists	4	1.2
Prefer other options- rely on correct plantings, other indicators, natural management instead	4	1.2
Can't be bothered	2	0.6
Small farm size/Hobby farm	2	0.6
Access to machinery	1	0.3
Would like government to provide it	1	0.3
Soil is too hard	1	0.3
Total	**347**	**100**

Table 31 Perennial plant responses

	N	%
Lucerne	146	22.8
Native grasses/clovers - unspecified	70	11.0
Phalaris	67	10.5
Clover - unspecified	57	8.9
Rye grass	49	7.7
Cocksfoot	39	6.1
Sub clover	34	5.3
White clover	19	3.0
Red grass	15	2.3
Tall Fescue	11	1.7
Clover - Seaton Park	6	0.9
Clover - Balansa	6	0.9
Corkscrew grass	6	0.9
Strawberry clover	6	0.9
Medics clover/Tarragio	6	0.9
Native trees	5	0.8
Kangaroo grass	4	0.6
Arrowleaf - Zulli Clover	4	0.6
Wallaby	4	0.6
Curly/windmill grass	4	0.6
Clover - Dalkeith (subterranean)	4	0.6
Jemalong clover	4	0.6
Trefoil	4	0.6
Chicory	3	0.5
Warrigo grass	3	0.5
Red clover	3	0.5
Rose clover	3	0.5
Haifa - white clover	3	0.5
Oats	3	0.5
Summer grasses	2	0.3
Mt Barker Mahra Clover	2	0.3
Clover - annual	2	0.3
Narrow leaf clover	2	0.3
Spear grass	2	0.3
Paspalum clover	2	0.3
Glucenes/ciders	2	0.3

Table 31 Perennial plant responses cont…

Salt bush	2	0.3
Sorgum	2	0.3
Barley	2	0.3
Clover - Nungarin	1	0.2
Millet	1	0.2
Popany Vetch	1	0.2
Pitted blue grass	1	0.2
Foxfoot	1	0.2
Low clover	1	0.2
Stipa grass	1	0.2
Persian clover	1	0.2
Goulburn Clover	1	0.2
Sephi barrel medic	1	0.2
Barrel clover	1	0.2
Forbes	1	0.2
No. 9	1	0.2
Silver grass	1	0.2
Umbrella grass	1	0.2
Anthonia species	1	0.2
Couch	1	0.2
Cane grass	1	0.2
Coffee plant/wild licorice	1	0.2
Cow peas	1	0.2
Lupin	1	0.2
Woogenellup clover	1	0.2
Clare clover	1	0.2
Rhodiums	1	0.2
Paricums	1	0.2
Crops	1	0.2
Peas / Legumes	1	0.2
Sahara grass (hardy)	1	0.2
Wimmera rye grass	1	0.2
Prairie grasses	1	0.2
Rye corn	1	0.2
Total	**639**	**100.0**

Table 32 Reasons given for planting perennials

	n	%
Feed/pasture/stock/grazing/fodder	181	46.6
Improve soil health/productivity/fertility/nutrients	37	9.5
Nitrogen fixation/improve nitrogen levels	21	5.4
Minimise/prevent/improve/control erosion	19	4.9
Suited for conditions- resilient/drought resistant/grows well	17	4.4
Uncultivated/already there/grows naturally/self germinating	16	4.1
Groundcover/minimise dust	14	3.6
Hay making	13	3.4
Terrain unsuitable- hilly/can't be cropped/non-arable	9	2.3
Improved/better root systems/hold soil together	8	2.1
Part of pasture management/rotational system/balance cropping	8	2.1
Environmental reasons/sustainability/retain natural conditions	7	1.8
Higher carrying capacity/run more stock	6	1.5
For sale as feed	5	1.3
Control water table/salinity	4	1.0
Build up organic matter	3	0.8
Maximise stock productivity	3	0.8
Weed control	3	0.8
Utilise summer rainfall	3	0.8
Maintain moisture/minimise evaporation	2	0.5
Can't/hard to get rid of it	2	0.5
Saves time/work	2	0.5
Plant trees for shade/conservation	2	0.5
Most productive	1	0.3
Seed production	1	0.3
Wildlife corridor	1	0.3
Total	**388**	**100.0**

Table 33 Barriers to planting or retaining perennials

	N	%
Weather conditions - drought/climate/seasons/timing/moisture	169	45.9
No barriers	63	17.1
Money/finances/cost	40	10.9
Terrain/Topography not suitable - hilly/rocky/inaccessible/non-arable	16	4.3
Cropping program/continual cropping	14	3.8
Soil conditions- Minerals/ acidity/ type/ aluminium	11	3.0
Lack of time/timing programme too hard to fit in/time to sow again	7	1.9
Pest - Rabbits/Roos/Pigs/Emus/ Grasshoppers/Red legged earthmite/Blue mite	7	1.9
Lack of machinery to plant seeds/problems with equipment	7	1.9
Cost of seeds	6	1.6
Weeds compete - ie. woody weed	5	1.4
Stock/Over-stocking	3	0.8
Balancing productivity	3	0.8
Native seed not available/not cheap	2	0.5
No support - not included in Landcare group	2	0.5
Spray drift/weed control	2	0.5
Soil needs chemicals- lime/chemicals	2	0.5
Lack of soil testing	1	0.3
Lack of local knowledge about horse studs	1	0.3
Lucerne bloats cattle	1	0.3
Previous property owner flogged the land	1	0.3
Getting it to germinate	1	0.3
No permission to clear	1	0.3
Conditional CMA funding	1	0.3
Govt regulation - $300 for cultivation license	1	0.3
Need to replant	1	0.3
Total	**368**	**100.0**

Table 34 Native vegetation responses

	n	%
Grasses/clovers- unspecified	73	10.3
Eucalypts/gums – unspecified	69	9.7
Kurrajong- flame tree	53	7.5
Trees- unspecified	46	6.5
Remnant/uncleared vegetation/regrowth /locked up	37	5.2
Eucalypts- Yellow box	37	5.2
Cyprus pine	34	4.8
Wattle- unspecified	32	4.5
Red grass	25	3.5
Pine trees- unspecified	23	3.2
Box trees- unspecified	22	3.1
Eucalypts – White box	21	3.0
Eucalyptus – Grey box	16	2.3
Eucalypts- Ironbark	15	2.1
Eucalypts- Red gum	14	2.0
Wallaby grass	11	1.6
Eucalypts- Stringybark	10	1.4
Bular	9	1.3
Shrubs – unspecified	9	1.3
Wilga tree	9	1.3
Mallee – unspecified	9	1.3
Rosewood	7	1.0
Bottlebrush- Callistemon	7	1.0
Kangaroo grass	6	0.8
Trefoil	6	0.8
Spear grass	5	0.7
Rye grass (not native)	5	0.7
Eucalypts- Applegum	4	0.6
Corkscrew grass	4	0.6
Acacias – unspecified	4	0.6
Sheoak	4	0.6
Bimblebox	4	0.6
Casuarina	4	0.6
Salt bush	4	0.6
White pine	3	0.4
Black pine	3	0.4
Acacia- Myall tree	3	0.4
Umbrella grass	3	0.4
Pepper tree (not native)	3	0.4
Native clover	3	0.4
Eucalypts- Blue mallee	2	0.3
Cocksfoot (not native)	2	0.3
Summer grass	2	0.3
Windmill grass	2	0.3
Black grass	2	0.3
Phalaris	2	0.3
Number 9 grass	2	0.3
Emu bush	2	0.3
Oak – unspecified	2	0.3
Belah tree	2	0.3

Table 34 Types of native vegetation on properties cont…

Other/unknown	2	0.3
Melaleuca/Tea tree	2	0.3
Microlena stipowits - Weeping rice grass	2	0.3
Barley	2	0.3
Needlewood	1	0.1
Eucalypts - Fuzzy box	1	0.1
Eucalypts - Big box	1	0.1
Eucalypts - Bull mallee	1	0.1
Warrior bush	1	0.1
Biddy bush	1	0.1
Clovers	1	0.1
Eucalyptus - River gum	1	0.1
Eucalyptus - Black box	1	0.1
Silky oak	1	0.1
Peppercorn	1	0.1
Crowsfoot grass	1	0.1
Currawong	1	0.1
Wetlands	1	0.1
White gum	1	0.1
Barley grass	1	0.1
Pea grass	1	0.1
Broome grass	1	0.1
Prairie grass	1	0.1
Serrated tussock grass	1	0.1
Riparian	1	0.1
Virgin bush	1	0.1
Pillaga scrub	1	0.1
Peppercorns	1	0.1
Coolah grass	1	0.1
Total	**709**	**100.0**

Table 35 Reasons cited for having native vegetation

	n	%
Shade/shelter	99	24.3
Biodiversity/ecosystem- wildlife corridor/native animal, bird, insect habitat/balance	50	12.3
Uncultivated- Already there/remnant vegetation/regrowth/not in the way	42	10.3
Maintain soil health- minimise erosion/provide groundcover/improve soil structure	41	10.1
Wind protection/break	35	8.6
Grazing/feed/pasture	28	6.9
Aesthetics- beautiful/attractive	21	5.2
Terrain/topography- Land not suitable to be cropped/hilly/non-arable	20	4.9
Clearing not allowed/ too difficult- costly/ inaccessible area/ offset through CMA	15	3.7
Better suited to conditions- survives well/that's all that'll grow/ drought tolerant	13	3.2
Control water table/salinity	6	1.5
Part of pasture management/rotational system- Balanced grazing/crops/resting land	6	1.5
Like/prefer native vegetation	5	1.2
Natural border- better on fence line	4	1.0
Offsets carbon emissions/ reduces global warming	3	0.7
Improve/maintain water quality and flows	3	0.7
Around creek/river	3	0.7
Retain moisture/limit evaporation- crops	2	0.5
Timber- fencing/firewood	2	0.5
Biological control- encourages birds which reduce insects	1	0.2
Orchard	1	0.2
Protection from spray drift	1	0.2
Not grazing that area	1	0.2
Increase productivity of stock	1	0.2
CMA funding for fencing	1	0.2
Haven't got rid of it yet	1	0.2
Natural sequential farming- fertilise topsoil and works its way down	1	0.2
Part of property plan	1	0.2
Total	**407**	**100.0**

Table 36 Barriers to having native vegetation

	n	%
No/nothing	170	51.8
Weather conditions- climate, lack of moisture/water	46	14.0
Cost/money	30	9.1
Loss of productive land/productivity- less area for stock/crops	15	4.6
Weeds compete- summer weeds	11	3.4
Need to fence off from stock	9	2.7
Time	8	2.4
Government regulations	7	2.1
Size of property/space available	6	1.8
Increases pests- kangaroos/wild pigs	4	1.2
Terrain/land type/environment	4	1.2
Lack of knowledge	4	1.2
Equipment/machinery- difficult to use/need to buy	2	0.6
Other people's views/prevailing conservatism	2	0.6
Is not good as stock feed	2	0.6
Age/ too old	2	0.6
Previous bad land management	1	0.3
Don't believe in having native vegetation	1	0.3
Small pine trees are invasive	1	0.3
Stock eats native veg (horses)	1	0.3
Working in a partnership - different ideas	1	0.3
Lack of labour	1	0.3
Total	**328**	**100.0**

Table 37 Weed control techniques used

	n	%
Spray - boom	204	27.9
Spray - spot	178	24.3
Grazing	74	10.1
Hoeing	56	7.7
Chemical spray	44	6.0
Cultivation	34	4.6
Chipping	34	4.6
Ploughing	21	2.9
Manual	15	2.0
Slashing	12	1.6
Fallow weeding	9	1.2
Biological (pest species)/grubbing	6	0.8
Competing pasture	6	0.8
Burning	5	0.7
Digging	4	0.5
Goats	4	0.5
Spray - aerial	4	0.5
Crop rotation	4	0.5
Cut by hand	3	0.4
Stocking	3	0.4
Chop it out	3	0.4
Harvest for hay	2	0.3
Mechanical removal	2	0.3
Tillage	2	0.3
Integrated	1	0.1
Weeds are not a problem	1	0.1
Layering	1	0.1
Total	**732**	**100.0**

Table 38 Reasons for using weed control techniques

	n	%
Efficiency- effective/practical/quick/convenient/ easy	170	51.2
Cheap/most economical /cost efficient	40	12.0
Minimise/reduce chemical use/spraying	25	7.5
Well suited/ tailored- to situation/terrain/ property size/type	13	3.9
Improve/maintain/protect soil conditions	10	3.0
Good coverage /covers large area	8	2.4
Fits with property management	8	2.4
Only viable option	8	2.4
Improve/retain pasture/crops/grasses	7	2.1
Combined methods work best	5	1.5
Ground cover retention	4	1.2
Conservation/reduce impacts on native species	4	1.2
Organic farmers	4	1.2
Keep burrs out of sheep/stock	3	0.9
Moisture retention	3	0.9
Maximise yield	3	0.9
Not applicable	2	0.6
Recommended- in literature/by agronomist	2	0.6
Manageable to do on own	2	0.6
Avoid weeds becoming resistant to chemicals	2	0.6
Stock can't contain weeds- not enough stock/don't eat certain weeds	2	0.6
Always done it that way	2	0.6
Safest method	1	0.3
Don't have a lot of weeds	1	0.3
Spraying doesn’t work in summer	1	0.3
Uses less petrol	1	0.3
Widely accepted practice	1	0.3
Total	**332**	**100.0**

Table 39 Barriers to using weed control technique

	n	%
No/nothing	143	43.9
Cost	53	16.3
Weather conditions- lack of rain/water	32	9.8
Time	20	6.1
Prefer not to use chemicals/reduce chemicals	16	4.9
Terrain/ land not suitable	15	4.6
Chemical drift- neighbours won't allow (vineyards/ cotton)	8	2.5
Labour	7	2.1
Some methods are not appropriate/effective for property (because of size etc)	6	1.8
Government regulations	4	1.2
Lack of knowledge	3	0.9
Cultivation- not effective/don't want to do it	2	0.6
Grazing alone is not effective enough, need to use chemicals	2	0.6
Chemicals not appropriate/available	2	0.6
Environmental damage- to waterways/from stock compaction	2	0.6
Size of property too small	2	0.6
Want to employ minimum till methods	2	0.6
Stock withholding periods	1	0.3
Need new equipment	1	0.3
Planning	1	0.3
Unnecessary	1	0.3
Dust	1	0.3
Working in a partnership - different ideas	1	0.3
Difficulty of hoeing	1	0.3
Total	**326**	**100.0**

Table 40 Activities to minimise stock impact on property

	n	%
Control/reduce stock numbers	106	24.6
Stock rotation	92	21.3
Fencing off natives/waterways	52	12.1
Controlled grazing	29	6.7
Reduce paddock size/small paddocks	18	4.2
Retain ground cover	15	3.5
Feed pens/feed lots	15	3.5
More water points in paddocks	14	3.2
Increase native vegetation	12	2.8
Has best breeds/choose goats over cattle/sold all cattle	9	2.1
Drought feed lots	7	1.6
Cell grazing	6	1.4
Hand feed when needed	5	1.2
Laneway system between paddocks	4	0.9
Limit access to areas	4	0.9
Minimal tillage	4	0.9
Contour ground	4	0.9
Rotational cropping	3	0.7
Not flogging the paddocks too much	3	0.7
Don't plough over creek/flood/tree lines	2	0.5
Ground drilling	2	0.5
Minimise stock access to water points	2	0.5
Move troughs around	2	0.5
Grow fodder crops	2	0.5
Mix of cell grazing & time control grazing	2	0.5
Don't fence off trees	1	0.2
Mulch	1	0.2
Sow oats	1	0.2
Levelled property	1	0.2
Let stock run on the creek/native vegetation	1	0.2
Minimise use of chemicals	1	0.2
Crash grazing	1	0.2
Soft hoofed stock	1	0.2
Cut hay for use later	1	0.2
Sow down pasture	1	0.2
Select paddocks with heavy soil (to reduce wind erosion)	1	0.2
Netted trees	1	0.2
Rest paddock	1	0.2
Soil conservation plan	1	0.2
Resew pastures	1	0.2
Designated area for imported hay	1	0.2
Larger paddocks	1	0.2
Total	**431**	**100**

Table 41 How stock impact is reduced

	n	%
Reduce soil degradation (erosion, compaction etc)	138	44.4
Groundcover retention/conserve native/perennial pastures	73	23.5
Don't overgraze	34	10.9
Preserve growth to regenerate/give plants time to grow	16	5.1
Conserve waterways/creek beds/riparian areas	11	3.5
Improve soil structure/nutrients	9	2.9
Prevent tracking	7	2.3
Stock control	5	1.6
Other (no significant impact)	5	1.6
Keep stock from hollows	2	0.6
Reduce stock movement	2	0.6
Graze on weeds	2	0.6
Creates balance	1	0.3
Drought lots	1	0.3
Don't have to handfeed stock	1	0.3
Keeps fish in dams	1	0.3
Preserve unused land	1	0.3
Help with feed	1	0.3
Prevent worms	1	0.3
Total	**311**	**100.0**

Table 42 Barriers to minimising stock impact

	n	%
No/Nothing	142	43.6
Weather conditions- drought/lack of and timing of rain	77	23.6
Cost	31	9.5
Loss of productivity/income/profit- need stock to make money	19	5.8
Time	10	3.1
Size of property/having enough paddocks	6	1.8
Quantity of feed/lack of feed	5	1.5
Labour	4	1.2
Problems with fencing- won't fence creeks unless paid	4	1.2
The terrain	3	0.9
Problems with markets- stock prices	3	0.9
Problems with platypus in creek/native animals	2	0.6
Stock numbers/over-stocking	2	0.6
Difficulties getting water to stock- need use creek	2	0.6
Reduced ground cover	2	0.6
Rules and restrictions (bureaucrats)	2	0.6
Locking up stock problematic- after rain/keeping in separate mobs	2	0.6
Loss of productive land available/pasture	2	0.6
Dispute over whether willows should be removed	1	0.3
Not enough pasture development/suitable monoculture	1	0.3
Can't lock off areas for long periods	1	0.3
Nature of stock	1	0.3
Can't put stock near riverside	1	0.3
Bad management	1	0.3
Equine influenza (can't move horses anywhere)	1	0.3
Keep weeds down	1	0.3
Total	**326**	**100.0**

GLOSSARY

Biospheric environmental values – a value system that conveys concern for the physical and naturally occurring environment (such as native animals, birds and plants).

Catchment Action Plans (CAPs) – 10 year Natural Resource Management plan for the Central West which outlines specific Management Targets aimed at improvement of natural resources.

Conservation farming – farming practice that draws on a range of farming methods aimed at minimising soil disturbance. Practices include stubble retention and minimum or zero tillage.

Contour banks – interval spaced, low gradient earthen structures that cross cultivated slopes. The intention is to prevent erosion through intercepting run off, and diverting flow.

Co Operative Learning – a process of planned change through mutual recognition of an issue and mutual exchange of support.

Cronbach's alpha – a measure of the extent to which a set of questionnaire items are consistent. It is a correlation value and the closer it is to 1.0 the better, or more internally consistent, the items are considered.

Dorper Sheep – a fast growing meat producing sheep. The Dorper is an easy care animals that produces a fleece of little wool that is shed late spring summer.

Egoistic environmental values – a value system that conveys concern about the impacts of environmental problems on family and self.

Holistic farming – a farming paradigm that models farming on what occurs in the naturally occurring ecosystem.

Latent Variable – a variable which itself is unobservable (or theoretical), but that can be measured through the combination of a number of directly observable variables.

Locus of Control (LOC) – whether one believes their actions are controlled by themselves (internal LOC), or controlled by people or conditions external to themselves (external LOC).

Minimum till – broad acre farming methods of post-harvest stubble retention. Distinct machinery pathways are made preventing crop soil compaction, allowing for a deeper soil and moisture profile.

Model fit indices - **Chi-square** is a test of differences in frequencies which can be used to estimate the statistical significance (or validity) of conclusions about the differences between groups. It also can be used as a measure of the goodness of fit (the extent to which a derived modelling solution can reproduce the original data). As a measure of goodness of fit, a non-significant or smaller chi-square indicates a good fit, while a large value indicates a poor fit. **CFI** (Comparative Fit Index), **GFI** (Goodness of Fit Index) and **RMSEA** (Root Mean Square of the Errors of Approximation) are further statistics associated with goodness of fit. Goodness of fit indices are measures of the extent to which the derived model approximates the original data. A good fit is one that explains the data well. These indices need to be within a certain limit to indicate a good fit. More detailed information can be found in Structural Equation Modelling references such as Diamantopoulos and Siguaw (2000).

Social Learning – learning through the creation of an environment that supports a collective learning process.

Structural Equation Modelling – statistical technique for understanding the causal relationships between two or more latent variables.

Stubble retention – where stubble residue is maintained rather than removed through grazing or burning.

Farm Succession Planning – a process of future planning whereby family farming practices are succeeded to the next generation.

Zero till – broad acre farming method of post-harvest stubble retention. Distinct machinery pathways are made preventing crop soil compaction, allowing for a deeper soil and moisture profile.

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