

Integrating Socio-economic and Biophysical Data to Underpin Collaborative Watershed Management

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Abstract

Watersheds are widely accepted as a useful geography for organising natural resource management in Australia and the United States. It is assumed that effective action needs to be underpinned by an understanding of the interactions between people and the environment. While there has been some social research as part of watershed planning, there have been few attempts to integrate socio-economic and biophysical data to improve the efficacy of watershed management. This paper explores this topic and suggests that social researchers have been overly reliant on readily available census data. With limited resources for social research, our watershed partners in Australia chose to focus on gathering spatially-referenced socio-economic data using a mail survey to private landholders that would enable them to identify and refine priority issues; develop and improve communication with private landholders; choose policy options to accomplish watershed targets; and evaluate the achievement of intermediate watershed plan objectives. Our experience with seven large watershed projects provides considerable insight about the needs of watershed planners, how to effectively engage them, and how to collect and integrate social data as part of watershed management.

Key terms

Watershed management, catchment management, integration, Australia

INTRODUCTION

Collaborative watershed planning is now firmly entrenched in the United States (Griffin, 1999) and Australia (Ewing, 2003). These are multi-party processes where government agencies and local communities negotiate and share decision-making for the management of natural resources within a watershed (Duram and Brown, 1999; McGinnis et al., 1999). Recent evaluations have tempered some of the initial enthusiasm for collaborative natural resource management (CNRM) (Kenney, 1999), but CNRM is widely believed to enhance social learning, build social capital, reduce



stakeholder conflict, increase government accountability, and ensure that local knowledge informs planning (Curtis and Lockwood, 2000; Conley and Moote, 2003; Schusler et al., 2003).

Beginning with the five-year, \$AUD 1.25 billion Natural Heritage Trust (NHT) in 1997, successive state and Australian governments have invested substantial public funds in efforts to improve the management of land and water degradation issues, including dryland salinity, water quality and introduced pest plants and animals (Curtis et al., 2003). Much of this expenditure has been made on the basis of the priorities established through the watershed planning processes coordinated by regional Catchment Management Committees (CMC). State governments appoint most CMC members, but a mix of regional community representatives and agency staff is purposefully included on these committees (Ewing, 2000). State and Australian government agencies have recognised the importance of building the capacity of these groups to undertake and implement their watershed plans (Webb and Curtis 2002). The Australian experience with watershed groups suggests that CNRM has facilitated the emergence of an additional tier of local organisation that appears to effectively bridge the gap between local community groups and government agencies. These watershed groups appear to provide governments with increased confidence that public resources invested in improved natural resource management (NRM) will be expended efficiently and will be properly accounted for (Curtis and Lockwood, 2000).

It is now widely accepted that people modified Australian landscapes over millennia and that land and water degradation is the result of interactions between people and the natural environment (Vanclay, 1992). As the seminal discussion paper, *Managing Natural Resources* (Commonwealth of Australia, 1999: 7), emphasised, efforts to manage degradation must '... take account of the links within and between natural systems and the interplay of economic, social and biophysical factors that influence natural resource decision making. An integrated approach is needed.' Even a cursory examination of state and Australian government guidelines reveals that watershed plans are to be based on an understanding of the social context and must consider the social impacts of proposed actions. Indeed, there appears to be increased appreciation of the potential contribution of the social sciences to NRM in Australia. For example, most major Australian government NRM research and development agencies have established social research programs. At the same time, there appears to be little evidence that watershed plans in Australia are being underpinned by social research (Barr et al., 2000), or that substantial progress has been made in methodological approaches to integrating social, economic and biophysical data to underpin watershed management (Commonwealth of Australia, 2002).

International literature suggests that issues to do with the application of social research in watershed management are relevant to a wide audience. As Kuczenski et al. (2000:216) explain, '... while numerous authors concede that social structure is relevant to watershed management ... very little systematic information on the social structure of watersheds has been compiled or is available to scientists or resource managers.' In this and other papers, these authors reported their work combining land cover data from the Landsat satellite with census-derived housing density data to identify relationships between people and their environment that should assist watershed managers (Radeloff et al., 2000).

This paper will explore this topic, suggesting that social research continues to be a low priority for investment of funds and that social researchers need to be more active in engaging with watershed management processes. We will also argue that social researchers in Australia and overseas have relied too heavily on readily available census data that has limited usefulness in watershed management. These observations are supported by our experience with watershed groups over the past five years. Experience from working with seven large watershed projects across three states has provided considerable insight into the data needs of watershed groups, how to effectively engage them, and how to build their capacity to integrate social data for watershed management. Key findings from the most recently completed project in the Wimmera region in the state of Victoria are used to illustrate the usefulness of this approach.

SOCIAL RESEARCH TO UNDERPIN WATERSHED MANAGEMENT

Watershed groups in Australia are required to develop regional plans that set out how the land, water and biodiversity of the region are to be managed. Each watershed plan is to be endorsed by state and Australian government agencies prior to their implementation. While there are state and regional differences, these watershed groups are typically asked to:

1. articulate their vision and objectives, (Where do we want to go?);
2. describe their catchment condition and identify the key regional challenges, (Where are we now?);
3. explain how they will implement their strategy, (How do we go forward?);
4. identify targets for the implementation of management actions and for improvements in resource condition that will enable the assessment of progress towards plan objectives, (How do we know what we have achieved and learned?).

Clearly, there are opportunities for social research to play an important role at each stage of the planning phase identified above. Cavaye (2003) has recently prepared a practical guide outlining how watershed groups in the state of Queensland might integrate social and economic issues into their regional plans. Drawing on our experience we suggest that social researchers could:

- contribute to processes that capture the range of stakeholder perspectives about possible futures for watersheds;
- draw on secondary and primary data sources to describe the social structure and change over time in that structure in a watershed;
- employ processes that enable stakeholders to explore the trade-offs inherent in many resource allocation decisions across different issues and parts of a watershed;
- draw on a range of theoretical and empirical research that would enhance the communication activities of watershed groups, the uptake of recommended practices for managing land and water degradation, and the efficacy of investment through community education;

- assist groups to develop measures of social progress that can be attributed to investments and actions undertaken through their watershed plans; and
- employ social impact assessment tools to predict and ameliorate the negative social impacts of proposed interventions, including changes to land use or resource access.

Despite the rhetoric supporting the value of social research in watershed planning, the reality is that governments and watershed groups in Australia have generally not invested in social research. Social researchers have mostly been involved as facilitators of community consultation/stakeholder engagement processes and there has been little social research beyond that which has drawn on secondary sources, principally the Australian Bureau of Statistics' Population and Housing and Farm Censuses, to profile the social structure of watersheds. There is a small group of social researchers with expertise in NRM and limited research capacity is part of the explanation for the small amount of social research in this field.

Australians profiling watershed communities have usually included attributes that measure some aspect of the four capitals: human capital, produced-economic capital, social capital, and natural capital (Webb and Curtis, 2002; Cavaye, 2003). Barr et al. (2000) used census and other national data-bases to combine social and economic data to explore the structure of agriculture over time in the watersheds of the Murray–Darling Basin. Using local government areas as the unit of analysis, this seminal study examined attributes such as farm size, farm family income, farmer age, entry and exit from farming, and changes in farming family numbers, and clearly demonstrated that these attributes had changed over time.

The analysis of data collected through farm and household censuses can provide useful information, but as Schultz et al. (1999) and Curtis et al. (2001) demonstrated, these data are unlikely to satisfy watershed managers who need to understand the behaviour of the private landholders who control most of the land in their watersheds. In the first instance, these national data collection processes are unlikely to address most of the topics for which data is needed. Our experience working with watershed groups in Australia (Curtis et al., 2001) suggests that groups need information that will assist them to:

1. identify and refine investment priorities from amongst a range of issues;
2. develop and improve communication with private landholders;
3. choose from amongst the mix of policy options available to accomplish watershed targets; and
4. evaluate the achievement of intermediate watershed management objectives over time.

Private landholders, principally farming families, manage almost all of the modified land in the watersheds we are studying. Drawing on our recent experience working with watershed groups (Curtis et al., 2001), the extensive literature on adoption studies in Australia (Vanclay, 1992; Barr and Cary, 1992; Cary et al., 2003), and our studies of adoption for sustainable farming practices (Curtis and De Lacy, 1996), native grasses

(Millar and Curtis, 1997), farm forestry (Race and Curtis, 1998), and riparian areas (Curtis and Robertson, 2003), we suggest that watershed groups require information from private landholders about their:

- level of awareness and concern about the social, economic and environmental issues affecting their property and watershed;
- values they attach to their property;
- knowledge and understanding of processes leading to land and water degradation and of how to implement recommended practices;
- level of confidence in recommended practices;
- property size;
- on and off-property income and debt levels;
- involvement in short-courses;
- stage-of-life and involvement in succession planning;
- long-term plans for their property;
- current and future landuse;
- adoption of recommended practices (see Table 2 for examples); and
- response to policy options expected to change landholder behaviour and achieve watershed plan targets.

It is also very difficult for national data collection processes to have the flexibility required to accommodate differences in the social contexts and the information needs of regional watershed groups. Not only will the issues be different, each watershed group is likely to want information to underpin decision making for a different set of policy choices. This is a critical issue if social researchers are to play a major role in capacity building. Our experience highlights the importance of engaging project partners in decisions about:

- what information is to be collected and why;
- how the information to be collected and analysed;
- who will have access to the data and on what conditions; and
- how will the data be used to improve watershed management outcomes.

Data collected through a national census is usually only available at a local government scale and therefore has limited application in understanding decision making by individual landholders. If census data cannot be geo-referenced at the property scale or aggregated to concord with resource management units (RMU), researchers are limited in their ability to integrate social and economic data with biophysical data layers. Most national census occur at five or ten-yearly intervals. With the time lag between data collection and release, available information can be out-of-date, sometimes before it is even released.

With limited resources for social research, our Australian watershed group partners chose to focus on gathering spatially-referenced socio-economic data using a mail survey to private rural landholders that would enable them to address the four topics identified above. As part of our discussions of research methodology with our watershed group partners we explored other options for data collection and addressed our partners' concerns about: the extent they could influence the selection of research topics; whether mail surveys can achieve response rates necessary to ensure reliable information is collected; that statistically useful information would be available at their planning scales; the ability of other regional stakeholders to access the data; and how we would maintain the confidentiality of personal information provided by landholders.

The following sections introduce the watersheds where our studies have been completed or are underway, explain the process of watershed group engagement in more detail, summarise our approach to data collection and analysis, and use some of the key findings from the most recent watershed study in the Wimmera region to demonstrate the usefulness of the approach.

THE WIMMERA WATERSHED STUDY

At the invitation of the Goulburn Broken Catchment Management Authority (GBCMA), our first watershed project commenced with this group in the state of Victoria in 1998 (Curtis et al., 2001)[Figure 1]. We have also completed projects commissioned by watershed groups in the Ovens (2001) and Wimmera (2002) regions of Victoria [Figure 1]. State and Australian government programs managed by the regional watershed groups funded these projects. In 2003 we received funds through the national component of the NHT program to implement projects in the states of Queensland and New South Wales and to undertake an additional study in Victoria. These projects are underway in the Queensland Murray–Darling and Burnett Mary watersheds of Queensland, the Lachlan in New South Wales, and the Glenelg Hopkins in Victoria [Figure 1]. With projects completed or underway across seven watersheds in three states, and with a spread of inland and coastal watersheds, we are confident that our methodology is reliable.

Given the limitations of space in a paper, we will draw on the key findings from the unpublished, but completed study in the Wimmera region to demonstrate the usefulness of our approach. A technical report outlining findings from this research is available (Curtis and Byron, 2002).

The Wimmera watershed is located in the western part of the state of Victoria [Figure 1] and covers approximately three million hectares (20 per cent of Victoria). Landform in the Wimmera is typically gentle rolling plains interspersed in the south with a series of isolated volcanic hills and small mountains (maximum elevation of 750 metres). The Wimmera River runs inland from these isolated mountains in the south to a series of large terminal lakes in the north. The climate is typical of south-eastern Australia, with hot, dry summers and cool, moist winters, and winter rainfall is higher and summer temperatures lower towards the coast in the south. Eighty-five per cent of the native eucalypt forests and grasslands have been cleared to make way for European

agriculture, mainly dryland crop and livestock farming based on cereals and sheep for wool and meat. Isolated, but important pockets of native vegetation are protected in the public lands of the Little Desert and Grampians national parks and the Hindmarsh and Albacutya terminal lakes. Primary production and associated processing industries are the main contributors to economic wealth. Tourism focussed on the national parks and wineries is also an important industry. The population of the Wimmera is around 50,000, with almost a third of these people living on family farms or in small towns. The major townships include Horsham, with a population of 15,000. The Wimmera watershed group (the Wimmera Catchment Management Authority (WCMA)) has identified the priority resource management issues as water erosion, dryland salinity, soil structure and soil fertility decline, increasing soil acidity, and introduced pest animals and weeds.

The Wimmera watershed has been divided into nine resource management units (RMU). Each RMU represents a part of the watershed that has similar landform, soils and vegetation [Figure 2]. The WCMA has used these RMU as their basic planning units. At the WCMA's request, survey data analysis and presentation has occurred at the RMU scale.

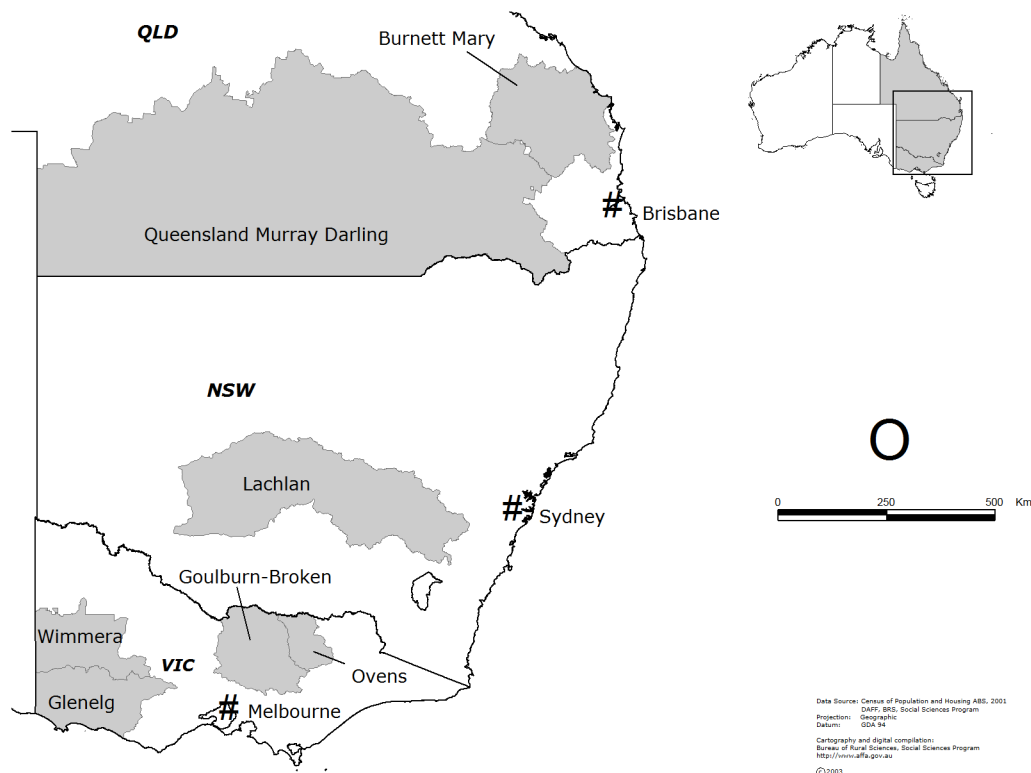


Figure 1. Location of watershed projects in Australia

PROCESS OF ENGAGEMENT FOR THE WIMMERA WATERSHED

Experience to date suggests that a nine to 10 month research process is needed to effectively engage our watershed partners and their major stakeholders in a process that draws on local knowledge, builds commitment to the research, and enhances capacity to interpret and implement key findings. At the heart of the research process is the work of a project steering committee (PSC) and a project reference group (PRG).

The PSC is a small executive comprised of representatives from the contracting parties that is responsible for day-to-day project management, including supporting the PRG. The PRG is the fora where researchers and partners/stakeholders address and settle the questions identified earlier.

- What information is needed?
- How is the information to be collected and analysed?
- Who has access to the data and on what conditions?
- How will the data be used to improve watershed management outcomes?

The PSC needs to be clear about selection criteria for the PRG, expectations of the time commitment of PRG participants, the process for reaching decisions and the level of authority that rests with the PRG, and the resources available to support the work of the PRG. PRG membership should reflect the breadth of watershed stakeholders and comprise representatives with a responsibility or commitment to implementing research findings. The PRG should be chaired by one of the partner/stakeholder representatives, with appropriate facilitation and administrative support provided through the PSC. PRG decisions should be based on reaching a shared or consensus view and non-agency participants in PRG should be paid sitting fees and have their travel costs reimbursed.

In the Wimmera project, the nine PRG participants were selected by the WCMA and included four landholders who were WCMA Board representatives (one of these chaired the PRG); three WCMA staff responsible for watershed strategy development and program implementation; and two state agency staff, including a social scientist with responsibilities for providing support to regional watershed planning processes. PRG participants were informed that they would be required to attend at least four full day workshops over a ten-month period where they would work with the researchers to determine the content of the survey; provide feedback on draft research reports; and assist with the communication of research findings, including at stakeholder workshops. PRG participants were also advised that they would need to be available to contribute up to five days outside formal meetings to review draft survey instruments and reports.

From the outset, it was clear to PSC and PRG participants that the work of these groups involved a genuine partnership between researchers and practitioners, that all participants would be learning from each other, and that all knowledge and assumptions could be contested. The challenge was to work with project partners to facilitate a process that ensured this happened. As social researchers we had to demonstrate that we could explain our theories and methods; listen to others; respond positively to criticism; negotiate compromise positions; meet agreed timelines; persevere and overcome obstacles; and deliver credible and useful research findings. We made a commitment to

regularly communicate with the PSC and key members of the PRG by email and telephone. These communications included discussions about specific survey questions; how we would identify survey pre-test participants; how the WCMA might contact local councils to obtain their ratepayer (property owner) data base so we could identify the mail-out recipients; updates on the survey response rate during the mail-out process; progress reports during data analysis and report preparation; feedback from PRG on draft reports; and ideas for communicating research findings to stakeholders and the wider community.

Much of our success with the Wimmera PRG depended on the outcomes of the first one-day workshop. At that workshop PRG members introduced themselves; WCMA staff on the PSC provided an overview of the research brief and the work of the PSC; the social researchers introduced the methodology, key findings and research outputs from earlier projects in Victoria; and there was a facilitated discussion of the Wimmera project objectives, the research approach and timeline, how the project would be explained and promoted to stakeholders, and the topics to be included in the mail survey. At the end of the first workshop there was agreement on the research objective (see below), the topics (but not specific questions) to be included in the mail survey (see above), a timeline for the research, and the role of the PSC (see above). It was agreed that the social researchers would develop a preliminary survey that would be circulated to PRG members prior to the second workshop in four weeks time.

The second meeting of the PRG began with a short presentation to reiterate the research purpose, approach and timeline. WCMA members of the PSC provided an update of work to pull together the survey mail out list using the ratepayer lists from the seven shires in the watershed. The meeting then focussed on an in-depth discussion of survey questions. A review of each topic commenced with an explanation of the contribution of that topic to project objectives. Participants were then asked for their comments in terms of whether the topics were comprehensive, statements were unambiguous, terms used would be understood by recipients, and issues addressed were those that affected survey recipients. At the end of the second workshop it was agreed that the social researchers would develop a draft survey for distribution by email to PRG members, with feedback to the researchers via the PSC prior to a revised draft being pre-tested by focus groups across the watershed. With advice from PRG members, the PSC identified participants for two focus groups of five to six participants from across the region, with participants representing the range of likely survey recipients. Apart from pre-testing the survey, the focus groups were also a way of engaging key WCMA stakeholders and building understanding and support for the research process.

Two months elapsed between the second PRG meeting and the development of the draft survey, conducting the survey pre-test focus groups and final approval of a revised survey by the PRG. The survey mail out, with two mail outs and four reminder notices (three for the first mail out), occupied a further six weeks (see below). Data analysis and preliminary report preparation occupied a further four weeks.

The third PRG meeting reviewed preliminary research findings. Summaries of survey data were presented to the PRG and tentative findings used as a basis for exploring different interpretations of the data and identifying ways findings might inform watershed planning. It was agreed that the social researchers would submit a draft report to the PRG for comment. The final report was to be presented to the PSC for approval.

The PRG also decided to publish the research findings in a technical report and a four-page brochure and to hold a two-day workshop with WCMA and state agency staff responsible for watershed management to review research findings and their management implications.

The two-day workshop was held in October 2002, eight months after the project commenced. Over 60 participants from the WCMA Board and staff, state agencies, local government, the regional development board, agribusiness and other industries, and the media attended. While the research findings would require substantial changes in the way stakeholders approached their work, there was widespread agreement that the research was credible, timely and important for watershed management. The social research team participated in the workshop, but not as the facilitators or leaders of the workshop sessions. PRG members chaired the workshop and worked with Wimmera watershed program managers to lead the workshop sessions and document the discussion and outcomes from those sessions for the WCMA. In a very real sense we had passed the ownership of the research and the responsibility for its uptake to the WCMA board, staff and other watershed stakeholders.

APPROACH TO DATA COLLECTION AND ANALYSIS

The key research questions

Discussions with the PSC and the PRG identified that the following key research questions were to be addressed using data from the mail survey of landholders.

1. What are the high priority issues for private landholders in the watershed?
2. What are the values that private landholders attach to their properties?
3. Are private landholders aware of dryland salinity and is awareness linked to adoption of practices recommended to ameliorate this issue?
4. What are the main factors constraining the adoption of practices recommended to address key land and water degradation issues?
5. To what extent are landholders taking up new or emerging enterprises and are these enterprises likely to substantially improve landholder profitability in the short-term?
6. To what extent do landholders' long-term plans for family succession or the sale of their properties present opportunities for changes in on-property management that will enhance the achievement of watershed plan objectives?
7. Would stronger incentives encourage private landholders to undertake higher rates of revegetation on cleared land or remnant vegetation protection?
8. How can the WCMA demonstrate achievement of watershed management objectives?

The following discussion of research findings will address some of these key research questions.

The mail survey process

On the advice of the PRG, all properties smaller than ten hectares were removed from the lists of approximately 4,000 landholders provided to the WCMA by the seven local governments in the Wimmera watershed. To ensure statistically useful numbers of respondents across the nine watershed resource management units (RMU) [Figure 2], 1,000 landholders were randomly selected from the ratepayer lists. Scrutiny of the landholder list provided by the WCMA identified 41 duplicate names that were subsequently removed from the list to provide a final sample of 958 landholders. Tables containing the landholder list and their rural property information were entered into a Geographic Information System (ArcView).

The survey design and mail out process followed Dillman (1979) *Total Design Method*. The survey instrument was developed in consultation with the PRG and after pre-testing with small focus groups (see above), was printed as a 12-page B5 sized booklet. The initial survey mail out included a cover letter and was followed by three reminder/thank you cards in successive weeks. A second mail out, with one reminder/thank you card was undertaken to all non-respondents to the first mail out. All surveys were addressed to the property owner/owners identified on the ratepayer lists. The 112 cases where we were advised that the intended survey recipient was too old, ill or deceased, or that the property had been sold, were removed from the original sample to provide a final sample of 846. With 619 completed surveys returned, the final response rate was 73 per cent, with a range from 65 per cent in RMU 6 to 76 per cent in RMU 9.

Data analysis

Findings presented in this paper are derived from analyses undertaken using a range of descriptive statistics and binary logistic regression. All analyses were undertaken using the SPSS statistical package. Survey data was entered into an ArcView GIS that contained layers for RMU, salinity discharge sites, topography, and remnant vegetation. The expert and mail survey data layers were then used in a number of analyses requiring the integration of socio-economic and biophysical data layers. In the first instance, we were able to assess landholder awareness of dryland salinity, and the efficacy of expert maps by comparing salinity affected areas identified by landholders and those mapped by experts (key research question three). This analysis adopted a methodology pioneered in our previous work and recently published (Curtis et al., 2003). In other analyses we used survey data and life expectancy tables provided by the Australian Bureau of Statistics to identify the year when the management of each property was expected to change hands, and therefore, model the extent of property turnover across different RMU (key research question six).

FINDINGS

This section presents the findings for a limited number of the key research questions for the Wimmera study. The purpose is to demonstrate the relevance of survey data to watershed managers, and particularly, the value of combining socio-economic data obtained through the survey with existing biophysical data layers.

Providing information to improve landholder engagement

Survey respondents were asked to assess the importance of a range of social, economic and environmental issues in their district. Eighteen topics had been identified through discussions with the PRG and survey pre-test workshops. The four highest rated issues addressed aspects of the declining viability of small towns and rural communities. Subsequent workshop discussions emphasised the importance of watershed managers demonstrating how an investment in NRM would also address issues such as the lack of employment opportunities for young people in the district.

Dryland salinity is a high priority NRM issue in Australia. The National Action Plan for Salinity and Water Quality (NAP) has identified 12 priority regions in Australia for investment. The Wimmera is one of three watersheds in the Lower Murray NAP region. Twenty-three per cent of survey respondents indicated they had areas where plants showed signs of the effects of saline water. For most of these respondents the area affected was relatively small (median 10 hectares compared to median property size of 900 hectares). Only 22 per cent of respondents rated dryland salinity as an important or very important issue affecting the long-term productive capacity of land in their district. By comparison, 58 per cent rated reduced river flows impacting on river health as an important or very important issue. Overall, dryland salinity was ranked 11 out of the 18 topics included in the survey. Again, the clear message is that watershed managers need to link efforts to manage high priority national or state issue, in this case dryland salinity, with improved outcomes across the social and economic issues that are a higher priority for most land managers.

As explained above [Figure 2], the Wimmera has been divided into nine resource management units (RMU) that have similar landform, soils and vegetation. As might be expected, there were statistically significant differences in the high priority issues of survey respondents across the different RMU. Further analysis using Pearson or Kuskal-Wallis chi square tests showed that the social context of the RMU was also different [Table 1] and this information suggested that watershed managers should take these differences into account. For example, local watershed or Landcare groups are currently the most important means of engaging landholders in watershed NRM programs (Curtis et al., 2002). Survey data showed almost half of all landholders across the Wimmera were Landcare participants and there was a significant positive relationship between participation in these groups and NRM programs and watershed planning outcomes, including adoption of more sustainable farming practices [Table 2]. Compared to other parts of the Wimmera, only a small proportion (10%) of the landholders in RMU 1 were involved in Landcare. Landholders in RMU 1 were also atypical of most Wimmera landholders in that most were living on smaller properties and were not farmers by occupation [Table 1]. Efforts to engage RMU 1 landholders in watershed management would need to move beyond appeals to protect agricultural production or income and

address their interest in biodiversity conservation and recreation and their long-term plans to remain on their property [Table 1]. With relatively low household incomes, efforts to engage landholders in RMU 1 in on-ground work might also need to be supported by strong cost-sharing arrangements [Table 2].

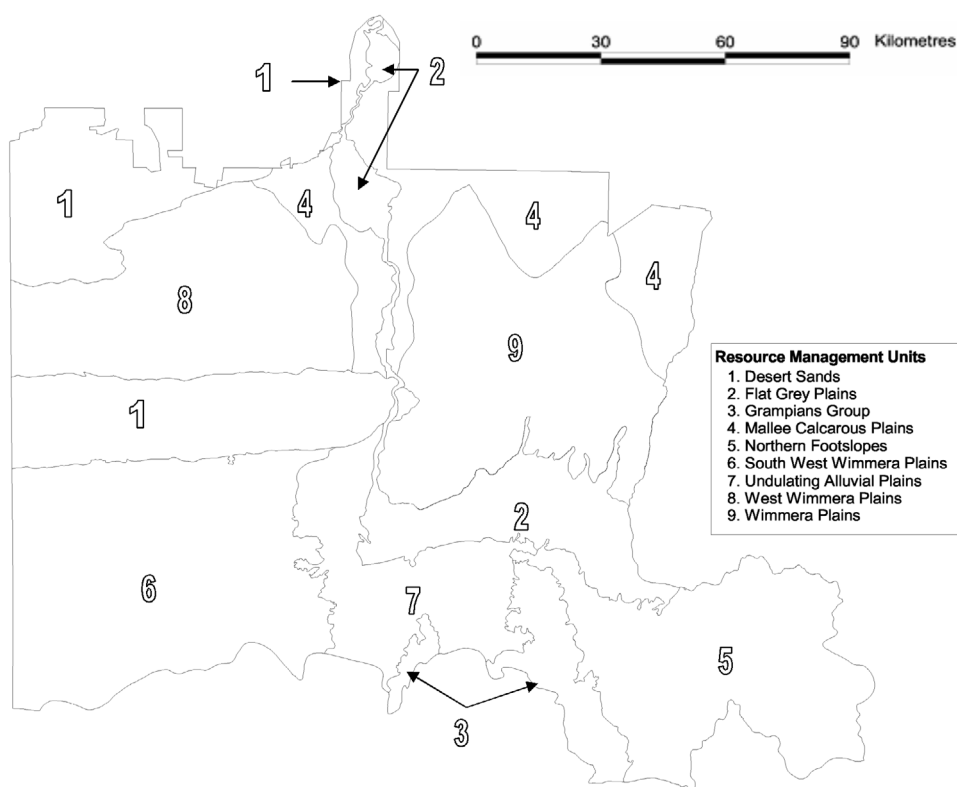


Figure 2. Resource Management Units in the Wimmera watershed

Table 1. Social structure and landholder characteristics in selected Resource Management Units
Wimmera watershed 2002 (N=619)

Variables	RMU 1 (n=33)	RMU 3 (n=10)	Total all RMU
Farmer as primary occupation	70%	50%	80%
Median property size	1,290 ha	161 ha	900 ha
Median hours worked on property per week	50 hours	11 hours	50 hours
Median total household income (annual)	\$75,000	\$30,000	\$60,000
% said property provided majority of household income	70%	10%	81%
Median time lived in local area	42 years	30 years	46 years
% said they planned to continue to live on-property	30%	60%	55%
Landcare membership	49%	10%	47%

Table 1. (cont'd) Social structure and landholder characteristics in selected Resource Management Units
Wimmera watershed 2002 (N=619)

Variables	RMU 1 (n=33)	RMU 3 (n=10)	Total all RMU
% reported saline affected areas on their property	50%	25%	23%
% said salinity was a threat to water quality	28%	40%	22%
% said access to health services was a priority issue	53%	40%	56%
% said soil acidity was a threat to on-property productive capacity	13%	0%	10%
% said changes to waterways affect the quality of recreational experiences	31%	50%	45%
% knew the processes leading to soil acidification	21%	11%	20%
% said farming practices leading to soil erosion undermined on-property productive capacity	6%	40%	12%
% adopted planting trees and shrubs	48%	80%	60%
% adopted watering stock off-stream	90%	40%	72%

Providing information to refine policy approaches

Awareness of dryland salinity

A key assumption underpinning the NHT and NAP is that landholders are often unaware of the extent and impact of less obvious forms of land degradation such as dryland salinity. It has also been assumed that a lack of awareness was an important factor contributing to the limited adoption of practices likely to manage dryland salinity (Vanclay, 1992). As a result, there has been a large investment in community education to raise awareness and understanding of dryland salinity in priority watersheds, including the Wimmera. As part of the Wimmera survey the PRG wanted to assess landholders awareness of dryland salinity and to explore links between concern and awareness of dryland salinity and adoption of more sustainable farming practices.

Drawing on a previously published methodology (Curtis et al., 2003), we employed an ArcView Geographical Information System (GIS) to compare survey respondent's assessments of whether they had areas where plants were affected by salinity, with maps of saline discharge sites prepared by state agency watershed managers. There was also the opportunity to test the efficacy of the expert maps by assessing the capacity of these maps to predict the areas identified by survey respondents as being affected by salinity.

In the Wimmera, the expert maps agreed with the assessments of 90 per cent of the respondents who said they did not have plants affected by dryland salinity [Figure 3]. A substantial number (15 of 43) of the survey respondents that the expert maps suggested were unaware of dryland salinity were located in RMU 6 [Figures 2 & 3].

Although dryland salinity was not rated as highly as many other issues, those who reported areas affected by dryland salinity were significantly more concerned about the impacts of dryland salinity on water quality and the productive capacity of their property and the district. Those reporting areas affected by dryland salinity were also significantly more likely to adopt the practice of planting trees and shrubs, a key to managing saline affected land [Table 2].

These findings suggest that most landholders have an accurate understanding of the current extent of dryland salinity and that the substantial investment in salinity education in the Wimmera has been effective in raising awareness and enhancing adoption. Landholders may not be aware of future salinity problems and this may be a factor inhibiting the adoption of ameliorative action by landholders. To the extent that state and regional watershed managers expect the extent and impact of dryland salinity to expand significantly, they will need to invest in efforts to identify and map these trends so they can present credible information to landholders.

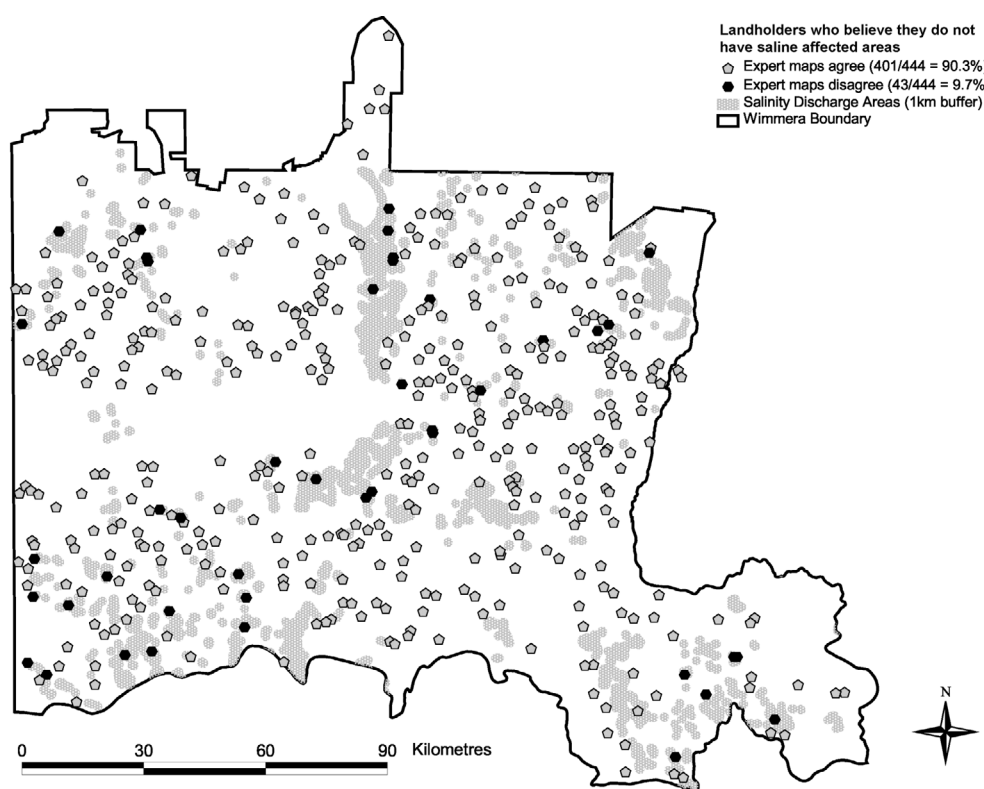


Figure 3. Comparing landholder awareness of salinity with expert maps
Wimmera watershed 2002, (N=619)

Understanding landholder adoption of sustainable farming practices

Survey data provided strong affirmation of the efficacy of the capacity building approaches currently used by watershed managers to support the adoption of more sustainable farming practices by private landholders. There were significant positive relationships between adoption of practices and both respondent's concern and awareness of dryland salinity, and between their self-assessed knowledge of the

processes leading to land and water degradation and their adoption of practices recommended to manage those processes. There were also significant positive relationships between involvement in Landcare, Top Crop (an industry led extension program), property planning, and other publicly funded NRM programs likely to lead to increased awareness, knowledge and adoption [Table 2]. With a majority of respondents indicating there were topics where they still lacked sufficient knowledge to take action, low levels of confidence in some recommended practices, and information from our analyses that half of all properties would change hands by 2015, there will be an ongoing role for these capacity building processes in the Wimmera.

Modelling the impact of stronger cost-sharing arrangements

Low returns from agriculture have affected the capacity of landholders to take up recommended practices, particularly those that are expensive or are likely to lead to substantial public or off-site benefits (Curtis et al., 2001). In this study, higher on-property profitability was linked to significantly higher adoption of the recommended practice of watering stock off stream [Table 2]. Successive Australian and state governments have acknowledged the public benefits that flow from much of the remedial action taken by private landholders and have agreed to share the cost of this work (Curtis and Lockwood, 2000). The Wimmera PRG was particularly interested in exploring the extent that stronger cost-sharing arrangements would motivate landholders to increase the replanting of native trees and shrubs on their properties.

Survey recipients were asked to indicate their level of interest in committing to additional revegetation work in exchange for an incentive package that provided for establishment costs (\$1,000 per hectare), plus a fee to cover opportunity cost and the active management of the revegetated area over a ten year period (equal to per hectare returns from grazing). About half (48%) said they would take up the incentive proposal and all of these respondents said that the proposal would substantially increase the area they planned to revegetate over the next three years (median of 12 hectares). The total area to be revegetated over the three years was equal to one per cent of the entire watershed, or an area equal to the amount of saline affected land in the watershed. Armed with survey data for each RMU, watershed managers in the Wimmera will be able to model the extent that stronger cost-sharing arrangements will achieve their revegetation targets in high priority RMU for both biodiversity conservation (habitat conservation) and salinity mitigation (lowering water tables) (Lockwood et al., 2002). The view that a variety of policy approaches is needed was reinforced by the finding that 52 per cent of respondents would not/were unlikely to take up the incentive scheme.

CONCLUSIONS

Given the limited availability of socio-economic data relevant to watershed planners, our watershed partners settled on the collection of spatially referenced data through a mail survey to rural landholders. Data collection has focussed on exploring landholder awareness and concern about issues; knowledge of and confidence in recommended sustainable farming practices; adoption of those practices; and the long-term plans of landholders for their properties.

Table 2. Independent variables linked to the adoption of recommended sustainable farming practices
Wimmera watershed, 2002 (N=619)

Independent variables		Recommended practices									
		Expenditure to control pests plants/animals	Used minimum tillage practices	Stock watered from a trough or tank	Recorded soil test results	Sown introduced perennial pastures	Non-wetting soils treated with clay	Native bush or waterways fenced	Fenced to protect gullies/waterways	Traffic reduced on seasonally wet soils	Trees and shrubs planted
		● denotes a positive relationship ○ denotes a negative relationship									
FARM MANAGEMENT	Property size	●					●				
	Areas where plants show signs of salinity					●					
	Written property plan				●			●	●		
	Plan to lease/share farm majority of property					○					
	Likely to increase land managed				●						
	Lease/share farm land owned by others		●							●	
	Plan to live on property in the long-term										●
	Property budget		●								
SOCIO-DEMOGRAPHIC	Property provides majority of household income								○		
	Property important as an attractive place to live			●							
	Level of on-property profit			●							
	Hours worked on-property			●							
	Off-property income										●
	Age									○	
	Farm work a break from normal occupation						○				
	Member of a Top Crop group		●		●						
	Member of a Landcare group	●									
	Work on property funded by government							●	●		●
	Likely to apply for revegetation grant		●					●			
	Lived longer in the local district		●								
CONCERN	Threat of salinity to water quality in district								●		
	Removal of native vegetation and decline of birds and animals							●			●
KNOWLEDGE	Value of woody debris in rivers or streams								●		
	Collecting samples for testing soil fertility or acidity				●						
	Perennial pastures ability to prevent water tables rising					●					
	Processes leading to herbicide resistance		●								
	Area of saline affected land in the district										●
	People to contact for advice about government help to manage gully/stream bank erosion							●			
	Identifying sodic soils in the district						●				

This approach represented a break from previous efforts to provide socio-economic data to underpin watershed planning that have relied on national data collections such as the Population and Household and Farm censuses. The higher cost of this watershed-based survey work can be justified on the grounds that large public investments are being made through regional watershed plans and the existing secondary data sources cannot explain the behaviour of the private landholders who control most of the land in the watersheds.

It was our intention to provide a thorough description of the research approach, especially the process of watershed partner engagement. Above all else, this process must be flexible to meet the needs of watershed partners and their unique regional contexts and the process cannot be fast-tracked without jeopardising the substantial benefits of CNRM processes. Our experiences suggest that the use of a project reference group, part of a wider commitment to collaborative partnerships, has benefits in terms of drawing on local knowledge, providing access to local government mailing lists and state agency data layers, and building lasting commitment and capacity to understand and utilise data and research findings. Working collaboratively with watershed partners we were able to effectively address concerns about the confidentiality of survey respondent information and the need for longer-term partner access to research data. We have also demonstrated that by applying sound research methods it is possible to consistently achieve mail survey response rates in excess of 60 per cent: response rates that provide watershed managers with high levels of confidence in the reliability of data obtained.

By drawing on findings from the Wimmera watershed study we illustrated the value of the spatially referenced landholder information collected through our mail surveys. In the Wimmera region there were significant differences in social structure at the RMU scale, including differences in the size of properties, landholder occupations and land management practices. Watershed managers who were aware of these differences and the key factors affecting the uptake of recommended practices should be better equipped to develop communication strategies and policy options to accomplish watershed targets. By integrating our survey data with state agency maps of saline discharge sites we were able to test the extent that landholder awareness of dryland salinity matched the expert maps. The assumption had been that landholders underestimated the extent of dryland salinity on their properties and that this lack of awareness undermined efforts to ameliorate the effects of salinity. Our analyses suggested that almost all landholders had accurate knowledge of existing saline affected areas. This finding has important policy implications. In the first instance, the high level of landholder awareness of areas currently affected by dryland salinity appears to affirm the value of the substantial investment that has been made in community education, including through Landcare and TopCrop groups, to raise awareness and understanding of salinity.

Wimmera survey questions also explored respondent interest in taking up incentives for work that would lead to increased native vegetation on private land. Analysis of survey data suggested that stronger incentives would make an important contribution to the achievement of watershed plan objectives, but that other policy options would be needed to engage at least half the survey respondents. Combining information survey respondents provided about their age and long-term plans with Australian government life expectancy tables allowed us to model the extent and location of future property turnover across the region. Half of all properties are likely to be in different hands in just

over 10 years. This will be an unprecedented transfer of property management and will represent both an opportunity and a challenge to watershed planners. To the extent that these new landholders will be new settlers in the watershed there is likely to be a loss of local knowledge and a greater need for Landcare and TopCrop groups to undertake outreach or extension work. At the same time, watershed managers may decide that this turnover in property ownership represents an opportunity to achieve substantial changes in land management practices, for example, through market purchases of strategic parcels of land.

Watershed partners will be able to return to their survey data to explore other questions. For example, private farm forestry is a priority action identified by a number of watershed plans to counter the effects of rising water tables that have mobilised saline ground water. Survey respondents have been asked to provide information about their current and intended involvement in farm forestry and the importance of a range of social and economic constraints affecting their capacity to adopt farm forestry. Only some parts of most regions are suited to farm forestry in terms of rainfall, soils and proximity to processing plants. By integrating survey data with these data layers it will be possible to assess the extent landholders have taken up or are interested in adopting farm forestry in locations where it is considered a viable option. Survey data can also assist with the evaluation of programs where those programs have been applied to a specific region or part of a region. It is relatively straightforward to make a comparison between those landholders where there has been an intervention and those landholders where there has not been an intervention to assess program impact across landholder awareness, knowledge, confidence or uptake of specific practices.

These examples and others provided earlier illustrate the potential of survey data to assist watershed managers to refine their investment priorities; develop and improve their communication with private landholders; select from the range of policy options to accomplish watershed targets; and over time, use this baseline data to evaluate the achievement of intermediate watershed plan objectives (improved awareness, knowledge, confidence in practices, adoption of practices).

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