Science communication in Australian agriculture:

A study of communication between scientists and farmers on the issue of salinity in Harden, New South Wales

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Originality statement

The submitted thesis, "Science communication in Australian agriculture: A study of communication between scientists and farmers on the issue of salinity in Harden, New South Wales", is entirely original and all sources have been acknowledged.

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Abstract

Paramount to improving land management practices and combating environmental crises like salinity in Australia is the smooth communication of scientific research, and opportunities for farmers to contribute their local knowledge. Farmers and scientists can communicate in different ways and this study seeks answers to a series of research questions exploring science communication in Australia agriculture, with a specific focus on the topic of salinity.

Communication methods can be assessed by directly asking farmers what salinity communications they use and value. This study distributed a postal survey to farmers in the Harden Murrumburrah area of New South Wales: an area known to be contributing salt to major drainage catchments. Observations were also made at Harden Murrumburrah Landcare Group meetings, together with discussions with visiting scientists and the Landcare coordinator.

The literature review, postal survey results and observations reveal that farmers highly value face-to-face communication with scientists. Scientists gain scientific credibility and local knowledge from this association also. Landcare provides a format for farmers to communicate with each other, and for scientists to improve their research by gaining valuable input from farmers.

Science communication in Australia agriculture should continue to utilise a combination of methods, with an emphasis on face-to-face communication in community group formats like Landcare meetings. Meetings such as these allow farmers to consolidate various scientific messages within a local context with like-minded peers, and for farmers and scientists to reconcile diverse scientific, social and agricultural drivers. Newspaper articles and salinity-specific publications will continue to be important and, once rural internet connections and internet training are improved, a Landcare-sponsored unified salinity 'portal' is suggested as a potentially powerful tool in the dissemination of research and encouraging farmer feedback Australia-wide, for salinity as well as for other environmental challenges.

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Table of contents

List of figures

List of tables

List of abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AFFA	Department of Agriculture, Fisheries & Forestry - Australia
BRS	Bureau of Rural Science
CPAS	Centre for the Public Awareness of Science
CSIRO	Australian Commonwealth Scientific and Industrial Research Organisation
DIPNR	Department of Infrastructure, Planning and Natural Resources
DLWC	Department of Land and Water Conservation
HMLG	Harden Murrumburrah Landcare Group
MDBC	Murray-Darling Basin Commission
NAP	National Action Plan
NLP	National Landcare Project
NRM	Natural Resource Management
NSW DPI	New South Wales Department of Primary Industries
PMSEIC	Prime Minister's Science, Engineering and Innovation Council
UC	University of Canberra

Chapter 1 Introduction

Background

As a result of over two hundred years of land clearing for agriculture, Australia has a problem: Dryland salinity. The salt appearing at the land surface today has accumulated naturally in the sub-surface over millions of years and is transported by surface and groundwater flow. Removal of deep rooted trees, such as native evergreen trees, and their replacement by shallow-rooted crops and pastures (Stirzaker, Vertessy and Sarre, 2002) has allowed the groundwater table to rise, bringing the salt to the surface (BRS, 2003).

The area affected, costs and severity of dryland salinity are expected to become much worse before positive changes are observed. According to the National Land and Water Resource Audit (National Heritage Trust, 2000) the area of land estimated to have shallow water tables, and therefore likely to be salt effected, will increase three-fold from 5.7 million hectares (ha) to 17 million ha by the year 2050. Dryland salinity decreases agricultural production, increases the frequency and severity of floods, degrades water quality and reduces the availability of native flora and fauna habitats. Dryland salinity also damages infrastructure such as roads, pipes, cables, bridges and buildings.

The 29 May 1998 meeting of the Prime Minister's Science, Engineering and Innovation Council recognised the issue of dryland salinity, and its impact on rural industries and the landscape, as an example of an economic and social issue of high priority (PMSEIC, 1998b). And while salinity has been recognised as a serious land management issue for decades, particularly in Western Australia, it was thrust into the political spotlight by the audit of the Murray-Darling Basin in 1999-2000 (Lunter, 2003). Showing its commitment to land management issues in January 2004, the Federal Government allocated over $406.3 million to the establishment of Catchment Management Authorities (CMAs); the CMAs aim to engage regional communities in the key natural resource issues facing their catchment (DIPNR, 2004).

Agricultural and natural resource management are often thought of as technical issues involving the application of science (Vanclay, 2002) to reach a 'solution'. Purely scientific solutions cannot be implemented in isolation, however, as they require the support of, and application by, the farmers on the land. Farmers are people and farming is a socio-cultural practice, governed by social and cultural traditions (Vanclay, 2004). Solutions must be developed in collaboration with, and supported by, the agricultural community to be effective.

Without remediation, the total cost of salinity on agriculture will have flow-on environmental, economic and social effects for all Australians, not just farmers.

Although many Australians are aware of salinity as an important problem, and are concerned about its impacts on agriculture, the land and the economy, it tends to be overshadowed by day-to-day affairs (OMRG, 2003). The stakeholders directly involved are farmers, local councils, community groups and government. At the property scale are farmers, dealing with the problem directly, processing and applying the information available. Local councils and community groups take responsibility for affected regions and catchments while governments manage the financial and political situation at the state and national levels.

Scientists in Australia have been working on salinity issues for almost a century. The earliest publication on the topic was presented to the Royal Society of Western Australia on the 13th of November, 1923, entitled "Increase of salt in soil and streams following the destruction of native vegetation" by W. E. Wood (1924). Scientific research into salinity in Australia has come a long way since the early 1900s. Today entire government departments, non-government organisations and cooperative research centres are devoted to the scientific study of salinity and to setting land management policies that address the problem.

Theoretically the primary role of each group of stakeholders seems clear. Governments distribute funding, scientists undertake research, and farmers and community groups take action. However, the communication processes operating between the parties is very complex and largely misunderstood. Ultimately, each party's goal is the same; to manage the Australian landscape for future generations in an economically, environmentally and socially viable framework. This is an impossible task without excellent communication between these groups. Therefore, this study aims to improve understanding of the communication process between farmers and scientists. This knowledge will help ensure that sustainable land management practices become acceptable and workable farming practices by facilitating effective communication between scientists and farmers.

Statement of the problem

According to Vanclay (2002): "Farming is a social and cultural activity. Farm management practices are physical manifestations of cultural expression, which are loaded with social meanings and significance. Thus, they are not solely technical. Farmers want practical advice, but that advice needs to be based on a social understanding" (p. 23). This emphasises the importance of communication that is not only practical, but customised to the particular needs and culture of the farming community.

The ways in which governments and scientific organisations attempt to communicate with farmers are many and varied. The quality and content of salinity information they communicate includes causes, effects, treatments and technology, together with the political and economic situations and predictions, and are currently transferred through extension agents or community groups, mass media, the internet or targeted media.

Some studies have been made into the use of specific agricultural information transfer media, and specifically the effectiveness of community groups (Carr, 1997; Major, 1998; Alexander, Brittle, Ha, Gleeson and Ridley, 2000). Other studies have asked communication-focussed questions as part of larger studies on salinity and farmers' land management practice adoption (e.g. Fisher, 1995; S. Tate, pers. comm., 2004). Others asses farmers knowledge and how they learn (e.g. Lee, 1998; Moore, 2003).

There have been no recorded studies that specifically investigate which salinity communication methods Australian farmers use and value, or the impact of the various methods on farming practices (Chapter 2). Although community groups, such as Landcare, have been evaluated for their membership demographics and awareness levels (Alexander, 1995), there have been no studies of their performance with regards to science communication.

Salinity and the Harden Murrumburrah area

Governments of all of the Australian states recognise salinity as a major environmental and land management problem currently being faced by farmers and the wider community. New South Wales, for example, has 70-80% of irrigated land threatened by rising water tables and associated salinity problems (DLWC, 2004).

The Murrumbidgee Catchment covers an area of about 82,000 square kilometres and drains into the nationally significant Murray-Darling river system (NSW DLWC, 2003). Home to approximately 520,000 people, and including Australia's capital, Canberra, and its largest inland city, Wagga Wagga, the Murrumbidgee catchment has one of the most diverse climates in NSW. Waterways in the catchment have undergone considerable modification since European settlement, and are host to 14 major dams, 8 large weirs and over 10,000 kilometres of irrigation channels. The agricultural production within the Murrumbidgee catchment is worth over $1.9 billion annually, a component of this being the dryland cropping industry worth $790 million. The major land management issues facing the Murrumbidgee catchment include salinity (dryland and irrigation), erosion (gully, sheet, rill, wind, and streambank) loss of remnant vegetation, high-watertables, bad water quality, noxious weeds, wetland management, feral animals, acid soils, aging rural population, increasing social

issues related to land degradation, and general pollution from large urban areas (Murrumbidgee Landcare, 2009).

According to the Murrumbidgee Catchment Stressed Rivers Assessment (NSW DLWC, 1999) the Jugiong Creek sub catchment contributes one of the highest salt loads of any sub catchment to the Murrumbidgee River and has been named as one of the areas in NSW with the greatest potential for developing dryland salinity. The primary stress factors affecting the sub catchment are cropping and salinity. Twenty-one percent of the sub catchment area is cropped and 74% is grazed. Native trees remain in only 6% of the catchment area (NSW DLWC, 1999).

The agricultural future of the Harden Murrumburrah community is at risk. Effective two-way communication of scientific, political, economic and agricultural information is necessary to protect the productivity of the region and the future of this rural community.

Landcare

"Landcare is a uniquely Australian partnership between the government, the community and business to 'do something practical' about protecting and repairing the environment" (Landcare Australia, 2008, p. 3). It began in 1989 when the National Farmers' Federation and the Australian Conservation Foundation lobbied the government of the day to commit itself to an emerging community movement called Landcare. Today all levels of government support the program and groups can now access funding directly from the Australian Government.

Landcare Australia seeks to develop a "landcare ethic" amongst all Australians. Its core objectives are (Landcare Australia, 2008):

- to raise corporate sponsorship for the Landcare and Coastcare movements; and
- to raise community awareness of the programs.

Harden Murrumburrah Landcare Group

As of January 2004, the Murrumbidgee catchment had a Landcare membership of 3,700 people within 120 groups (Landcare NSW, 2004). The Harden Murrumburrah Landcare Group (HMLG) formed in 1989 and as of 2004 had a membership of 254 (L. Hufton, pers. comm., 2004) and encompasses the Jugiong Creek (Harden Shire) catchment. Its vision is of "sustainable and profitable long term farming and grazing throughout the Jugiong catchment with a healthy environment for current and future generations". The goal of the HMLG is to encourage 'best practice' management in all areas of land use. The major

issues for members include soil acidity, salinity and water logging, pasture management, biodiversity, remnant vegetation, conservation farming practices, weed control, erosion, soil degradation, tree planting and protection of wildlife habitats, water quality, technology, education and agricultural economics (Harden Murrumburrah Landcare Group, 2003).

Research questions

This study seeks to contribute to the understanding of science communication in agriculture from a farmer's perspective. Based on a review of available literature, qualitatively observing how science is communicated by Landcare and by quantitatively recording farmer's opinions of existing science communication media and strategies, specifically on the topic of salinity as a land management issue, this study will address the following research questions:

1. **What existing salinity communication methods and processes do farmers use and value?**
2. **What science communication takes place at Landcare meetings?**
3. **Does being part of Landcare make a difference to information exchange and farming practice?**

The study will focus on the issue of salinity in the Harden Murrumburrah area of New South Wales. The township of Harden Murrumburrah is 140km north west of Canberra and is within the Jugiong Creek Catchment of the Murrumbidgee Catchment.

Overview of research method

Based on an evaluation of research methodology and an understanding of the problem, postal surveys and direct observations were selected as the primary research tools for this study. In order to discover and examine the existing salinity communication methods and processes that farmers use and value I employed a literature survey (Chapter 2) and a postal survey which would ask farmers which communication methods they favoured. Observations and discussions at Landcare meetings also contributed to answering the first research question. In order to observe what forms of science communication took place at Landcare meetings it was necessary to attended several meetings and record how science was communicated. As only a few meetings could be attended during the study period, discussions with a Landcare coordinator and several scientists active with Landcare were also used to answer the second research question. Finally, to assess the impact that being a member of Landcare has on information exchange and farming practice required structuring postal survey questions in a way that allowed comparison between Landcare and non-Landcare members on these topics.

This method was selected because it could reach the largest number of farmers, was the easiest and least invasive and labour intensive method for farmers and addressed the research questions.

Assumptions

A study of the information exchange preferences of broad-acre crop farmers in southern New South Wales with respect to salinity can have only limited applicability to Australian farmers as a whole. The conclusions and recommendations from this study are based on a particular case.

This study recognises that farmers are not an homogeneous group. The farming community can be sub-divided not just by farming style and geographic location, but also by wealth, age, life-cycle stage and likelihood to accept and adopt new ideas and sciences. "Farmers can be categorised on every single variable that can logically be considered in conjunction with agriculture" (Vanclay, 2002, p. 10).

Significance of the study

This study provides a small snapshot assessment of the efforts by scientific organisations, government initiatives and the media to communicate salinity science to farmers. It examines the attitudes and opinions of the target audience regarding the delivery process, content and quality of the information and will provide information about the preferences of farmers for different communication strategies.

The results of the study will be relevant to the stakeholders involved in salinity research and policy, farmers and other people interested in communication in agriculture. It will assist scientific organisations, government land management and environmental workers to draw up communication plans for the future. A better understanding of the communication that occurs between the agricultural community, scientists and the government will result in smarter environmental and land management policies for Australia. The science process and scientists can influence the policy making process (Lunter, 2003). If farmers and other land managers are involved in the scientific process and with the scientists who influence policy decisions, then they will appreciate, accept and implement the policies better.

Thesis structure

This study is presented as a series of five chapters. The next chapter, the literature review, includes a discussion of literature related to the communication of science, particularly in Australian agriculture. Chapter 3 outlines the methods used in this study, including their application and limitations to answering the research questions. Chapter 4 presents the data

resulting from the postal surveys and observations made at Landcare meetings. A discussion of the findings, followed by recommendations and conclusions is presented in Chapter 5.

Chapter 2 Literature Review

Introduction

For communication of scientific information to be relevant and effective, it must be based on an understanding of the issues and the audience to be addressed. Therefore, this chapter provides an overview of agriculture as practiced in Australia and identifies the major land management issues facing farmers today. A particular emphasis is given to the issue of dryland salinity as it is one of the major environmental and economic challenges facing Australian farmers today. This is followed by a discussion of science communication and especially the modes of communication currently applied in Australian agriculture.

Australian Agriculture

> *"Agriculture is diverse and dynamic. The powerful tie to nature endows agriculture with its richness, seasonal rhythms and variegated patterns across a landscape. Human society adds its own diversity and impulses for change. Agricultural technologies – the means employed to provide food and fibre necessary for human sustenance and comfort – reflect not only the characteristics of environments but also the characteristics of those that devise and use them. Successful technological innovations – those that come to be used – suit people as well as environments"* (Dvorak, 1993, p. xvi).

Australian agriculture is governed by a delicate combination of social, economic and environmental factors. Australia has an enormous economic dependence on the agricultural industry and its products. The export earnings for Australian farm commodities, including crops and livestock, are estimated to be around $30.8 billion in 2008-09 (ABARE, 2009). As farming is fundamental to the Australian economy, its history and culture, Australians generally assume that farmers will undertake the best long-term land management practices for future generations of farmers and Australians. Therefore farmers must tread a delicate balance between financial stability and sustainable farming systems. This places enormous responsibility on the shoulders of farmers in their capacity as land managers, economists and as members of families, communities and society.

The final sentence in the quote by Dvorak (1993) above highlights the many factors involved in the communication of science in the field of agriculture: innovation that suits people as well as the environment. A constant theme in the literature reviewed in this chapter is that a combination of social and scientific understanding is needed in Australian agriculture. Even

more importantly, an understanding of the two-way communication of information and ideas between farmers and scientists is needed to understand the social aspect of agriculture and to operate within it.

History of Agriculture in Australia

Prior to European settlers arriving in the late 18th century, indigenous people in what is now known as Australia were living in balance with the land, based on some 50,000 years of acquired knowledge and understanding. European settlers found a flat, ancient, and weathered landscape that was in stark contrast to their native countries. The land did not respond as expected to European farming methods, and signs of land degradation appeared almost immediately (Lockie and Vanclay, 1997).

Agriculture is the act of cultivating and rearing crops and livestock and is typically carried out by farmers. The elements affecting agriculture come from both the land and the people. Sometimes people do not always make the best decisions. Land clearing and overgrazing was encouraged by the Australian government for almost 200 years. The West Australian government 'Million Acres a Year' land clearing scheme in the 1950s and 1960s is one example of an unsustainable land 'development' program with disastrous results (Beresford, 2001).

The introduction of the terms 'sustainable' and 'sustainable development' in the late 1980s allowed governments to reconcile environmental protection with economic growth. Sustainable development integrated nature conservation, agricultural production, industrial development and social equity (Lockie and Vanclay, 1997).

With the pressure on farmers to manage the land sustainably, deal with the ongoing drought and keep bankruptcy at bay, practising agriculture in Australia today is fraught with difficulty. Monthly rainfalls were in the lowest 5% of historical totals in 2004, making it one of the hardest years for farmers so far. Data collected by The Weekend Australian newspaper showed that 67% of the nation's water is used for agriculture (Wahlquist, 2004). The severe drought of the last 10-15 years has hit agricultural production hard, requiring over $3 billion in Federal Government drought aid. During the drought's peak in 2006-2007 national farm production was slashed by two-thirds or $7.6 billion (ABARE, 2007). In NSW as much as 96.3 % percent of the state was drought affected (The Age, 2007). The NSW Government has contributed an further $470 million in drought assistance to farmers (NSW DPI, 2009).

In addition to the drought, the main causes for concern in Australian agriculture today are salinity, soil erosion, soil acidity, deteriorating water quality and access, loss of soil nutrients

and introduced pest animals and plants (Moore, 2003). Some researchers conclude that salinity, like many of the above-listed land degradation issues, is one of externalities (Vanclay and Lawrence, 1995) while others disagree (e.g. Pannell, McFarlane and Ferdowsian, 1999). Externalities are the off-farm effects that describe the impact of one economic agent on another and in the case of dryland salinity, the impacts may be on neighbouring farms, natural ecosystems, rural towns, water resources, roads and other infrastructure (Pannell et al., 1999).

The May 29, 1998, meeting of the Prime Minister's Science, Engineering and Innovation Council identified dryland salinity as 'the fastest-growing of all threats to Australia's agriculture and landscape' (PMSEIC, 1998a). A follow-up report presented at the Second Meeting of the PMSEIC recommended, among other items, that; research dollars and effort be invested into farming and land use systems, including socio-economic research and development to create an enabling environment; the development and use of small, specialist teams containing experienced professionals together with producers and community groups be encouraged; and ongoing funding be provided for groups such as Landcare and the National Heritage Trust (PMSEIC, 1998b).

Salinity in Australia

Causes of dryland salinity in Australia

Dryland salinity in Australia is caused by the combination of naturally high salt content in the subsoil, the unique nature of Australian soils and landscapes, and post-European settlement tree-clearing. Pannell, Ewing and Ridley (2003) and Stirzaker et al. (2002) provide useful reviews of the causes of dryland salinity and are summarised here. Salt has accumulated in the subsoil of most Australian agricultural land in naturally high levels as a result of rock weathering, the liberation of salt from ancient marine deposits and salt transport from the ocean with wind and rainfall. The natural vegetation prior to European settlement consisted of woody, drought-tolerant, evergreen perennials, which used all of the available water. This was changed to shallow-rooted, annual crop and pasture species that no longer use all of the rainfall. Combining these annual crops with a flat landscape and soils of low permeability resulted in a larger proportion of rainwater running off and entering the groundwater. Natural salt stores were dissolved and carried to the surface by rising groundwater tables and then into river systems. It is the redistribution and mobilisation of salt to the surface that causes dryland salinity.

Impacts on agricultural land and infrastructure

The extent and impact of dryland salinity to Australian agricultural land is staggering (Figure 2.1). If current practices continue, a threefold increase in the area at risk from dryland salinity - from about 6 million to 17 million hectares - is estimated over the next 50 years by the National Land and Water Resources Audit. By 2050, 20,000 km of streams may be affected by salinity; 52,000 km of roads will be at risk of salinity damage; and more than 200 towns could suffer infrastructure damage (Coram, Dyson and Evans, 2001). Obviously the effects of salination are not limited to loss of productivity, reduced profit levels and land values on individual farms. The widespread effects of salinity for the community include affected farm and town water supplies, damage to farm and town equipment, threats to wildlife habitats and the biological integrity of creeks and rivers, and the deterioration of road surfaces (Vanclay and Lawrence, 1995).

Possible farm management responses

Salinity management at the farm scale can be divided into preventative/remedial measures and adaption of new practices to manage salt-affected (recharge) areas (Pannell, 2001). While scientists, land managers and policy-makers agree that retaining native vegetation and planting trees is essential, planting trees in catchments is a long-term and expensive preventative measure (Stirzaker et al., 2002). In the scenarios summarised by Pannell (2001), perennials will need to be established in well over 50% of every affected catchment, with any resulting positive effect observed on the time scale of decades. Economically, existing perennial plants suitable for recharge areas are not profitable (Pannell et al., 2003). Adaption, by introducing farming systems based on salt-tolerant species and engineering solutions, seems more economically practical and realistic in the short term (Pannell, 2001). However, existing plants suitable for saline and waterlogged soils in discharge areas are not as profitable as hoped, and engineering solutions (e.g. deep open drains) are variably effective and downstream effects are not yet fully understood (Pannell et al., 2003). A well-designed, strategic revegetation program, especially in medium-rainfall mid-catchment areas, appears to be the better long term option (Powell, 2000).

Figure 2.1 Areas containing land of high hazard or risk of dryland salinity in 2000 (National Heritage Trust, 2000).

People and policy

Salinity science research has been high on the national political agenda since 2000. The National Action Plan (NAP) for Salinity and Water Quality, replaced in mid-2008 with the government's new natural resource management initiative Caring for our Country, set policy direction for addressing dryland salinity and deteriorating water quality (NRM, 2009) However, natural resource management is not solely driven by science and environmental best-practice. People are involved. Pannell (2001) comments that policies such as the National Landcare Program have, for many years, encouraged farmers to make "personal sacrifices and financial commitments" to salinity prevention.

Land management practices of farmers are based on social, cultural, historical, political, economic and environmental variables (Vanclay and Lawrence, 1995). The NAP recognises that regional communities need information about natural resource management, but also the ability to assess environmental change and the effectiveness of management

interventions (Coram et al., 2001). It is not simply a case of distributing information, but a two-way conversation taking into account the pre-conceived ideas, prior experience and existing knowledge of each participant. It is the farmers who implement land management practice in most of Australia, and they have pre-conceived ideas of scientists, politicians and the media. Similarly, "politicians and conservationists often comment in off-the-record statements that farmers' attitudes to the environment are not conducive to effective land management" (Vanclay and Lawrence, 1995, p. 75).

Many authors argue that simply 'having information' is not enough. "While awareness is relatively easily achieved, the adoption problem is too complex and multifaceted..." (Pannell, 2001). Also, farmers are reluctant to treat technical issues as distinct from social and economic factors (Fisher, 1995).

The management of dryland salinity is a complex issue, affected by local- and national-scale environmental, social, economic and political factors. An open, flexible relationship is required for communication between farmers, scientists and policy makers. An examination of the existing pool of knowledge surrounding communication in agriculture is necessary. Clearly one uniform national solution for dryland salinity in Australia, ready to be easily applied by all farmers on all scales in all areas, is not possible or reasonable.

Science communication in agriculture

Communication is sharing knowledge. Human development relies on our ability to communicate. In this age, when knowledge is expanding more rapidly than at any other period in history, our greatest limitation is our inability to disseminate new knowledge effectively (Cribb and Hartomo, 2002). "All learning is dependent on language and communication" (Yager, 1991, p. 53).

Communication is a dynamic, multi-directional and perpetual operation. This is especially true in the communication of scientific knowledge, ideas and processes, both within the scientific community and beyond. However, science communication is often seen as simply transporting information in one direction: from the scientist to the public. This is the 'transportation model' of science communication (Macdonald, 1996). The role of science communication can also be seen as one of simply translation. The 'translation' model of science communication involves a straightforward simplification and translation of science for the public (Macdonald, 1996). Science communication in agriculture, however, is more than transport, translation, or the marketing of scientific knowledge or of a new technology.

If we communicate for the purpose of sharing knowledge, then we must consider with whom we are sharing the knowledge and for what purpose. "Scientists, science agencies and high tech companies must come to recognise that the knowledge possessed by the community in the form of values, beliefs, traditions, morality, feelings, behaviours is critical to the uptake of scientific knowledge" (Cribb and Hartomo, 2002).

Sources of information

Science communication in agriculture is disseminated using various media, ranging from single person-to-person communication right through to mass media. Communication difficulties arise because there are many different sources of information, mixed messages and the credibility of sources is not always known. The 'audience' also has preconceived ideas when they receive the messages. There is an incredible amount of communication aimed at farmers in agriculture, including internet, mass media (e.g. rural and national newspapers, television, and radio), technical/scientific papers and conferences, and via community groups and/or extension agents, agricultural specialists and agents, conversation with neighbours, stock and station agents, and formal and informal education. However, there has been no rigorous assessment of which of these information pathways are most conducive to influencing farmers' land management practices based on scientific research.

Formal and informal learning

Context is important when acquiring new information and the prior experiences of the learner will be used to make connections between the new information and prior knowledge, skills and experiences. During formal education, the context in which a subject is taught is usually unfamiliar, poor or even absent compared to real-life experience. Informal learning allows individuals to apply practical knowledge to solve everyday problems (Choi and Hannafin, 1995).

In a study of the relationship between farmer education and farm management ability, Bamberry, Dunn and Lamont (1997) summarise farmers' attitudes towards formal agricultural education. Factors that influence farmers' attitudes in this respect include; the practicality and applicability of courses to farmers' individual situations and local conditions; the availability of appropriate information about the content of courses and the teaching approaches used; and the delivery modes and assessment strategies making allowances for the seasonality of farm work and farm commitments.

During a series of in-depth interviews, Bamberry et al. (1997) found that the current informal education sources used by farmers included other farmers, family and friends in other businesses, visits to other farms, organised field days, agricultural suppliers and service

providers, agricultural consultants, seminars and conferences, farmer associations and farmer-directed groups, as well as media including newspapers, journals, radio and television.

In most cases, farmers rate local knowledge, hard work, and working with little supervision as more important characteristics for farmers than trade or university qualifications (Moore, 1990).

'Experts' vs. Local Knowledge

Farmers consider 'expert advice' as just one source of information available to them, piecing it together with a combination of personal observation, reading technical material and conversations with neighbours (Fisher, 1995). In Australian agriculture, 'experts' take the form of extension agents and scientists. One of the most important factors involved in evaluating those perceived as possessing 'expertise' is the style in which the claims to authoritative knowledge are made. McKechnie (1996) suggests that people are more suspicious of the *way* in which views are presented, rather than the views themselves. Local knowledge, as defined by Millar and Curtis (1997), is the knowledge and experience farmers gain from trial and error, personal observation and interaction with others in their local environment. In a study of the generation and communication of local knowledge of dryland salinity of among farmers in the Hunter Valley of south-eastern Australia, Fisher (1995) observed that local knowledge tended to be holistic and contextualised. He states that 'expert advice' will gain authority and respect if the presentation is consistent with local values and addresses all the factors perceived by farmers to be relevant to the problem and applicable to a particular local district. Any sort of assertion of authority in terms of specialised, local knowledge by the 'expert' is dangerous and often leads to loss of reputation (McKechnie, 1996).

A similar conclusion was reached in a study of hill sheep-farmers in the Lake District of Northern England, carried out by Wynne (1996). Wynne discusses the importance of trust in scientists and his/her institution and his/her credibility and social skill. In the study, Wynne examined the 'intensive expert advice' being delivered by scientists to the farmers whose sheep had been exposed to radioactive fallout from both Chernobyl and a local nuclear facility. He found that the farmers were disappointed with the way in which the scientific knowledge was delivered, particularly with the scientists and extension agents inability to 'reflect upon the status of their own knowledge' and their ignorance of hill-farming environments, practices and decision-making, and of farmers' knowledge. He found that scientific credibility was influenced by the information itself and by the way the information and the scientific process was communicated socially. Similarly, in his 1998 evaluation of

mixed media's ability to communicate climate change information to farmers, Lee (1998) states that an audience is more likely to take an interest in communication activities when they perceive the information as relevant, non-confrontational and useful. He also points out that evaluation of communication programs seldom occur (Lee, 1998).

Extension agents

Extension staff or agents are people whose ultimate goal is to influence a change in practice in the rural community (Boyd, 2003). They are capable of entering the frames of reference of both graziers and researchers, switching their style of language at will (Ross, Abel and Manning, 1996). Understanding another person's frame of reference is essential for effective communication and recognises another person's assumptions, experiences, associations and feelings relevant to a subject.

However, agricultural extension has been criticised for its top-down, unidirectional and linear approach to technology transfer, product promotion and for marginalising farmers' local knowledge (Vanclay and Lawrence, 1995). Traditional agricultural extension tends to: promote and sell agricultural science research ('innovations') as improvements without question; be unequally distributed; and marginalise or even ignore the local 'indigenous technical knowledge' of farmers (Vanclay and Lawrence, 1994).

Fisher (1995) concludes that agricultural extension may be most effective when it is interactive rather than directive. He says that "Farmers prefer 'setting an example' to 'telling people what to do'" (p. 4) The Australian Landcare network is a model of extension based on the ideology that the farmers themselves set the agenda and determine the priorities (Vanclay and Lawrence, 1994).

Community networks and landholder groups

Farmer-directed groups are an increasing source of informal education (Bamberry et al., 1997). Often, farmers undervalue their local knowledge but the process of sharing experiences and collectively solving problems heightens awareness of the value and application of local knowledge (Millar and Curtis, 1997). 'Information exchange' embodies the concepts of two-way dialogue, participation and equality among the various participants (Carr, 1997).

Inaction on complex issues such as natural resource management is often caused by a lack of shared understanding between stakeholders of what the problem is, rather than lack of scientists' solutions (Blacket, 1996). Linear technology transfer will therefore not be effective

towards an unreceptive audience. A learning-based approach will foster a more effective way of understanding and improving complex issues (Blacket, 1996).

Community networks and landholder groups form when farmers recognise that they need to communicate with each other. There are many advantages to farmer-directed groups, including: sharing of knowledge and information; identification of information needs; identification of farm management problems; recognition by members of the need to upgrade their skills in particular areas; realisation of the need to learn problem-solving skills to cope with change; and the ability to set the agenda in line with group needs (Bamberry et al., 1997). Agricultural extension may be most effective when it is interactive rather than directive (Fisher, 1995).

Farmers are more likely to adopt new commercial or environmental practices if they have accepted the importance of the new practice within their particular subculture or farming style. Until farmers recognise the importance of a particular environmental problem or the suitability of a management practice for dealing with that problem, widespread adoption is unlikely (Vanclay and Lawrence, 1994).

National Landcare Program (NLP)

The National Landcare Program was formally established in 1992 by the Department of Agriculture, Fisheries and Forestry. The program evolved from conservation groups working in Victoria in the late 1980's (Sobels, Curtis and Lockie, 2001). The program supports the sustainable use and management of natural resources and encourages landholders to undertake landcare and related conservation works by supporting collective action by communities. Local landcare groups, the centrepieces of the NLP, are based on local watersheds or neighbourhoods and address local environmental degradation in a cooperative and integrated manner (Lockie, 1998).

Sobels et al. (2001) found that Landcare groups are an improvement over traditional extension methods because they: provide increased access to funding and the ability to convert it into on-ground work; provide more efficient coordination of like-minder farmers; develop new communication structures for information exchange and learning; create and empower more knowledgeable land managers; are managed as accountable, professional organisations; and benefit from effective and dynamic leadership.

Groups, such as Landcare, have the potential to blend local and scientific knowledge, but need to maximize farmer participation and use the combined knowledge to make decisions and find solutions (Millar and Curtis, 1997). Once farmers are motivated to seek information,

the most preferable way to learn is to speak with someone and ask questions directly. Farmers will 'filter' non-personal information sources, skipping over non-local or irrelevant background information (Lee, 1998).

There are also disadvantages to farmer-directed groups. Members of community groups like Landcare can be perceived as 'elite' and 'exclusive' and not representative of 'real' farmers in a district. This was one of the findings in a study carried out by Donohue (1998). The study was specific to the Harden Murrumburrah Landcare Group and based on a random telephone survey. Donohue's main findings were that farmers had a strong interest in holistic, sustainable and profitable farming. She concluded that there was a tendency to refer to active Landcare members and the executive as 'they', and to see them as different to 'regular' farmers. As for the future of the group, those surveyed felt they needed to target young people to take an interest in the group or were happy to 'leave it to the experts running it' to make decisions about the future.

The Landcare movement in Australia has been assessed from many perspectives, both internally and externally, but there have been no direct studies of the use and effectiveness of science and science communication within Landcare groups. Alexander et al. (2000) assessed the membership and demographic of Landcare groups and identified that farmers were more likely to be Landcare members if they had reported various land degradation issues on their properties. Curtis, Shindler and Byron (2002) use Landcare as an example for assessing how local watershed groups can continue to survive and grow their memberships. While they provide an excellent overview of empirical research exploring the achievements and future directions for groups like Landcare, they do not assess or discuss the details of the communication mechanisms within such groups. Similarly Kelly and Stannus (2002) conclude that Landcare can have a positive influence on changing land management practices and implementing government policy, but also do not explore the communication mechanisms within Landcare. In contrast, Brown (1997) does discuss communication pathways within Landcare, but not in relation to scientific information. Based on the literature reviewed for this study, farmers are rarely surveyed for their attitude toward, nor their engagement in the scientific process. The lack of critical assessment of the nature of science communication within Landcare groups makes it difficult to use Landcare as an effective instrument for facilitating science-based land management decisions.

Salinity in the Media

Print and television media are one source of information for farmers to build knowledge and to use in decision-making. A survey of references to 'dryland salinity' in Australian media

reveals that salinity coverage peaked in the media around late-2000 and 2001, and continues to be a common subject in the media throughout the 2000's.

In a survey of Albury-Wodonga residents about water issues Howard (2000) found that media or media personalities were the largest influence on behaviour towards the environment. He found that television, newspaper and radio – in that order – were the three most effective source of information. But when making a big change, print and television media can rank as low as fifth out of six as a learning source for change. In an investigation of how farm-management teams go about learning to manage their businesses and to make strategic and tactical changes, (Kilpatrick and Johns, 2003) found that only 28% of farmers used print and electronic media as their primary influence to a change in farm business management. Such media ranked fourth after experts, observation/experience, farmers, training, and ahead of agricultural organisations, as sources used by farmers in learning for change as an influence in change (Kilpatrick and Johns, 2003).

Farmers and the internet

The internet as a tool for agricultural exchange has been the subject of discussion and many publications over recent years. In an investigation into why UK farmers do or do not choose to use the internet to run their farm business, Warren (2004) points out that a problem will only arise if the Internet becomes the default medium for knowledge transfer. Currently, research agencies almost always make their research and other information available on a web site. It is not the sole medium for information transfer but it does appear to be the dominant one. The internet, like the mixed-media package evaluated by (Lee, 1998), is relatively new to farmers and is increasingly being used to communicate agricultural information to them. Significant behavioural changes are unlikely to occur if the learning styles and needs of farmers are not incorporated into the production of these internet sites (Lee, 1998).

Two constraints to farmers accessing all this information on the web are the lack of reasonable quality computers in farm households, and the current state of the telecommunication infrastructure in parts of rural Australia (Black, 2000). In their critical examination of the 'digital divide' – a perceived social gap between those who use the internet and those who don't – Willis and Tranter (2006) find that the internet usage increases with higher education and income levels, and with professional and white-collar occupational class, and decreases with age. While a difference in internet use between metropolitan and rural areas is recognized, they conclude that this difference is due more to high-cost and poor-quality telecommunication services, rather than geographical location. As

a nation, Australia is lagging behind other Western countries with respect to internet investment in regional areas (ABC News, 2005).

However, internet use in rural Australia has been increasing in recent years. In a survey of Central Queensland grain and beef farmers Rolfe, Gregor and Menzies (2003) found that the value of the Internet is not necessarily replacing other means for sourcing information, but is making certain tasks more efficient, e.g. electronic banking services or ordering goods on-line. They did also find that some value comes from providing better access to information, especially technical information.

Accessing information over the internet is, at least at this point in time, a poor substitute for one-on-one or group communication, and creates the added complication of information overload and measuring information reliability (Black, 2000).

Summary

Australian farmers are responsible for a multi-billion dollar agricultural industry. The role of land manager is a difficult one, requiring a delicate balance of finances, family, sustainability and environment. Salinity is just one of many problems during this time of drought. The solutions to Australia's raft of land degradation issues are both social and scientific, suited to the land and its people. Fortunately, funding and research organisations have now recognised the need for assistance and the social requirements of any proposed solutions.

Science communication in agriculture is more than a transportation or translation of the scientific message, and more than the marketing of a commercial or research product. A review of the available literature reveals that the modes of information exchange in agriculture are many and varied. Formal learning tends to lack a familiar context and therefore relevance; informal ways of learning are preferred. Informally, information can be obtained from experts, such as scientists or extension agents, or neighbours, family and co workers. Community networks blend local and scientific information in a familiar context. Landcare is one such group, and is probably the most integrated into Australia's farming community. Its strength lies in engaging local people and the ability to maximise farmer participation. Print media, television and radio are also forms of informal learning and have a role in on-farm learning and information transfer. The internet is increasingly being used as a tool to obtain agricultural information but is limited by access and speed in rural Australia.

The review of literature presented here gives a broad overview of agriculture in Australia, the problematic issue of salinity and the sources of information and knowledge sharing available to farmers. However it also identifies some major gaps in the understanding of the delivery

of scientific research to farmers. In particular it notes the lack of assessment of the effectiveness of different science communication mechanisms, especially in relation to dryland salinity. It identifies the importance of community groups, like Landcare, in local watershed networks, but provides no information about existing science communication pathways within these groups.

The research presented in the following chapters aims to fill in these gaps and to provide a clearer understanding of effective science communication strategies in Australian agriculture.

Chapter 3 Methods

Introduction

Australia has a salinity problem, among other land management issues. The previous chapter detailed many of the ways that farmers and scientists communicate but also highlighted that communication between farmers, other land managers, scientists and policy-makers needs to be better understood. This chapter described the methods used to address the three primary research questions of this study:

1. What existing salinity communication methods and processes do farmers use and value?
2. What science communication takes place at Landcare meetings?
3. Does being part of Landcare make a difference to information exchange and farming practice?

The main methods employed in this study include a postal survey and observation of science communication at Landcare meeting. This combination was chosen to meet the specific needs of each of the research questions. This chapter explains the reasons for choosing the data collection methods, a description of the methods used, and the role they play in answering the research questions. The chapter concludes with a discussion of the limitations of the methods.

Data collection methods

Surveys

There are many ways to measure the frequency of use of different forms of media. Some common quantitative measures include the number of newspapers sold, hits on a web site, and television ratings of specific shows. None of these measures, however, directly assesses the effectiveness of the different media as a communication tool. Newspapers like *The Land* and television shows like *Landline*, which often cover the topic of salinity, are not devoted specifically to the subject, so their readership and ratings provide no information specifically regarding salinity communication. Perhaps a more effective way to measure the effectiveness of media at communicating salinity-related issues is to ask the intended audience: farmers.

Surveys are performed to better understand and explain social phenomena. The social phenomenon examined in this study is communication in agriculture: specifically the dialogue between farmers and scientists and how this communication is perceived and rated by the

farmers themselves. In social research it is difficult to measure wide-scale public opinion so the views of a particular sub-group, thought to be representative of a wider group, are sought (Marsh, 1982). It is not feasible to canvass the opinions of all farmers on science communication in agriculture so this study focussed on a particular agricultural issue and farmers in a particular geographical area.

Surveys can collect both subjective feelings and factual information (Fowler, 1984). In order to answer the research questions it was necessary to collect data from farmers that included both their opinions and perceptions of the agricultural issue and communication media types, and to record factual information, such as memberships of community groups and demographics.

Different survey types are suited to answering different research questions. These include interviews conducted in person or over the telephone, written questionnaires administered to a group, by mail or distributed in person. Trochim (2000) discusses the relative advantages and disadvantages of each, but I will discuss only the advantages and disadvantages of postal surveys and why this method was chosen the over others for this study.

In the early stages of this research, I had intended to interview farmers about the media they use to access salinity information and how it influences their land management practices. However I changed to a postal survey as it provides several advantages over personal interviews. A postal survey:

- Can access more people and therefore more opinions. Due to time and financial constraints I could canvass more people with a postal survey.
- Will provide privacy and anonymity to the interviewee. As I had planned to ask questions about the condition of farmers land, financial situation and age, it meant they might be more honest.
- Allows people time to think and formulate answers. Long responses are possible. Respondents can take time to answer a combination of specific and open-ended questions.
- Will provide access to a geographically dispersed sample of people, reducing the travel time and costs compared to face-to-face interviews.
- Provides for a relatively quick turn-around with minimal administrative overhead.

Objective and representative sampling was important to this study so the opinions of both Landcare and non-Landcare members was sought. It was also important to ask both Landcare and non-Landcare members the same questions, and a self-administered, written

survey allowed for this consistency. Farmers in the research area had not been surveyed on this topic before and the survey was designed to suit the analysis requirements needed to answer the research questions.

However the postal survey method may have some disadvantages that could introduce bias, discussed in detail below;

- Inflexibility
- Low response rate
- No personal contact

Inflexible

Postal survey questions are inflexible because they cannot be tailored to specific responders or their individual responses, but it is possible to compensate for this by providing space throughout the survey and especially at the end for longer, open-ended questions. There remains the limitation that there is no opportunity to follow up on a respondent's answers to clarify their meaning.

Low response rate

Postal surveys traditionally have a low response rate. Fowler (1984) outlines three main reasons why those selected to be in a surveyed sample do not actually provide data. These are:

- the survey *does not reach* the respondent,
- those asked to provide data *refuse* to do so
- those in the sample are *unable to* perform the task.

When people refuse to provide data, they may merely have no interest or are indifferent to the subject; they would be interested in responding but are too busy; or simply don't like surveys, the researcher or the institution (R. Lamberts, pers. comm., 2004). Other forms of survey may be similarly affected. When the survey was conducted, only a limited number of farmers had reliable access to e-mail or the internet. The response rate of phone surveys can be limited by the pre-conception that unsolicited phone calls are trying to sell something or are seeking donations (Belcher, 2000).

No personal contact

Postal surveys don't allow for any personal contact so there is no chance for the researcher to explain the research and appeal to the interviewee to respond. Personal contact can be more effective than a cover letter. However, communication in interview situations has been the subject of many social science research studies. The personal attributes of the

interviewer can affect the responses (Marsh, 1982) perhaps eliciting a response through a personal connection or dissuading the respondent through misspoken words or negative body language. In some cases the subject may try to please the interviewer, may be apprehensive about being evaluated by the interviewer, or will tend to agree with anything the interviewer says.

Observation

Observation is an effective qualitative method used by researchers. The aim of observation is to gather first-hand information about social processes in a naturally-occurring context (Silverman, 2001). Observation is a research technique where the investigator looks, listens and records information through direct participation in, and/or observation of, a social group.

As a research tool, observation was useful when answering the research questions, particularly 'what science communication takes place at Landcare meetings?' This could also be achieved by interviewing key persons in the Landcare movement and analysing the text of Landcare meeting minutes. Due to time constraints and the scope of this study, observations at a number of Landcare meetings and informal discussions with members, scientists and the coordinator at these meetings was deemed sufficient to answer the research questions.

Population and sampling

The reason for collecting data about a sample is to reach conclusions about an entire population, not just the sample *per se* (Fowler, 1984). For this study it was not practical to sample all of the stakeholders involved in salinity research (e.g. scientists, managers, communicators, extension agents, and farmers). Therefore a sample of farmers from a specific geographical area – Harden – was chosen.

The sample was chosen based on the Harden mail drop area as defined by Australia Post. This method is known as 'area probability sampling' and can be used to sample any population that can be defined geographically (Fowler, 1984). It is a method recommended for sparsely populated rural areas (Fowler, 1984). The particular rural mail drop area was identified through discussion with the HMLG coordinator, Louise Hufton.

There are 240 mail drops in the Harden mail drop area. Theoretically 240 farmers had surveys delivered and were given the opportunity to participate in this study. These respondents were assumed to be demographically representative of the farming population in the district.

During research design, population issues, such as literacy, numeracy, language, cooperation and geographic restriction need to be considered (Trochim, 2000). I addressed these issues in various ways as outlined below.

A basic level of literacy was assumed for the sample population. A 1996 ABS survey of adult literacy (McLennan, 1996) found that about one fifth of adults employed in agriculture, forestry and fishing had very poor literacy skills: 19-22% struggled to understand and use information from various texts, including newspapers, magazines and brochures; 17-19% had limited document literacy, i.e. the ability to locate and use information contained in materials such as tables, schedules, charts, graphs and maps; and 15-19% lack the ability to perform arithmetic operations using numbers contained in printed texts or documents. This may reduce the possible number of respondents by about 20%. However, it was assumed that farmers had greater written literacy than computer literacy, making the postal survey preferable to an email- or internet-based survey.

Computers and the internet are only accessed by a small percentage of rural communities. According to 2001 ABS data less than 20% of people in the Harden Statistical Local Area had used the internet at home, work or elsewhere in the week preceding the 2001 Census (ABS online data, 2004). Internet connections in rural Australia at the time of the survey tended to be very slow, and therefore frustrating to use regularly. Even in the 2006 Census, after the survey had been undertaken, less than half of the Harden Statistical Local Area population had access to internet at home and half of those people only had slow dial-up internet access (ABS online data, 2006).

It was assumed that all of the potential respondents spoke English. According to the 2001 ABS Census, English was stated as the only language spoken at home by 93.9% of people in the Harden Statistical Local Area (ABS online data, 2004).

Using the Australia Post Harden rural mail drop area was advantageous for several reasons:

- The area was geographically defined
- The identities of the respondents were not revealed
- A list of people was available to Australia Post
- The surveys were delivered as a rural mail drop for 11c each - a considerable saving when compared to normal postage.

Cooperation was encouraged in a number of ways. The cover letter and section headings throughout the survey stress that the survey was not testing the respondents knowledge, nor

was it recording the value or quality of their property. The wording also explained that the results would be used to assist farmers.

Having considered the population and sample characteristics, it was also necessary to look at respondent selection (Fowler, 1984). In the Harden district, farms fall into three categories: owned by a corporation, run by a manager, or run by large or small farming families (L. Hufton, pers. comm., 2003). The survey was targeted toward the person on the property primarily responsible for information gathering and decision-making. Each survey was hand-addressed 'To the land manager' and the cover letter was also addressed to the land manager. The term 'land manager' was intentionally used to cover both property owner/managers and employed live-in property managers, and to be gender non-specific.

Survey design

When designing the survey and cover letter two main objectives were kept in mind – to gather the necessary information to answer the research questions, and to make the survey easy to fill out to facilitate the highest possible response rate.

Cover letter

Farmers were invited to keep the cover letter for their records. The cover letter;

- Appealed for their cooperation in completing and returning the survey,
- Described the aims, importance and applicability of the research,
- Emphasised the confidential nature of the data they provided,
- Explained who was carrying out the research and
- Informed that the research was approved by the Australian National University Human Research Ethics Committee (Protocol 2004/105; see Appendix B for approval letter dated 27 May 2004).

The task required of the respondent was outlined in the cover letter and it was explained that their contribution ended with them posting the completed survey back.

The cover letter was not stapled to the rest of the survey – the part to be returned – to encourage the respondent to keep it. The cover letter was printed on Centre for the Public Awareness of Science letterhead and photocopied onto plain white paper.

Instrument testing

The survey was designed in collaboration with my supervisors and incorporated the suggestions of other CPAS students. Feedback was also solicited and incorporated from a dairy farmer and his wife from Cowra, outside the study area.

Survey layout

The main survey was divided into 5 sections (See Appendix A for the full questionnaire). Section one asked a series of questions about salinity. The intent of this section was to find out if a farmer's land was affected and if so, how the affected areas had been identified (i.e. existing or traditional knowledge) and what measures had been used to address the problem. It also asked how the problem was perceived on a farm and catchment scale. It was important to ask about scale because previous studies have found that farmers tend to manage their properties as closed systems, and consistently perceive land degradation to be more severe in the district than on their own property (e.g. Moore, 2003). This has implications for communication. In this series of questions they were also asked about environmental and economic effects – to see if they differentiated between them.

The best way to find out which media and outreach efforts are reaching the intended audience is to ask the farmers where they get their information from. Section two sought the thoughts and opinions of the respondents regarding the availability and quantity of salinity information available to, and used by, them. Based on the available literature it seems that research and outreach organisations tend to focus on *what* they are communicating rather than *how* they communicate and to whom. They are considering the end product of their research, rather than considering the audience.

Section three asked a series of questions about community groups so I could correlate community group membership and attendance with other information, and also to assess how often farmers attended meetings and which groups they were with.

Section four asked a series of questions designed to relate salinity information to it's affect on farming practices. It sought information on other land management issues, since salinity is only one of the many land management issues faced by farmers, while scientists tend to look at a specific problem in relative isolation.

Demographic and education information was requested in section five. This section was intentionally placed near the end of the survey because it is an easy and quick section to fill out. This information was sought to correlate age, education and gender with the other information collected.

A final section provided writing space for comments on three areas – salinity information, communication with scientists and general comments.

Types of questions

Of most importance when designing this survey was that the questions were easy to understand and to answer. This meant using dichotomous (two possible responses) and scaled responses (using a bi-polar scale with a neutral point and opposite positions of opinion) as much as possible. Filter questions (where a question determines if the respondent has the qualification or experience to answer a subsequent question) were also used to eliminate respondents having to answer unnecessary questions. Finally, open-ended (or free response field) questions were asked to record opinions. While these open answered questions should be treated as anecdotal, rather than as measures (Fowler, 1984), they were valuable for recording extended answers and first-hand information. Using a combination of question types can hold the respondent's interest, and is a more thorough collection method.

Some examples of the different types of questions used in the questionnaire are:

DICHOTOMOUS

2.1 Do you read any salinity-specific publications at least once a month? For example; 'SALT' magazine.

Yes/No

SCALED RESPONSE

1.5 Please rate how severe a problem you believe salinity to be *in the Harden Murrumburrah catchment.* Please circle the response that best reflects your opinion.

Salinity is NOT PRESENT in the catchment 1	Salinity is MINOR in the catchment 2	Salinity is MODERATE in the catchment 3	Salinity is SEVERE in the catchment 4	Salinity is VERY SEVERE in the catchment 5

FILTER

3.2 Are you a member of the Harden Murrumburrah Landcare Group (HMLG)?

Yes	*Go to question 3.3*
Former member	*Go to question 3.4*
No	*Go to question 3.4*

OPEN

2.9 Please list any *other* sources you would use or have used for finding information on salinity. These could include formal and informal sources such as the radio, newspaper, the internet, community meetings or even talking to neighbours.

.....

.....

Returns

Farmers were given the choice to return the surveys. I explained in the cover letter that participation was not compulsory.

The final step in increasing the likelihood of response to the survey was to include a self-addressed, pre-paid envelope. At the end of the survey, I indicated that 'returned surveys would be appreciated by the end of June, 2004'. The farmers were given over 5 weeks to return the survey.

On the 1st of July, 2004 an article explaining the research project, the survey and encouraging returns was published in the local newspaper, the Harden Murrumburrah Express and also in a local newsletter. I wrote the article which was then endorsed by the HMLG coordinator. This was one of the best ways to encourage both Landcare and non-Landcare members to return surveys. The HMLG coordinator offered to e-mail reminders to Landcare members, but I felt that this would bias the returns towards Landcare members and did not accept the offer. All surveys received were returned by mail to CPAS.

Survey data analysis: Coding

As the surveys were returned, I labelled each survey/respondent with a 3-digit sequential ID number. Each of the answers to the closed questions on the survey was coded. For example, dichotomous questions were coded yes = 1 and no = 2 and the scaled answers were scaled from 1 – 5.

Answers to the open questions were recorded in a Microsoft Word document and sorted by respondent and by question. These detailed answers were transcribed and categorised for analysis. This anecdotal material was inspected for recurring issues and themes by grouping the answers by question in a table. Since the farmers felt that these open questions were important enough to respond to, it was valuable to include these answers in the assessment.

Landcare meeting observations

HMLG meetings occur monthly at the Carrington Hotel in Harden, NSW. I attended my first meeting in November 2003 to discuss my project with them. At the February meeting, a motion was raised and carried giving me permission to attend the meetings for my research, despite not being a financial HMLG member.

Observation, as a research method, was used to answer the question of what science communication takes place at Landcare meetings and to identify the media used by farmers to access salinity information.

Observations were made at four HMLG meetings. This involved: taking notes; recording attendance numbers and gender; talking and listening to discussions before, during and after meetings. I also obtained the minutes of the meetings I attended. I participated in discussions only rarely, contributing my background knowledge as a geologist and a person who has worked on salinity studies in the past when asked to. Between meetings I communicated with the HMLG coordinator, Louise Hufton, by e-mail, telephone and in person.

Discussion of methods

The information required to answer the research questions asked in this study could only be obtained by gathering the subjective feelings of a specific public group. Pieces of required information could have been obtained from other sources – e.g. there is information about numbers of farmers affected by salinity, newspaper readership, web site hits - but no place where the information was combined. Only a special-purpose survey could gather the required combination of information.

Using a combination of methods

In order to answer the research questions, a combination of research methods were applied to this study. The observations made at the Landcare meetings were used to plan and carry out the postal survey. Also the observations provided a broader context in which to place the results obtained from the postal survey. Observations were also used in isolation to answer specific research questions.

Using a combination of quantitative (survey) and qualitative (observations) methods and data is known as triangulation. In order to minimise the biases and limitations of each individual method in this study basic triangulation was employed. This involved assessing the survey

responses in light of the observations made at the Landcare meetings attended, and the discussions with the coordinator and visiting scientists.

Limitations of methods

Limitations of the survey method have been discussed throughout this chapter but some additional issues are indicated here. Observation, on its own, is not a rigorous research method. But combined with the survey, it provided a context in which to better understand the survey results.

Each month farmers receive several surveys from companies about their products, or from organisations asking their opinion (L. Hufton, pers. comm. 2004). My survey may have been viewed as 'just another survey' and disposed of. Also, many of the other surveys offered a motivation to return the survey in the form of a prize – such as a year's supply of fertiliser from a fertiliser company or a laptop computer. This survey did not.

I also acknowledge my own bias as the investigator. My background and training as a geologist who has studied salinity and worked with farmers provides a stable grounding for the project but may also introduce a personal bias based on personal opinions and experience.

Summary

Having evaluated other research methods, I decided to issue a self-administered, written survey distributed by post to farmers in the Harden rural mail drop on the subject of salinity and science communication in agriculture. This, when combined with observations made at local Landcare meetings, provided the most effective methods for answering the research questions. It canvassed a large number of farmer's opinions, was easiest on the respondents and addressed the research questions.

The collected results are presented in the next chapter.

Chapter 4 Results

Introduction

In order to partially evaluate of the success of efforts by scientific organisations, government initiatives and the media to communicate salinity science to farmers in the Harden Murrumburrah catchment area I have posed these questions:

1. What existing salinity communication methods and processes do farmers use and value?
2. What science communication takes place at Landcare meetings?
3. Does being part of Landcare make a difference to information exchange and farming practice?

This chapter presents the results of a postal survey distributed to farmers, the observations made at the Landcare meetings and the information gleaned from informal discussions with the Landcare coordinator and scientists involved with Landcare during the course of this study.

The results of the survey will be presented in seven sections: response rate, demographics, perception of the salinity problem, sources of information, community groups, comments and additional observations. The additional observations include discussions with key players, such as visiting scientists, and are presented at the end of the chapter.

The survey

During the first week of June 2004, 240 surveys were distributed to the Harden rural mail drop area. Over the following 6 weeks 20 surveys were returned. A newspaper article encouraging recipients of the survey to return it was published in the July 1 edition of the local newspaper; *The Harden Murrumburrah Express*. The article, titled 'Have your say on salinity information exchange', explained the research, the researcher, the survey and encouraged recipients to respond. It is not clear what effect this article had on the response rate.

Conditions during the survey period were not ideal for farmers. At this time farmers in the district were busy sowing crops as they had missed the optimum sowing date and had also just received a little, much-needed rain, and were dealing with the ongoing drought. In addition, discussions with farmers at the Landcare meeting after the survey was distributed revealed that farmers received numerous surveys by mail, and this was one among many. However the farmers who did reply were, on the whole, enthusiastic and provided detailed,

anecdotal responses. One farmer even called to discuss the issue of communication with farmers in more detail and several others indicated that they could be contacted again if the study progressed further.

In addition to the information gathered in the survey, I was able to attend four of the monthly HMLG meetings between November 2003 and June 2004 and make observations. During this period I was also in regular contact with the coordinator of the group, Louise Hufton, who provided additional information about the HMLG specifically and Landcare in general.

Response rate

Of the 240 surveys distributed, 20 were returned giving a response rate of 8.3%. The response rate of the postal survey was much lower than anticipated.

Participation was explained in the cover letter as being voluntary making the 20 respondents self-selected. Where a respondent's decision to participate may be correlated with a trait that affects the study (in this case literacy, education level, strong feelings or a keen interest in salinity) an element of self-selection bias is introduced (Winship and Mare, 1992). Despite this, a small but rich data-set of opinions and comments was acquired. As the sample size is too small to allow robust statistically analysis, a commentary of the trends in the responses and the anecdotal comments made in free fields is presented here, rather than a strict statistical analysis of the results.

Demographics

All of the respondents reside in the Harden rural mail drop area located to the north and west of Harden, NSW (Figure 4.1). The demographic information gathered via the survey included age, gender and education.

Eleven of the 20 people who responded to the postal survey indicated that they were aged between 40 and 55. Six of the respondents were aged over 55 years and 3 people indicated that they were aged between 25 and 40 (Figure 4.2a).

Of the 20 respondents, 17 were male and 3 were female (Figure 4.2b).

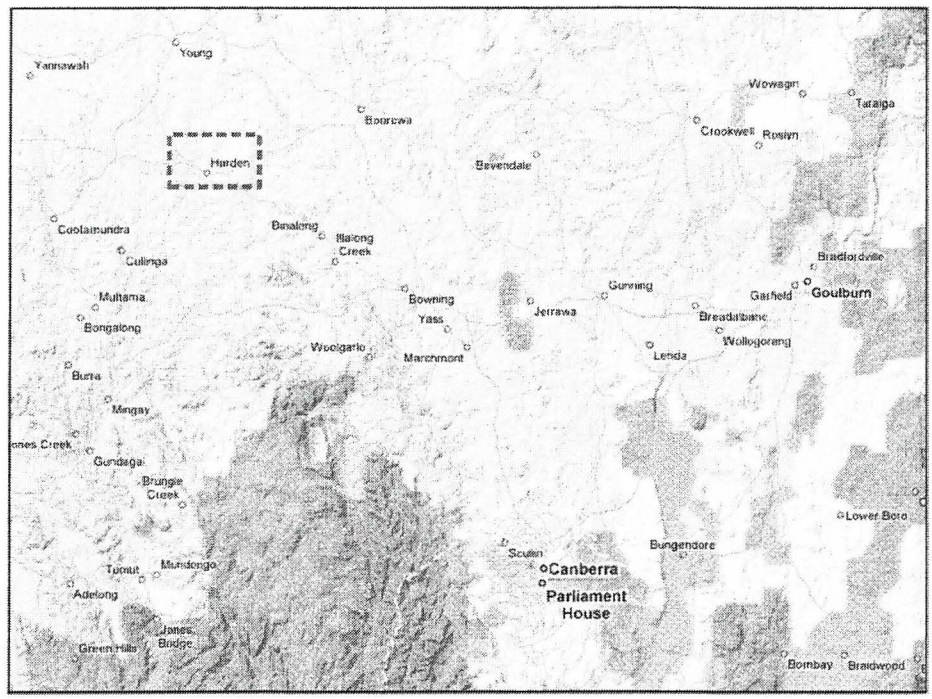

Figure 4.1 Section of New South Wales, showing Harden and Canberra (Source: google.maps.com)

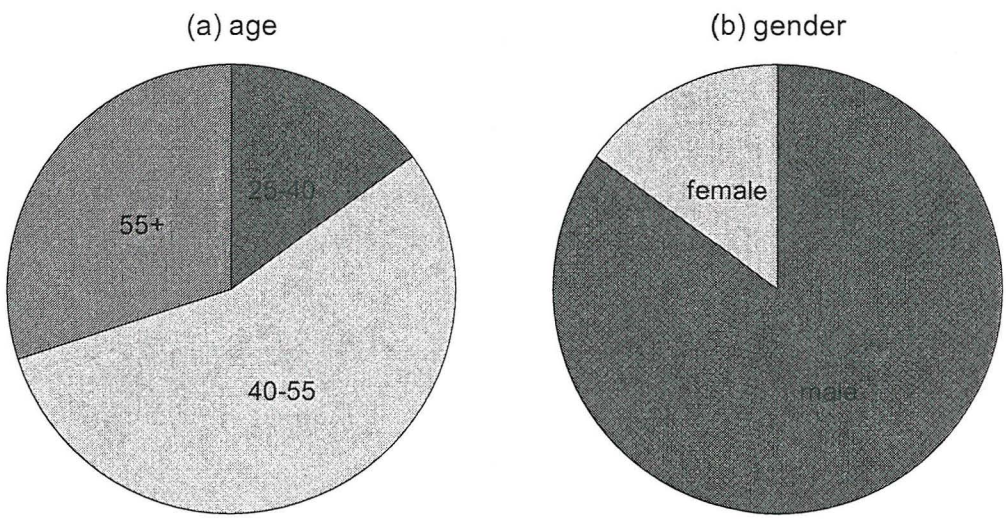

Figure 4.2. Gender and age information for the respondents

A similar gender ratio was observed at Landcare meetings. The average number of males present at the four meetings I attended was 11, and the average number of females was 1-2. This included one meeting that coincided with a World Cup rugby final, so the average numbers at a regular monthly meeting is actually about 15 males and 1-2 females (L. Hufton pers. comm., 2004). Visiting scientists and I were not included in this count.

As shown in Figure 4.3 the largest group represented in the respondents to the postal survey were males aged between 40 and 55. Next largest was a group of males aged 55 years and over (5/20).

Despite the low response rate, the sample population could be considered indicative, if not representative of the broader population. Census statistics available for the Harden local area show that about 30% of the employed population work as tradespersons or labourers or in related fields (ABS online data, 2006) and that those employed in these occupations are dominantly male. Three-quarters of the farmers who responded to this survey were males between 40 and 55+. This is assumed to be 'typical' of the population studies based on ABS data. Not all of the almost 30% are strictly 'farmers', however farm managers and farm hands are included in these categories.

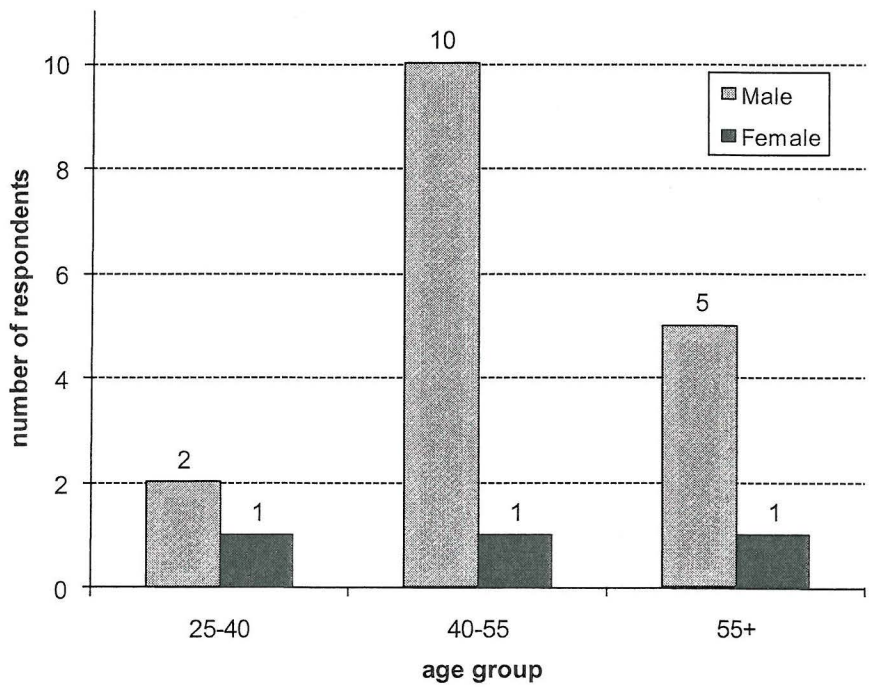

Figure 4.3 Gender distribution for each age group

Education

Question 5.3 asked if the respondent, or others on the farm who have a role in farm-management, had a formal agricultural science or general science qualification. The examples given in the question were university or Tafe courses. Respondents were given three choices:

- I have a formal qualification
- Someone else on the farm has a formal qualification

- No one on the farm has a formal qualification

Nine of the 20 respondents indicated that 'No one on the farm has a formal qualification', ten indicated that they (personally) had a formal qualification, and one respondent indicated that both they and one other person had a formal qualification.

The older (55+) and younger (25-40) female respondents had a formal qualification, while the 40-55 year old female respondent did not. Within the sample population it was observed that the younger respondents (i.e. under 55 years of age) had more formal education than the respondents over 55 years. The distribution of age compared with education level for all 20 respondents, male and female grouped together, is shown in Figure 4.4.

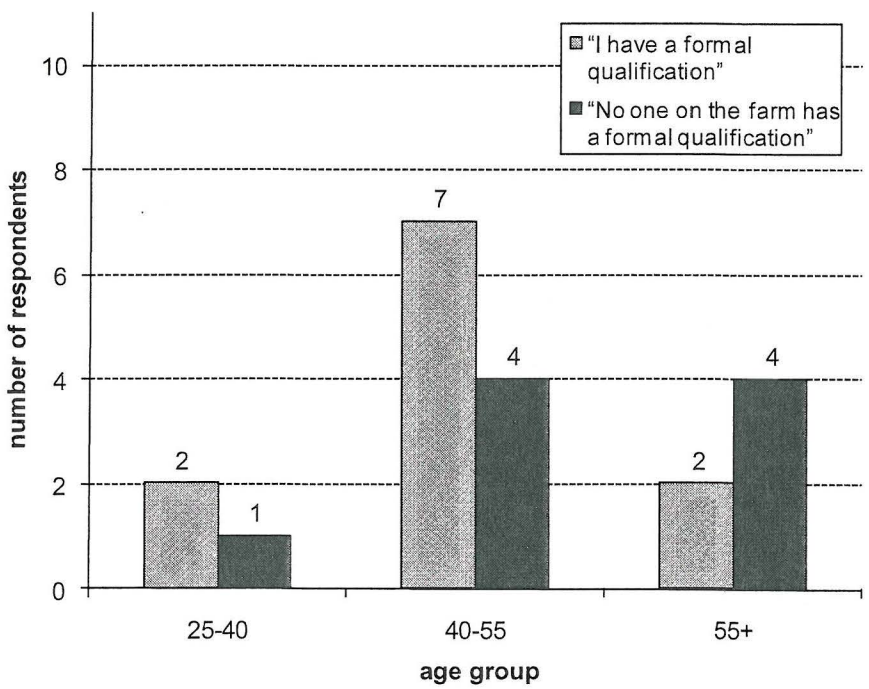

Figure 4.4 Respondent education level plotted against age groups

The education levels of the people at the Landcare meetings was quite mixed (L. Hufton pers. comm., 2004) though the people at the meetings tended to be older so, like the survey, probably had less formal post-secondary education. Apparently younger farmers with some level of tertiary qualification didn't typically attend Landcare meetings, and, according to Ms Hufton, "think they know it all already".

Perceptions of the salinity problem

The first section of the postal survey asked some questions about salinity on a personal/property scale and on a regional scale. There was space in this section for comments.

Property scale

Eleven respondents indicated that they had areas on their property that they considered less productive because of salinity. The remaining 9 respondents indicated that they did not.

The respondents who indicated that they had areas on their property that they considered less productive because of salinity were asked to list, in a free comment field, how they identified these areas. The examples of salt scalds and/or crop failure and/or dying vegetation were provided in the question.

By far, the most common answers were the identification of salinity-indicator vegetation species and surface scalding. Also mentioned were water-logged areas and areas of crop failure/under-performance. One respondent wrote that the areas affected by salinity were identified by a Department of Agriculture inspection.

The farmers were asked to rate the severity of the impact that salinity had had on their property on a scale of 1 – 5; 1 indicating that salinity was not present and 5 indicating that salinity had a severe effect. Of the 11 respondents who considered their property to be affected by salinity, ten considered their salinity problem to be 'minor'. One respondent considered the salinity on their property to be 'moderate'. Table 4.1 contains a list of responses to question 1.2 (Figure 4.5)

Respondents appeared to answer quite matter-of-factly to this question by simply listing the symptoms of salinity expressed on their property.

Respondents who listed salinity indicators in question 1.2 were asked to respond to question 1.3 by listing the methods and strategies they had adopted to treat salinity. The responses typically included planting trees, sowing deep-rooted pastures (e.g. lucerne and phalaris) and adding lime, and usually listed combinations of these. One respondent also listed covering bare patches with hay bales as a method employed to treat salinity. Table 4.2 contains a list of responses to question 1.3.

Table 4.1. How salinity was identified;
comments from respondents who identified areas of salinity on their property

Respondent	Comments in response to question 1.2
003	Bear [*sic*] patches, no vegetation
004	Excess water, spiny reeds and sea barley grass. Very boggy in winter
005	Salt scalds, sea barley grass, tree death.
006	Some crop failure in wet years, spiny rushes (pin rushes), some scalding
007	Salt scalds/rushes
012	Salt bush growth and scald
013	Spiny rush and salt scalds
014	Small areas salt scald, water-logging, bulrushes, affected trees, Dept. of Ag officer inspection
015	Small salt scald, area impetrated with needle rush, improved pastures will not grow, area only 1 ½ - 2 acres, has not spread over 27 years
016	Prior to this 3 yr drought, harvest equipment bogging in seepage areas previously unknown. Rising water table discharge area. Change vegetation within paddocks. Rose clover, black thistle, spiny rush.
019	Scalded areas, sea barley grass, spiny rush

Table 4.2 How salinity was treated;
comments from respondents who treated areas of salinity on their property

Respondent	Comments in response to question 1.3
003	Fed round bales out on bear [*sic*] spots
004	Adding lime, sowing down with Lucerne, trying to remove the spiny reed to achieve better pasture with phalaris pasture. Planting some trees – not much success
005	Lime/perennial pastures
006	Fenced off worst areas for forestry
007	Fenced off and planted trees in salt areas – limed all other areas and planted perennial pastures
012	Tree planting, phalaris establishment around perimeter affected area
013	Spraying with helicopter and planting Lucerne on surrounding lands
014	Trees planted, trees allowed to regenerate (trees fenced off initially)
015	No comments
016	Trees lines of river gum. Lucerne pasture
019	Liming, fencing out areas and planting trees, keeping stock out of these areas

In addition to being asked how severe the problem of salinity was on their farm, all of the farmers were then asked to rate the effect of salinity on their property based on two criteria – economic effect and environmental effect. Again these were scaled responses between 1 and 5. The results are shown in Figure 4.6.

Half of the 20 respondents claimed that salinity has not had a negative effect on their farms income. Seven of these considered themselves to not have a salinity problem, however three of the respondents who did have a salinity problem reported that it had a financial impact on their farm's income.

Respondents were also asked to indicate the environmental effect that salinity had on their property. Seven claimed that it has had no effect on their farm, 11 claimed it has a minor effect and two claimed that it has a moderate effect.

Most farmers responded the same for both effects but some separated the severity of the economic and environmental consequences (Figure 4.6). Five claimed that the environmental impact was more than the financial impact and two felt that the effect salinity has on the environment is less than the effect on farm income.

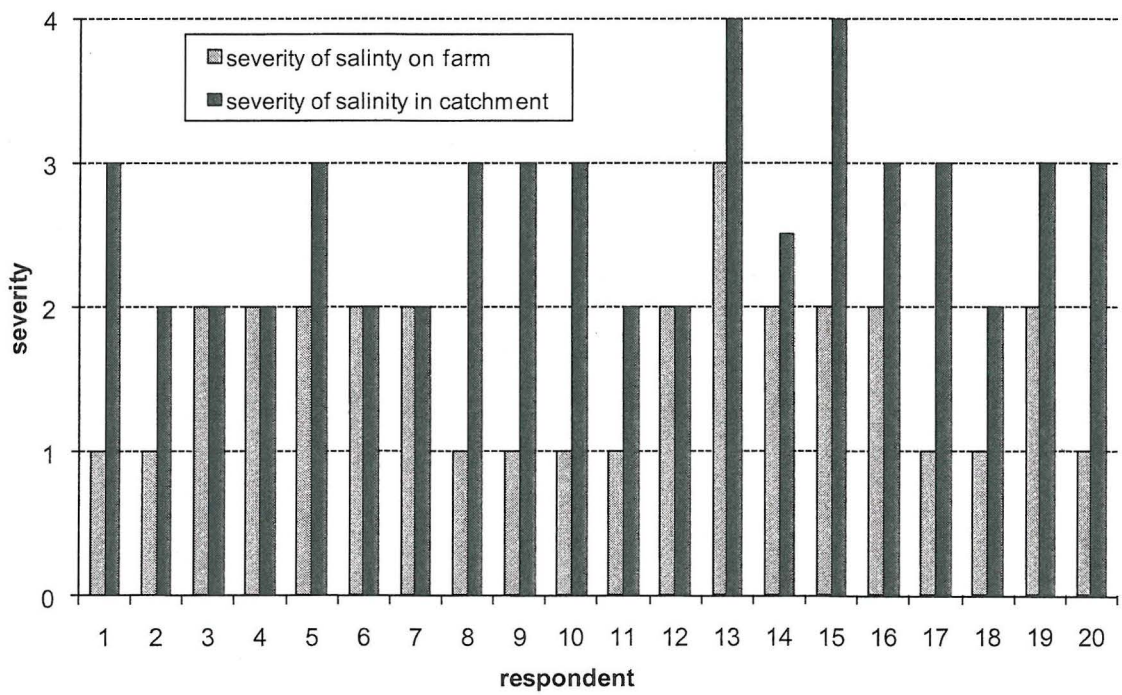

Figure 4.5 Perceived impact of salinity at the farm and catchment scale

Catchment scale

The farmers surveyed were asked to rate how severe they thought the problem of salinity was in the Harden Murrumburrah catchment. They were provided with a scale ranging from (1) 'Salinity is not present in the catchment' to (5) 'Salinity is very severe in the catchment'.

Most of the respondents viewed the severity of salinity in the catchment to be minor or moderate. Only one response indicated that they considered the problem greater than this and labelled it severe. One respondent separated the response into two answers, noting that salinity was minor in the land (soil) of the catchment and moderate in the water of the catchment (shown on Figure 4.5 as a value of 2.5).

Fifteen of the respondents considered that salinity was more severe in the catchment than on their individual property. Five considered that the severity of salinity was the same on the property as it was in the catchment (Figure 4.5).

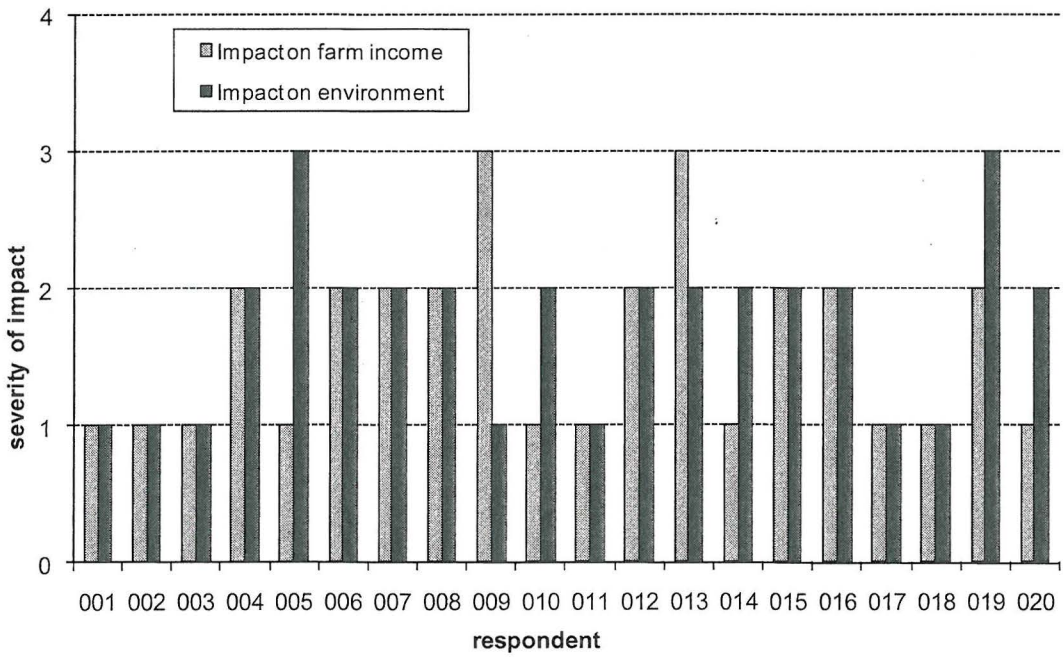

Figure 4.6 Perceived impact of salinity on farm income and the environment

Sources and value of information used by farmers

In the second section of the postal survey, farmers were asked a series of questions about their thoughts and opinions regarding the availability and quantity of salinity information in various media. This included traditional mass media (e.g. newspapers, radio), targeted media (e.g. SALT, a salinity magazine) and the internet, and also contact with scientists, peers and others through community meetings. There was an 'other' section for them to record sources not listed. The responses to a selection of the questions regarding the use of different media are summarised in Figure 4.7 and discussed below.

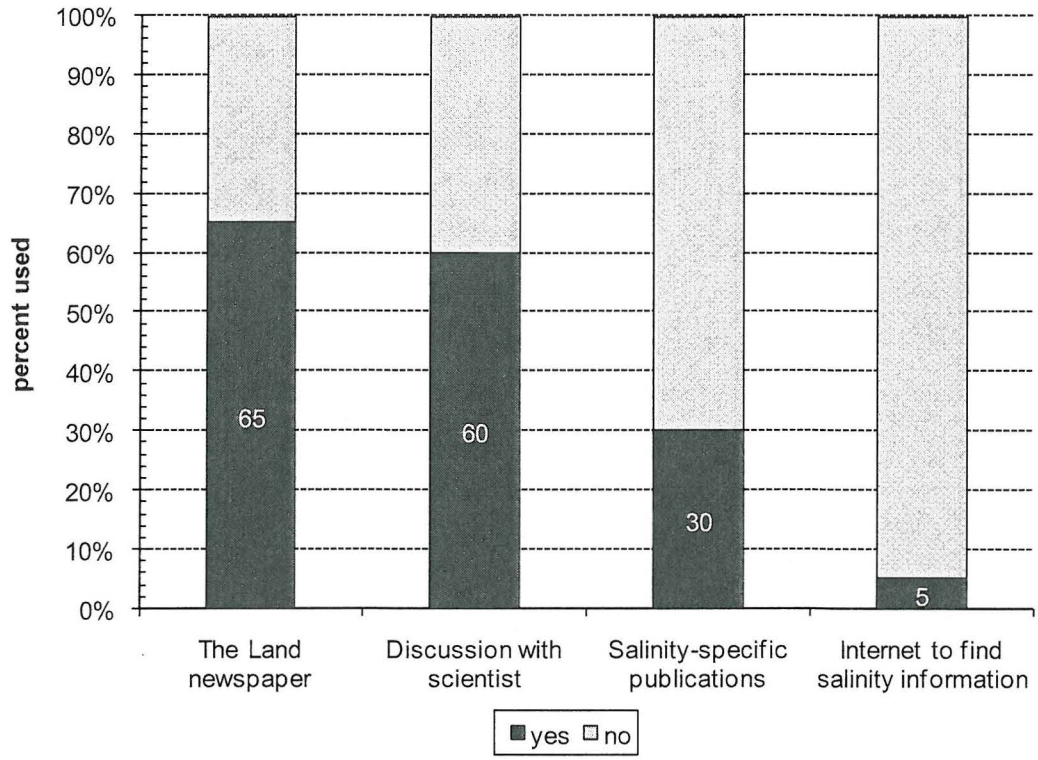

Figure 4.7 Different media used by farmers in the Harden Murrumburrah area

Salinity-specific magazines

Six of the 20 respondents answered 'Yes' to reading any salinity-specific publications at least once a month. Other regular newsletters, beside *SALT* are distributed to farmers in the district, such as '*The Australian Farm Journal*' and '*FarmLink*', which can contain salinity information and updates on scientific and agricultural research (L. Hufton pers. comm., 2004).

Rural newspapers

Of the 20 respondents 13 read '*The Land*' at least once a week. Those who did were asked an additional question about the quality of salinity information presented in '*The Land*'. Of those respondents who read '*The Land*' nine considered the quality of salinity information to be average or above and four considered it to be below average or below satisfactory. One even went as far as to say "same shit week in week out" (003).

The local newspaper, '*The Harden Murrumburrah Express*' seldom has any scientific or salinity-related stories (L. Hufton pers. comm. 2004).

Salinity on the internet

A series of three filter questions were used to inquire about farmer's use of the internet: whether they used it to find salinity information, which sites they visited and if they found them useful. Twelve respondents used the internet once a week, and of those only one person used it to find salinity information. The sites the respondent found to be most informative were developed by the Department of Natural Resources and Water Queensland Government and Australian Government Rural Industries Research and Development Corporation.

Discussions/interactions with scientists

Farmers were asked if they had ever discussed salinity with a scientist who is researching salinity. Twelve respondents indicated that they had. These respondents were asked to list the name and affiliation of the scientist or just to indicate 'Yes' if they would like the scientist to remain anonymous, or if they had forgotten their name. Table 4.3 lists the respondent's answers.

Table 4.3 Discussions with scientists

Respondent	Comments in response to question 2.8
003	Land and Water Conservation (checking water table)
005	Field days – Andrew Wooldridge – DIPNR Landcare meetings – Scott McCauley, Peter Baker - BRS
006	Various scientists through Landcare
007	Yes – Dr. J. Angus and Dr. Paul Hutchison, both of CSIRO
008	Yes, at field days in the area through Landcare
010	Ag Bureau Meeting – Bookham, through teaching and though own BaAppSc Ag, dealings with Landcare
011	Yes
012	Research on property and at Landcare meetings
013	Douglas Creek community group
014	Yes
018	Through Uni (Charles Sturt Wagga), Catchment Management, Landcare
019	Andrew Woodridge – DIPNR, Cowra

Of the 12 respondents who had had spoken with scientists about salinity, seven mentioned a community group connection, and six of these mentioned Landcare specifically.

Presentations by scientists to the HMLG

Of the four HMLG meetings I attended over seven months, three featured presentations by visiting scientists. This is a typical situation for the HMLG who try to arrange a guest speaker (usually a scientist) every 3 out of 4 meetings (L. Hufton pers. comm., 2004).

The guest scientists who presented to the HMLG during this study were from a range of institutions, all based in Canberra; Geoscience Australia, The University of Canberra Dryland

Salinity Hazard Mitigation Project and the Bureau of Rural Sciences. Other institutions include various divisions of the CSIRO (L. Hufton pers. comm., 2004).

The scientists were motivated to present their research at the HMLG for several reasons. Projects are often set up in collaboration with HMLG for mutual benefit. The collaborating scientists then present their work at Landcare meetings, giving a project status report, explaining scientific procedures, discussing findings and interpretations of results. They also receive feedback and share information and knowledge, and develop future collaborative projects and funding (J. Wilford, pers. comm., 2003, L. Moore, S. Macaulay pers. comm., 2004). The scientists also used these opportunities to distribute products like reports and maps. One of the scientists sums it up by saying; *"They are our clients... we can do great science but if we are not focused on outcomes that help people and the environment, then what's the point?"* (J. Wilford pers. comm., 2003). Another commented that *"it's very important to see natural resource management issues from a landholders', rather than just a professional scientist or policy-makers', perspective*" (S. Macaulay, pers. comm., 2004).

The HMLG is motivated to have scientists as guest speakers because the members hear the information "first-hand" (L. Hufton pers. comm., 2004). The farmers at the HMLG want the "facts behind the message" and they want it from a credible source. Another benefit is being able to interact with the scientist, and discuss how their research relates to other issues they are dealing with. During the meetings I attended, each of the presenting scientists was questioned during and after the presentation and included in long informal discussions afterwards. One of the conditions for working collaboratively, and sharing funding, is that the researchers report back to the HMLG regularly on their research (L. Hufton pers. comm., 2004).

During the meeting at which no visiting scientist was present, the group discussed the different messages (both scientific and political) that they were receiving from the various organisations the group deals with. A suggestion made by one farmer was that "we should get all of 'em together in one room and find out what's really going on". The suggestion involved organising a day-long or even half day workshop where all of the scientists working in the area presented their findings and discussed with each other what they thought. This did not happen during the period of this study.

Other sources of salinity information

The final question in the sources of salinity information section asked the farmers to list any other sources they used to access salinity information. This section was included to find out

about any sources not listed in the previous questions. Thirteen respondents indicated that there were other sources they used for gathering/accessing salinity information. These are listed in Table 4.4.

Table 4.4 Other sources of salinity information

Respondent	Comments in response to question 2.9
001	Talking, reading and radio
004	Talking to neighbours, watching Landline, reading some magazines, talking to some people in soil conservation.
005	Principally Landcare and field days
006	Radio and TV. Farm forestry information
007	Landcare network
008	I just am aware of salinity in the area and as such try to keep up with developments and research.
010	Radio ABC 666 Local newspaper Landcare
014	H-M Landcare Group Boorowa Landcare Group Dept. of Agriculture
015	Local Landcare group
016	YLAD Living Soils Landcare Family member is yr 4 student Land and Water science undergraduate specialising in soils, Sydney Uni
018	I have found information on every medium and talked to a lot of people about it
019	Community meetings
020	Departmental information, articles in rural magazines

Community groups were mentioned quite often in response to the question about other forms of communication. Also mentioned were conversations with neighbours and representatives of agricultural organisations, and reading magazines and the local paper. Television (programs like '*Landline*') and radio (ABC 666) were also mentioned.

Community groups

The third section of the survey asked the respondents for their opinions regarding community groups in general, and specifically the HMLG. The aim of this section was find out how instrumental community groups like the HMLG were in communicating scientific information, particularly salinity information.

The first question asked for an indication of people who had attended public meetings where the topic discussed was salinity. The examples given in the question were community meetings, Landcare meetings, field days and/or workshops. Twelve of the 20 respondents indicated that they had attended such meetings and these were asked to give details as to the nature of the meeting (either the name of the meeting or the group that organised it).

Landcare was mentioned by ten of these 12 respondents (mostly HMLG but also Bookham and no-specific-group Landcare). Other groups included: Bookham Agricultural Bureau; Douglas Creek community group; Forbes conservation farming; Wagga campus, Charles Sturt University; and the CSIRO.

The farmers were asked if they were current members, former members or never members of the HMLG. Of the 20 respondents, 16 were current members. These members were then asked how often they attend meetings. Half of the present members attended some, most or all meetings and the other half did not, or attended only a few meetings.

All of the farmers who reported having areas on their property that were less productive due to salinity were members of the HMLG (11/11), though the regularity of their attendance at meetings varied. The remaining 5 members of the HMLG in the sample population did not answer yes to having salinity problems on their property.

The final question in this section was a free field question asking about other community groups or events where salinity information is or was discussed. Five of the farmers responded and the other community groups they mentioned were (some respondents mentioned more than one);

- Australia Forest Growers
- Southern Tablelands Forestry Network
- Murray Riverina Forestry Network
- Farm adviser meetings
- Council meetings
- Edge Management (a business management group)

The influence of salinity information sources on farming practice

Salinity is not the only land management issue facing farmers in Australia today. Many factors influence their decisions with respect to farm management. The fourth section of the postal survey asked farmers where they placed salinity in their farm management priorities and how their awareness, knowledge and farm management practices have changed with respect to salinity over time.

Only one of the 20 respondents indicated that salinity management and prevention was their top priority with respect to farm management. The remaining 19 respondents provided long lists of issues and problems that they thought were more important (Figure 4.8). The most frequently mentioned issues were weeds and water. This includes the management of

weeds such as Patterson's Curse, and the sourcing and usage of water, especially in this time of drought. Closely following weeds and drought on the farmer's priority list was the control of feral animals and insect pests. Soil acidity, erosion and the management of infrastructure (roads, fences) were also mentioned more than once.

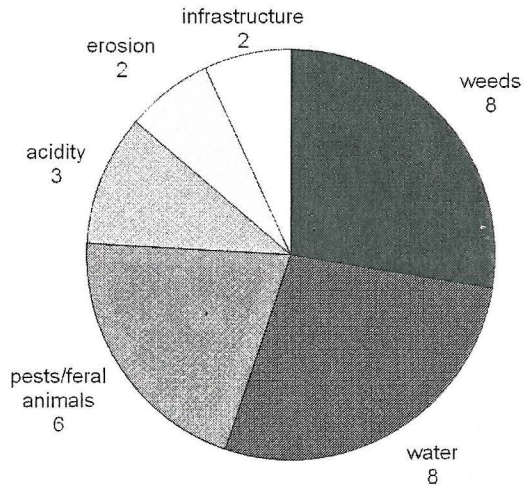

Figure 4.8 Other farm management priorities listed by respondents in response to question 4.2

The farmers were then asked about their own awareness and knowledge of salinity. I introduced this question by saying "over the last 10 years, salinity has become an issue of national importance and concern. More money is being given to scientists to study salinity, and publications about the salinity problem have been published in a variety of forms."

Table 4.5 shows the responses to the questions about awareness and knowledge over the past 10 years.

Table 4.5 Change in awareness and knowledge of salinity

In the past 10 years...	Decreased	Stayed the same	Increased
AWARENESS of salinity	1 (5%)	2 (10%)	17 (85%)
KNOWLEDGE of salinity	1 (5%)	2 (10%)	17 (85%)

The majority of farmers in the sample population felt that their awareness and knowledge had increased in the last 10 years. Few farmers drew a distinction between awareness and knowledge, answering the same for both. Of the 17 farmers who felt that their knowledge of salinity HAD increased over the last 10 years, 10 felt that this increase in knowledge had lead to a change in practice on their property.

The final question in this section asked farmers their opinion on whether farming practices in Australia had changed over the past 10 years in response to an increased awareness of salinity. Sixteen of the 20 respondents indicated yes, and 3 no, and one said sometimes.

Comments

At the end of the survey, space was left for the farmers to write comments. Responses in this section were separated into three categories;

- Comments on salinity information
- Comments on communication with scientists
- General comments, for example about this survey or on salinity in general.

In the following section I discuss the trends in these comments with respect to the farmer's perceptions of the salinity problem and toward scientists.

Perception of the salinity problem

The farmer's perceptions of the salinity problem in the catchment tended to down-play the issue. One farmer (007) commented on how it was only one of a number of farm management issues and encouraged "*holistic farm management*". He believed that "*there is a far too great an emphasis on salinity alone as a single issue problem which it is not*". Another (006) said that he does "*not believe salinity is as big a problem as it has been made out to be*".

Many of the comments from farmers were specific to their own farm situation, describing the condition of their property. One farmer said that it "*is more of a problem downstream*" (020).

In these comment fields the farmers also listed what they believed to be the causes of salinity in their district. These included a "*severe cropping phase*" in the 1980-1990s involving use of more chemicals (008), and that "*a lot of the problems today about salinity are caused by our past farming practices and the pressure that commercial entities place on farmers*" (008).

Communication with scientists

Most of the comments that the farmers provided about scientists were positive. In fact, one farmer (014) felt that the "best information has been brought to the district through contact with scientists and their projects which they have undertaken in the region". Some commented that the best ways to meet scientists is "to attend seminars and field days" (006) and that communication is "especially beneficial when organised through community groups" (007).

Summary

The farmers who participated in the survey were pre-dominantly males aged 40-55, and it was observed that there was a similar attendance at Landcare meetings. This demographic group is 'typical' of farmers in the area. Younger farmers tended to have more formal education and there was a general trend that older farmers prefer to learn in less formal ways, like meetings and field days. Half of the survey respondents were managing land affected by salinity, which had been identified by scalding and salinity indicator vegetations species, and treated by planting trees, deep-rooted pastures and the application of lime.

Of the four salinity communication methods and processes I asked about in the survey, most farmers use and value newspapers and interaction with scientists. A few read salinity-specific publications and only one respondent used the internet to find salinity information. Where farmers had spoken with a scientist, most of the time they were brought together by a community group like Landcare. Other sources of information used by farmers included radio, television (e.g. *'Landline'*), rural magazines and discussions with neighbours and agricultural agencies.

Science communication does occur at Landcare meetings. The meetings allow scientists to explain methods, assumptions, background information and results. They are there in person to answer questions, and to help make the information applicable to the farmers, and to the local situation, i.e. explaining in 'real terms' what is happening 'on the ground'. Farmers are given the opportunity to ask the scientist about conflicting research and messages, and to see how funding is being spent. Scientists are given the opportunity to 'pitch' ideas for future research funding and collaboration. Even when there is not a scientist present a Landcare meeting, science communication takes place in the form of farmers discussing ongoing scientific research and feedback from conferences and other meetings attended.

Chapter 5 Discussion and Conclusions

Introduction

Drainage catchments in the Harden area of New South Wales are some of the major contributors to high salt loads in the Murrumbidgee River (NSW DLWC, 2002). Land management practices are evolving in the area in an attempt to remedy the situation. For farmers in the area, and indeed land managers in general, to become part of the solution, more effective pathways for sharing information and the results of scientific research are required.

I have proposed that a better understanding of the communication between farmers and scientists will lead to better land management practices, better distribution and spending of research and government funding, and the implementation of more productive land management policies in this field. This study aimed to contribute to the understanding of science communication in agriculture predominantly from a farmer's perspective and focused on the land management issue of salinity in Harden.

Combinations of social and scientific factors are involved in the communication of technical information in agriculture. As discussed in Chapter 2, existing literature reveals that research organisations are beginning to acknowledge the social component of agriculture. It is important for all parties involved to realise that science communication in agriculture is more than a simple transportation or translation of a scientific method or results (Macdonald, 1996). Context, scale and language are important factors to consider when sharing scientific information with farmers. Farmers are reluctant to treat technical issues as distinct from social and economic factors (Fisher, 1995) and the key message from the literature review was that they prefer to learn informally, rather than formally.

Based on the reviewed literature and an evaluation of available research methods, this study analysed the responses to a postal survey distributed to farmers in the Harden rural mail drop area, in combination with observations at several meetings of the Harden Murrumburrah Landcare Group (HMLG). These methods were selected to complement and reinforce each other, and are detailed in Chapter 3.

This research project has collected a small dataset detailing communication mechanisms preferred by farmers in agriculture through a postal survey, observations at Landcare meetings and discussions with scientists and the Landcare coordinator. These were presented in Chapter 4. The response to the postal survey was disappointingly low, but it did

collect a rich dataset of opinions and comments that, together with observations at meetings, discussions with scientists and a literature survey, provide the basis for several recommendations for the future of communication in agriculture.

This chapter answers the three research questions posed in Chapter 1, explores the limitations of the study and provides several recommendations for improving the dialogue between farmers, community groups and research agencies.

What existing salinity communication methods and processes do farmers use and value?

Farmers are not eagerly awaiting the release of the latest salinity research. They are cautious and take time to accept new knowledge, and integrate it into their own situation. There are many communication mechanisms that farmers use to access salinity information but it appears that they value face-to-face communication – with each other and with scientists – the most.

Sections two and three of the postal survey asked questions about the science communication mechanisms farmers' use and value. The questions in these sections expressly asked them to comment on salinity-specific publications: the rural newspaper, *The Land*; the internet; discussions with scientists; 'other' sources used to access salinity information; and their membership and attendance at community meetings, field days, and other events.

Written publications

The review of the available literature produced mixed results as to how much influence newspapers and salinity-specific publications have on farming practices. In the postal survey, almost a third of the respondents read a salinity-specific publication at least once a month. However there was no correlation between those farmers whose property was affected by salinity and those who read salinity-specific publications. Some farmers did read salinity-specific publications even though their property was not affected, and some farmers whose properties were affected by salinity did not read salinity-specific publications. This result implies that these salinity-specific publications are not always reaching their intended audience.

The Land is a popular rural newspaper publishing 2-5 articles per month pertaining to salinity (The Land, 2009). In the survey, respondents who read *The Land* provided a mixed assessment of the quality of the salinity information it provided. Although *The Land* is not specifically oriented towards scientific issues, it certainly reaches a large proportion of those

farmers whose land is affected by salinity. This implies that it is underutilised for this purpose, and may have potential to be a powerful conduit of salinity and other scientific land management research, perhaps in the form of special supplement sections, or occasionally including free samples of salinity-specific publications.

Internet

Many scientific organizations invest significant time and effort into website development and posting information online and perhaps believe that this is effective communication of salinity information. It was observed by several authors in the literature review (Black, 2000; Rolfe et al., 2003; Willis and Tranter, 2006) that the internet has the potential to be a great source of salinity information for farmers, but was not there yet. Survey respondents only rarely used the internet, mostly once a week and only one of the 20 respondents used it to find salinity information. During the Landcare meetings I attended there was mention of the slow connections discouraging people from using the internet to find salinity, and science information.

This indicates that the internet, at this time, is not the best communication tool to reach rural people and communities. Until rural areas become better connected, and younger generations of farmers develop into decision makers on farms, the full potential of the internet for effective salinity communication with farmers will not be realised.

Discussions with scientists

Organised community groups provide a powerful forum which facilitates discussions and interactions between farmers and scientists. Of the 20 survey respondents, 12 had spoken with a scientist about salinity. Of these 12, seven mentioned a community group connection and 6 mentioned Landcare specifically.

Regular community group meetings and special events, e.g. field days, are convenient opportunities for scientists to reach many farmers. Of the four meetings I attended, three different scientists attended three separate meetings. They were each from different research groups, and all presented salinity and groundwater-related information. Each had a different style of presentation; however, question and answer sessions were always the most productive and engaging time for the farmers. The farmers kept the scientists in conversation long after the presentation and official part of the meeting had concluded.

Community groups

As mentioned above most of the interaction between farmers and scientists was facilitated through community groups. This will be discussed in full detail in the following section.

What science communication takes place at Landcare meetings?

Landcare meetings are a convenient opportunity for farmers to meet in a mutually respectful setting to share information within their local context. The meetings have a set structure and order but are not strictly formalized. Community groups, like Landcare, value individual strengths and encourage respect amongst peers. Farmers and scientists can meet together in community groups like Landcare, to reconcile scientific, agricultural and personal drivers.

During a discussion with a farmer at one Landcare meeting I attended, he mentioned that Landcare meetings were a social opportunity, replacing a group of farmers chatting outside church or a sporting club about land management issues. Traditionally farmers might meet at church or sports venues and by chance discuss land management issues. Landcare provides a forum to discuss specific local land management issues, encourages conversation between farmers and researchers, and spreads awareness beyond direct neighbours.

Community groups have the potential to bring people of different ages, generations and genders together to discuss land management issues. However, the HMLG meetings I observed were attended mostly by middle-age to older men, and the majority of the survey respondents were also men aged 40-55. This may indicate that male farmers in the 40+ age group prefer learning and sharing information in a community group setting. This is also considered the 'typical' farmer in this region. Perhaps younger generations prefer to find information on the internet, or through formal learning methods, like university. There was a trend in the survey respondents and at the Landcare meetings I attended for younger people to have more formal education.

Landcare meetings allow farmers and scientists to resolve different perceptions of scale. Farmers tend to have a holistic, whole-farm view of agriculture whereas scientists often have an issue-specific, landscape- or catchment-scale view of agriculture. A similar trend is observed with time scale. Scientists tend to look long term and farmers more short term. Bringing scientists and farmers together at Landcare meetings allows each group to reconcile what drives scientists and science, and what drives farmers and agricultural practice.

Information bought to a Landcare meeting, either by scientists or farmers can be consolidated and coordinated in a familiar context. A comment made at one Landcare meeting I attended expressed the frustration the group was feeling as a result of the mixed scientific and political messages the group was receiving. This was also a major finding at a

conference in 2002 also: "The current lack of institutional coordination was identified in the workshops as one of the main barriers impeding the uptake of sustainable practices" (Wilson, 2002, p. 8). There is clearly value in scientists presenting their research at Landcare meetings, but also a need for consolidation and coordination of the messages. Landcare meetings identify this need and have the potential to contribute to a coordinated approach to land management issues.

Science communication not only takes place at Landcare meetings, but through being a member of Landcare. HMLG newsletters, for example, are distributed between meetings and reach the 240-person-strong membership. Whilst the newsletters themselves contain very little scientific information, they do make the membership aware of upcoming events where science communication will take place, such as meetings and field days. Field days are organised visits to a farmer's property in the area to look a specific land management initiative or project. These events are an excellent science communication strategy because all of the attendees are willing participants exchanging information directly related to a local situation.

However, Landcare meetings may also be a forum for the miscommunication of science. A misinterpreted message may be perpetuated or reinforced in a community group setting. The possibility of incorrect information being disseminated is as likely as correct information being disseminated. A few minor, specific examples of this were observed at the meetings I attended.

Another possible disadvantage to catchment-based Landcare groups is that the group focuses only on the immediate area surrounding it. This may cause competition for funding between groups and hinder regional scale planning.

Community groups like Landcare can also be perceived as clique, within the group and also to other people who are not Landcare members. This could have an effect on the dissemination of scientific information and also on the distribution of funding. A discussion along these lines was observed at a meeting I attended. The issue seemed to be equal distribution versus targeted distribution of funding. When funding is available to treat a land management issue, should it be distributed equally or to those most affected? This is especially challenging when the funded treatment may result in an increase in property value. When a group of people, including scientists and farmers, sit down to distribute funding they have to be careful not to favour particular farmers or properties over others, or to favour a particular scientific method or agricultural solution, or to favour Landcare farmers or non-Landcare farmers. In most cases, it is scientists, and not farmers, who define where

areas in need of research are. But if the work done in these areas, despite being of long term value to the whole catchment, provides immediate improvement to the farm infrastructure for the individuals whose properties are involved, they will have an advantage should they chose to sell.

In summary it is clear that farmers respond best to face-to-face science communication, especially males aged over 40. The most favourable section of the meetings I attended was the question and answer session. In all cases the farmers kept the scientists in conversation for a long time after the presentation and official part of the meeting had concluded. It is good for the scientists too, as it provides a mechanism for identifying misconceptions and addressing these directly. It also allows the scientists to mesh with the holistic views of the farmers.

Does being part of Landcare make a difference to information exchange and farming practice?

The reviewed literature combined with the evidence collected in this study suggest that being part of Landcare has a beneficial impact on information exchange, and provides run-on benefits to finances and the environment by influencing farming practice. Scientists who associate themselves with Landcare groups also gain an advantage when it comes to information exchange.

Benefits to farmers

Farmers are motivated to manage their land for financial gain, to provide income for their families, because they are comfortable with the lifestyle and want to leave a legacy for the next generation. They operate on finite spatial and temporal scales, and not always with a catchment-wide perspective.

All 11 farmers who responded to the postal survey as having areas on their property that were less productive due to salinity were members of the HMLG, though the regularity of their attendance at meetings varied. This correlation could indicate that farmers realise the benefits of being a Landcare member when managing land management problems.

As discussed in the literature review, recognition of the values, beliefs and social setting of the receiver is critical to the uptake of any land management message. For farmers to make a change to their farming practices they first need to recognise the problem. Landcare provides a forum to discuss land management issues, such as salinity, in a room full of peers. All of the farmers who attended the Landcare meetings I witnessed were there to increase their knowledge of the issues they were facing, to improve their farming practice,

and to contribute information to researchers working in the field. Failure to recognise a problem means that the aim of the communication is not reached. Landcare groups represent a group of people who have taken the first step and are recognising problems and willing to take further steps to make a positive change.

Benefits to scientists

By regularly attending Landcare meetings, scientists can increase their scientific credibility 'on the ground'. As discussed by Wynne (1996) scientific credibility is based not only on the information presented but the social setting of the communication. Community groups like Landcare provide a ready-made social setting in which to present scientific information. A similar conclusion was reached by Lee (1998) who found that a relationship involving repeated and ongoing discussion needs to be built between farmers and advisors, particularly when communicating farm management conservation issues.

Scientists who are part of Landcare are able to experience not only the agricultural farm cycle but also the social cycle of an area. These scientists hold an advantage because they understand that their research results are just one element of a farmer's farm management role. They understand that new information must be presented holistically as one of many land management concerns, delivered the right way and in the right context. A quote by one of the scientists recognized that scientists are service providers in this situation, and that the farmers are the patrons 'buying' their research product; *"They are our clients... we can do great science but if we are not focused on outcomes that help people and the environment, then what's the point?"* (J. Wilford, pers. comm., 2003)

There is a perception by farmers of a lack of communication between scientists, scientific research organisations and government agencies that are supposed to be working on the same topic. Hence the perception of scientists by farmers can range from respect to indifference to distain. Farmers do not discriminate between scientists and scientific organizations and struggle to reconcile research drivers. A benefit of a catchment-based Landcare group is that it brings different fields of science and land management together and forces resolution between contrasting ideas and solutions (e.g. a government department recommends planting more of a certain crop and local extension officers suggest planting less or a different species). The ideal way to do this would be a workshop, as suggested by one HMLG farmer, where all of the groups working in a particular geographic area or drainage catchment come together to discuss what each group is doing, if their synergies are working, and where funding could be best directed and used.

Mutual benefit

As one scientists explained, many scientific organisations "use" farmers for research purposes and then dismiss them. This is an issue for the HMLG because they are so close to Canberra and are a well known and organised group. This was mentioned during a meeting I attended where the farmers discussed that a few scientists were "overdue" reporting back to them. For mutual benefit, scientists and research organizations need to establish and maintain lasting, meaningful and open communication relationships with Landcare groups. Unfortunately, as one of the scientists pointed out to me, the nature of funding and project work in scientific organisations is dependent on finance and driven by political agendas. Projects may finish before the Landcare group is satisfied, and so farmers may be reluctant to collaborate when approached again. However, the HMLG has learned to be opportunistic with respect to accessing skills, expertise, resources and funding when available.

The role of an intermediary between scientists and farmers, such as an extension officer, Landcare coordinator or research agency communicator, requires time to build relationships and respect, from both the people in the community and the scientists. Farmers also need to hear the research 'straight from the horse's mouth' on occasion. These intermediaries are vitally important as they have the ability to facilitate the communication and to translate local values into practical and relevant applications.

Communication in agriculture is a multi-directional conversation where scientists listen to and value input from farmers, and vice versa. Face-to-face communication through a Landcare meeting or event makes a big difference to information exchange and farming practice.

Study limitations

The following is an evaluation of the research methods used in this study. As discussed in Chapter 3, postal surveys have three main limitations: inflexibility, low response rates and a lack of personal contact.

A postal survey was used to allow farmers more time to contemplate their answers in an attempt to gather a high quality, un-biased, representative sample. In terms of examining science communication in agriculture the 8.3% response rate of the postal survey represent the opinions of a small group of the population, and the conclusions and recommendations of this study are limited to one particular area of science, salinity, and one particular sub-set of the population, Harden.

This study involved farmers in the Harden-Murrumburrah area and some of the scientists who worked there. This proved the correct sample group to answer the research questions, however, a wider sample of farmer participants would have been useful, and inclusion of local extension agents would have added an extra dimension. Extensions officers have an intimate relationship with both the scientists and the community and have a unique perspective on the science, the agricultural agenda and science communication in this area.

There was a disappointingly low response rate for the survey conducted. In cases where the response rates to a postal survey is between 5-20%, the final sample has little relationship to the original sampling population (Fowler, 1984). It is unlikely that a response rate in this range will provide representative statistics about the population as a whole, and it would be optimistic to generalise these results too much.

Postal surveys are not returned because the respondents are either unable to respond, refuse to respond or the survey does not reach them (Figure 5.1). Some farmers in the study area may not have been able to respond due to literacy or language limitations. As outlined in Chapter 3 possibly 20% of adults may have struggled to understand the text-based survey due to literacy restrictions, and up to 7% of the household in the area may speak a language other than English. An unknown percentage of the postal surveys may not have even reached the intended recipients.

Clearly a large section of the sample population refused to respond to the postal survey. One main factor may be that the survey was distributed when farm-based logistical issues related to cropping and drought were paramount in farmers' minds. Anecdotal evidence from discussions at Landcare meetings also suggests that farmers receive many postal surveys and may have 'survey fatigue', a term used by Hill, Roberts, Ewings and Gunnell (1997) to describe non-response to postal surveys. Many surveys also offer some kind of encouragement to fill out the survey, such as entry in a competition, and this survey did not. Additionally, some potential respondents may have decided not to respond because they saw that it mentioned Landcare and may not like Landcare or find it to 'cliquey'. Also, as discovered in the survey and in other literature, salinity is not the top priority for many farmers.

On reflection the best approach would probably be to have participants complete the survey during face-to-face interviews, rather than sending it to their homes. However, the issues for implementing such a survey would be finding a large enough gathering of a representative cross-section of the community to do this, and the time and expense associated with face-to-face surveying. The ability of the researcher to be present to explain the research would

have been advantageous, however there are also issues associated with having respondents complete the survey while the person assessing them is present.

Information gathered during the postal survey was augmented with observations made at Landcare meetings and discussions with scientists. Observations were the best approach to answering the second research question. Attending meetings and discussing individual perceptions in a collegial manner at Landcare functions lent an ethnographic element to the research, and provided a social context for interpretation of the information.

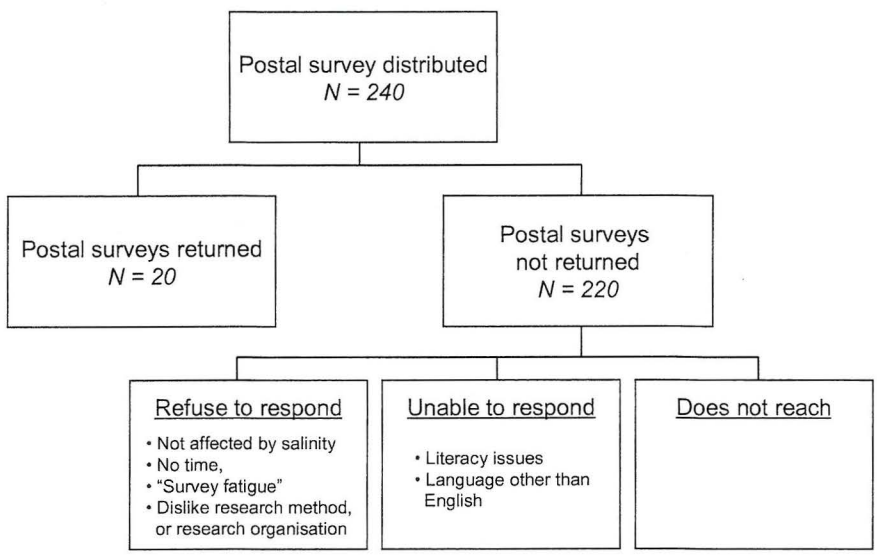

Figure 5.1 Categories of response and non-response to postal survey

Combining the two approaches was appropriate, and enhanced the quality of the results. For example, some opinions expressed in the survey may not have been discussed openly. The anonymity of the survey allowed for contentious issues to be mentioned.

In this study, information acquired from observations and discussions with people was as important as the results of the survey. This observation reinforces the importance of the experience of farmers who clearly favour face-to-face meetings as a communication method.

Recommendations

Recommendations for information exchange

Farmers may not be sponges waiting to soak up salinity information but they are genuinely interested in agricultural research and the opportunities it may provide them to enhance their business and land management practices. Although receptive to new ideas and practices,

the information needs to be presented in such a way that the farmers can relate it to their personal experiences and circumstance. A combination of approaches is the best method. While face-to-face communication is ideal, information gained from certain media and internet sources can also make a significant contribution.

Landcare groups encourage farmer participation in the scientific process, and both farmers and scientists benefit from this. Landcare groups would benefit from having a wider cross section of the farming community involved by persuading more women and young farmers to join, and promoting more frequent visits by scientists to Landcare meetings in the area they are working in. This would serve multiple purposes: 1) improve the knowledge and information exchange within the community; 2) ensure appropriate transfer of accumulated community knowledge regarding specific district challenges to younger generations of farmers; 3) introduce new ideas and perspectives from the younger generations with more education qualifications, and internet savvy.

The internet provides a powerful new opportunity for distributing information to farmers and soliciting their input. However, it should not be viewed as a replacement for the face-to-face interactions that have proven to be the most effective communication method. Instead, once bandwidth is increased and farmers have gained experience and training on how to use the internet effectively, it can provide a common framework for scientists to report their results, and promote contributions from farmers for ongoing research more effectively and with lower costs to all parties. The limited accessibility and use of the internet identified in this study is still an issue and training would be required. Given the vast amount of salinity information and number of agencies involved in salinity-related research, the effectiveness of two-way salinity communication via the internet would be enhanced by the development of a unified salinity 'portal' where salinity research and information is synthesised in one place and a consistent format.

Although the discussion took place over a decade ago, and the volume of information available has increased dramatically since then, Lee (1998) spoke to farmers who felt 'bombarded by information'. Any tool that increases a farmer's ability to find and discern the relevance of information, and to enter their own information, would be advantageous. A web-based salinity information portal and online discussion forum as suggested here would benefit from being associated with the Landcare name, and provide a useful feedback tool for information exchange across a wider geographical area.

Recommendations for influencing farming practice

Scientists, research organisations and the government are misinformed that salinity is the top land management priority for farmers. It is important that policy makers be involved in groups like Landcare to ensure they are aware of what the scientists are suggesting, what the farmers are prepared to do, where resources should be distributed, and specific community challenges that might impede state-wide or national salinity management policies.

A recommendation arising from this study is that scientists working on land management issues should visit Landcare and similar meetings and attend field days regularly throughout the course of their research, not just when they are seeking data, or presenting final results. Cross-organizational workshops where all of the researchers and managers working in the area come and talk with farmers in a single forum are a great suggestion presented by the farmers themselves. Such forums would include the scientists' views and findings with local issues and politics presented by the community. Having different research groups interacting with the farmers at the same time would help farmers clarify the key messages and identify the issues where contradictions by scientists indicate that the solutions and priorities are not yet established. The onus should be on the scientists to participate in such exchanges as it will build rapport with the farmers and lead to future and ongoing collaborations.

Conclusions

This study set out to identify existing salinity communication methods and processes used and valued by farmers, explore the science communication that takes place at Landcare meetings, and evaluate how being part of Landcare makes a difference to information exchange and farming practice. A postal survey was distributed to collect quantitative data and the results were combined with qualitative observations at several Landcare meetings. The response to the postal survey was low but several useful conclusions can still be drawn from the collected data.

- Farmers value face-to-face communication with scientists working on land management issues like salinity and such interactions are most commonly facilitated by community groups like Landcare. Salinity-specific publications may not be fully reaching their intended audience and rural newspapers are perhaps underutilized as a tool for communicating agricultural science. The full potential of the internet as a salinity information source has not yet been realised, mainly due to external factors such as low connectivity in rural communities.

- Landcare meetings provide a forum for discussing local land management issues, and an opportunity for scientists to visit and present relevant scientific research face-to-face. The meetings allow farmers to consolidate various scientific messages within a local context with like-minded peers, and for farmers and scientists to reconcile diverse scientific, social and agricultural drivers.
- An association with Landcare is beneficial to both farmers and scientists when it comes to information exchange. Farmers dealing with land management issues on their own farms realise the benefits of associating themselves with a group like Landcare as it will increase their knowledge, improve farming practice and contribute to scientific research. For scientists, the advantage of Landcare is an opportunity to improve scientific credibility by showing an interest in the social impact of their work.

A combination of science communication methods is recommended for scientists working in salinity research. While face-to-face communication at Landcare meetings is ideal in many ways, other media should also be utilized. A unified salinity 'portal' on the internet, once rural internet connections and internet training are improved, could be a powerful tool in the dissemination of salinity research and encouraging farmer feedback Australia-wide.

The scale of the land management problems faced by Australia as a nation can be overwhelming but collaboration between scientists, research institutions and land managers will enable significant advances to be made. The challenge for scientists and research organisations going forward lies in translating scientific findings, targeting communication methods used and valued by farmers and incorporating local knowledge into the research cycle. Continuing research into appropriate wide-scale, systematic distribution of land management research results in accessible and approachable formats and forums will improve the uptake and effectiveness of those results.

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Appendix A

Postal survey

31 May 2004

To the farm manager,

We are writing to ask you to participate in a short survey about salinity and sources of salinity information in the Harden Murrumburrah catchment. This research aims to improve future communication between farmers and scientists. Your participation is an important part of this research. This is a case study specific to the salinity issue in the Harden Murrumburrah catchment in New South Wales.

You are not obligated to participate in this survey. However, by returning a completed survey, you are consenting to take part in this research. Please keep this cover letter for your own information and records. All the information you contribute will be treated as confidential as far as is possible. Survey results will be collated, analysed and reported in aggregate form only - individual responses will not be identified.

This survey has been distributed on behalf of the researchers by a third party (Australia Post) and your name and address is unknown to us. Your name and details about your property will not be linked to any published results. The information obtained from this survey will be used only for this research. Your participation in this research ends once you have returned the survey in the envelope provided.

This research is being carried out by Kylie Foster, as part of a Master of Science: Scientific Communication at the ANU in Canberra, and has been approved by the ANU Human Research Ethics Committee. Should you have any ethical concerns about this survey, please contact;

The Secretary, Human Research Ethics Committee
Research Office
Chancellery 10B
The Australian National University ACT 0200
Tel: 6125-2900 Fax: 6125-4807
Email: Human.Ethics.Officer@anu.edu.au

Should you have any questions, comments or complaints about this survey or the issue of communication between farmers and scientists in the area of salinity research, please do not hesitate to contact myself, Kylie Foster, or my supervisor, Mr Rod Lamberts, via the contact details below.

Thank you.

Ms. Kylie Foster
MSc candidate
Centre for the Public Awareness of Science
Australian National University
Email: kylie_foster_175@yahoo.com.au
Telephone: 0419 528 914

Mr. Rod Lamberts (supervisor)
Centre for the Public Awareness of Science
Australian National University
Email: Rod.Lamberts@anu.edu.au
Telephone: 02 6125 0747

Section 1: In this section you will be asked a series of questions about salinity.

1.1. Are there areas on your property that you think are less productive because of salinity?

Yes *Go to question 1.2*

No *Go to question 1.5*

1.2. If there are areas on your property that you think are less productive because of salinity, please *list how you identified these areas*. For example, salt scalds and/or crop failure and/or dying vegetation. If you need more writing space, please use the other side of the last page.

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1.3. If you have attempted to treat the areas on your property that you think are less productive because of salinity, please *list the methods and strategies you have adopted*. For example, fencing off and/or adding lime. If you need more writing space, please use the other side of the last page.

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1.4. Overall, please rate how severe a problem you believe salinity *on <u>your</u> property* to be. Your answers can not be traced back to your property. Please circle the response that best reflects your opinion.

Salinity is VERY SEVERE on my property	Salinity is SEVERE on my property	Salinity is MODERATE on my property	Salinity is MINOR on my property	Salinity is NOT PRESENT on my property
1	2	3	4	5

1.5 Please rate how severe a problem you believe salinity to be *in the Harden Murrumburrah catchment.* Please circle the response that best reflects your opinion.

Salinity is VERY SEVERE in the catchment	Salinity is SEVERE in the catchment	Salinity is MODERATE in the catchment	Salinity is MINOR in the catchment	Salinity is NOT PRESENT in the catchment
1	2	3	4	5

1.6. In your opinion, has salinity had a negative effect on your farm's *income*? Please indicate the *financial* effect of salinity on your property by circling the response that best reflects your opinion.

very severe *financial* effect	severe *financial* effect	moderate *financial* effect	minor *financial* effect	no *financial* effect
1	2	3	4	5

1.7. In your opinion, has salinity had a negative *environmental* impact on your farm? Please indicate the *environmental* effect of salinity on your property by circling the response that best reflects your opinion.

very severe *environmental* impact	severe *environmental* impact	moderate *environmental* impact	minor *environmental* impact	no *environmental* impact
1	2	3	4	5

Section 2: In this section, we would like to know your thoughts and opinions on the availability and quality of salinity information.

2.1 Do you read any salinity-specific publications at least once a month?
For example; 'SALT' magazine.

Yes

No

2.2 Do you read the rural newspaper 'The Land' at least once a week?

Yes *Go to question 2.3*

No *Go to question 2.4*

2.3 Answer this question only if you read 'The Land'. In your opinion, is the coverage of salinity in 'The Land' satisfactory?

Salinity coverage in 'The Land' is *Below satisfaction*	Salinity coverage in 'The Land' is *Below average*	Salinity coverage in 'The Land' is *Average*	Salinity coverage in 'The Land' is *Satisfactory*	Salinity coverage in 'The Land' is *Highly satisfactory*
1	2	3	4	5

2.4 Do you use the internet at least once a week?

Yes *Go to question 2.5*

No *Go to question 2.6*

2.5 If you do use the internet at least once a week, do you use it to find salinity information?

Yes *Go to question 2.6*

No *Go to question 2.7*

2.6 If you do use the internet to find salinity information, could you tell us any of the sites you found to be most informative? (If you don't know the URL, or full internet address, any information you recall will be useful)

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2.7 Have you ever discussed salinity with a scientist who is researching salinity?

Yes *Go to question 2.8*

No *Go to question 2.9*

2.9 If you have discussed salinity with a scientist who is researching salinity, who initiated the contact? For example, was it a scientist who is or has been researching on your property, or a scientist who you may have met at a community meeting? Please list their name and affiliation, or just write 'Yes' if you would like for them to remain anonymous or you have forgotten their name.

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2.10 Please list any *other* sources you would use or have used for finding information on salinity. These could include formal and informal sources such as the radio, newspaper, the internet, community meetings or even talking to neighbours.

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Section 3: This section is asking for information relating to community groups, for example, Landcare.

3.1 Have you attended public meetings where the topic discussed was salinity? For example community meetings, Landcare meetings, field days and/or workshops.

Yes *Please give details below*

No *Go to question 3.2*

If yes, please list the name of the meeting or the organisation that organised it.

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3.2 Are you a member of the Harden Murrumburrah Landcare Group (HMLG)?

Yes *Go to question 3.3*

Former member *Go to question 3.4*

No *Go to question 3.4*

3.3 If you are a member of the HMLG, how often do you attend meetings?

I attend every meeting	I attend most meetings	I attend some meetings	I attend few meetings	I do not attend meetings
1	2	3	4	5

3.4 Are there any other community groups or events that you know of where salinity information is or was discussed?

Please use the space below to provide details of these groups or events.

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Section 4: This section relates to salinity information sources and the effects these may have had on farming practices.

4.1 Is salinity management and prevention your top priority with respect to farm management? (please circle)

Yes Go to question 4.3

No Go to question 4.2

4.2 If salinity prevention and management is NOT your top priority, please list the issues and problems you think are more important. For example, weeds and/or pest control.

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4.3 Over the last 10 years, salinity has become an issue of national importance and concern. More money is being given to scientists to study salinity, and publications about the salinity problem and results have been published in a variety of forms.

4.3a In the past 10 years, has your AWARENESS of salinity; *(Please circle the best response)*

Increased	*Go to question 4.3b*
Decreased	*Go to question 4.3b*
Stayed the same	*Go to question 4.3b*

4.3b In the past 10 years, has your KNOWLEDGE of salinity; *(Please circle the best response)*

Increased	*Go to question 4.4*
Decreased	*Go to question 4.5*
Stayed the same	*Go to question 4.5*

4.4 If your KNOWLEDGE of salinity has increased in the past 10 years, has this lead to a CHANGE OF PRACTICE on your property?

Yes

No

4.5 Do you think that farming practices in Australia have changed over the past 10 years in response to an increased awareness of salinity?

Yes

No

Section 5: This section asks you some information about the people on the property, particularly the farm manager who filled out this survey. Remember, the information will not be published with any reference to you or your property.

5.1 What age category do you fit into? Please circle the age range you age fits into.

0-15 16-25 25-40 40-55 55 +

5.2 Are you male or female? (Please circle)

Male

Female

5.3 Do you, or others who have a role in managing the farm, have a formal agricultural science or general science qualification? For example, University or Tafe courses. Please circle the response that best fits your situation.

I have a formal qualification

Someone else on the farm has a formal qualification

No one on the farm has a formal qualification

If you have comments you would like to make about this survey, please use the space provided below and the back page if you run out of space.

Comments on salinity information

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Comments on communication with scientists

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General comments, for example about this survey or on salinity in general.

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Thank you for participating in this survey.

Please keep the cover letter for your own records and place the rest of this survey in the reply envelope.

Returned surveys would be appreciated by the end of June 2004.

Appendix B

Australian National University Human Research Ethics Committee Approval

THE AUSTRALIAN NATIONAL UNIVERSITY

RESEARCH OFFICE
Human Ethics Officer
Sylvia Deutsch

CANBERRA ACT 0200 AUSTRALIA
TELEPHONE: +61 2 6125 2900
FACSIMILE: +61 2 6125 4807
EMAIL : Sylvia.Deutsch@anu.edu.au

27 May 2004

Ms Kylie Anne Foster
7 Marlee Place
Narrabundah
ACT 2604

Dear Ms Foster,

Protocol 2004/105
Scientific communication with respect to salinity issues between scientists and farmers in the Hearden-Murrumburrah catchment, NSW

On behalf of the Human Research Ethics Committee I am pleased to advise that the above protocol has been approved as per the attached *Outcome of Consideration of Protocol.*

For your information:

1. Under the NHMRC/AVCC *National Statement on Ethical Conduct in Research Involving Humans* we are required to follow up research that we have approved. Once a year (or sooner for short projects) we shall request a brief report on any ethical issues which may have arisen during your research and whether it proceeded according to the plan outlined in the above protocol.
2. Please notify the Committee of any changes to your protocol in the course of your research, and when you complete or cease working on this project.
3. The validity of this current approval is five years' maximum from the date shown on the attached *Outcome of Consideration of Protocol* form. For longer projects you are required to seek renewed approval from the Committee.

Yours sincerely,

Sylvia Deutsch
Secretary, Human Research Ethics Committee