Introduction

The agricultural industries which use Australia’s land and water resources are generally extensive in their use of land resources, high in output per unit of labour and a large proportion of output is sold in competitive export markets. Government payments and subsidies to most agricultural industries are low or insignificant. In North America and Europe governments encourage farmers to use conservation practices using cross-compliance programs linked to government payments to agriculture. Opportunities to follow this strategy in Australia are minimal. Regulation is likewise rarely used. Australia is a heavily urbanised nation whose standard of living has been closely linked to the world competitiveness of her agricultural industries. Australian governments have been wary of implementing legislative controls on rural land use practices for fear of damaging export competitiveness. Consequently, most Australian soil conservation programs rely predominantly on voluntary compliance or the informed self-interest of land users.

Salinity control strategies in Australia have embraced an active program of farmer education and voluntary programs to reduce land degradation. Many of these programs have incorporated local community groups, whose primary aims are to tackle land degradation and develop more sustainable land management practices.

Much of the strategy to encourage salinity control at the farm level is based on simple premises of apparently logical and rational behaviour on the part of landholders. The premise is that farm management behaviour will be modified in response to the message that salinity is a serious and increasingly pervasive problem which currently reduces, or will in the future reduce, the productivity of farm land and the viability of farm businesses.

This message has at times been met with relative inertia, suggesting at least three possible explanations of message failure: landholders have not yet recognised the problem; landholders have recognised the problem but do not assess it as serious; or, having recognised the problem, regard the seriousness of the problem but do not assess it as serious; or, having recognised the problem, regard the problem as possibly more advanced than Departmental perceptions in 1988. During this period there was no significant change in the extent of salinity on the survey area (Loddon Community Working Group, 1992). Rather, perceptions of the seriousness of the problem were heightened by government programs which drew attention to the problem. Our surveys showed awareness of salinity was even greater than indicated by the ABS census. In our 1988 survey 23 per cent of farmers reported bare patches caused by salinity, a figure of similar magnitude to that reported to the ABS. However, a further 30 per cent reported less obvious signs of salinity on their property (Vanclay and Cary, 1989).

A study of attitudes towards salinity control strategies in the Loddon-Avoca catchment

A study was undertaken in the upper Loddon and Avoca catchments in central Victoria (Wilkinson and Cary, 1993; Cary, Wilkinson, Barr and Milne, 1993). The enterprises undertaken comprise extensive grazing of predominantly merino sheep and some cattle, with some cereal cropping, and occasionally vegetable production, on the better soils. The soils in these catchments are prone to both soil erosion and salting. The catchments contain local and regional groundwater systems which contribute to soil salinisation. The district problems of land salinisation are rarely confined to the boundaries of individual farm properties. Revegetation of district farms may reduce both on-site and off-site soil salinity.

In 1988 personal interviews were conducted with a random sample of 131 respondents from the population of 329 farmers. In 1991 the sample of respondents was re-interviewed. By re-interviewing the 1988 respondents their beliefs and attitudes in 1988 could be related to their subsequent behaviours. Some respondents were unavailable for reinterview or had ceased farming in the area; 111 families were reinterviewed. In 100 cases the same person was interviewed, and in a further 11 cases another member of the same family was interviewed. Relevant data were obtained for landholders’ beliefs, management practices, and farm and demographic characteristics. Beliefs were elicited by qualitative methods, conventional response item measures and by a magnitude estimation pair-comparison method.

Problem Recognition

Many farmers were aware of salinity prior to the first survey. Between 1984 and 1989 the number of farmers reporting salt on their land rose from 10 per cent to 18 per cent. The reported area increased from 0.3 per cent to 1.5 per cent (ABS, 1989). The increase reported in the Loddon Shire was greater than in any other Victorian Shire during this period. In 1988 the Department of Conservation, Forests and Lands estimated the extent of obvious land salinisation in the catchment (defined as where agricultural production was minimal) at 0.25 per cent of the land area (Department of Conservation, Forests and Lands, 1988). Landholder perception of salinity was possibly more advanced than Departmental perceptions in 1988. During this period there was no significant change in the extent of land salinisation in the survey area (Loddon Community Working Group, 1992).

Concern about salinity

Whilst recognition of salinity was common, appraisal of this salinity as a problem was far less common. In 1988 only five per cent believed salinity was a major problem on their farm, and a further ten per cent appraised a moderate problem (Table 1). These views were unchanged in 1991.
Farmers saw the environmental problem of soil salinity as more serious in the wider locality than for their own properties. There was a small increase in aggregate beliefs about the seriousness of salinisation between the two surveys. While Table 1 might be construed to reflect the general environmental syndrome that the problem is 'not in my yard', land salinisation is not uniformly distributed over

<table>
<thead>
<tr>
<th>TABLE 1. Beliefs about the Seriousness of Land Salinisation Frequency of Response: Per Cent (T1: n = 131; T2: n = 111)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seriousness</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Major problem</td>
</tr>
<tr>
<td>Moderate problem</td>
</tr>
<tr>
<td>Small problem</td>
</tr>
<tr>
<td>Not a problem</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Mean Score&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>t value of difference of mean score from mean score for own property&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Mean of summated rating: 1 not a problem, 2 a small problem, 3 a moderate problem, 4 a major problem.

<sup>b</sup> All t values significant at prob. < .001 (two tailed test)

<table>
<thead>
<tr>
<th>TABLE 2. Stability of Perceptions of the Seriousness of Environmental Problem: Frequency of Response: Per Cent (n=111)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seriousness of problem (time 2 vs. time 1) Region</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>1 Same (unchanged)</td>
</tr>
<tr>
<td>2 Better</td>
</tr>
<tr>
<td>3 Worse</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Unstable (changed: 2+3)</td>
</tr>
</tbody>
</table>

Cochran Q test (unstable vs. same) = 17.2; prob. = .0002 (2 df)
properties and a serious regional problem may be reflected on a relatively small subset of properties. However, from an extension perspective the more important point is which appraisal will be a motivating factor in stimulating salinity control behaviour. A clue may be found in the relative stability of these beliefs. Beliefs about the seriousness of the problem in distal locations are more unstable than beliefs about the seriousness of the problem in the proximate
Respondents' judgements become less consistent, and less reliable, the more the problem is removed from their own fields of experience.

Evaluation of salinity control technology

The propositions that tree planting and pasture improvement can control salinity were well known and generally accepted. A set of beliefs about tree planting and pasture improvement were elicited by respondents making estimates of the associations between pairs of descriptors of the practices and relevant attributes of the practices. The size of these associations, measured as a distance, indicates the strength of the relevant belief. The closer the distances between the descriptors of the different belief objects, the more strongly the belief is held. The attitude of the average landholder towards the two practices is indicated by the distance from the practices to 'You'. The beliefs, therefore, are represented as the average distances between the two objects comprising the belief.

The belief that planting trees reduces soil salinity became more strongly held between 1988 (25.0) and 1991 (22.1); however, the change was not significant statistically (Table 3). Planting trees was most associated, but not closely associated, with reducing soil salinity. Between 1988 and 1991 there was a significant shift in beliefs regarding the value of pasture improvement for salinity control. Pasture improvement became more associated with reducing soil salinity.

Salinity control effectiveness is not the only important attribute of the salinity control technologies. In both surveys there was widespread belief in the shade, shelter and aesthetic benefits of tree planting. Beliefs in the long term profitability and capital appreciation benefits of tree planting and pasture improvement were less common, though still held by a majority of farmers. Between the two surveys pasture improvement became more associated with having a good farm and long-run profitability. Planting trees became more associated with having a good farm.

A minority of farmers indicated concerns at the

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing soil salinity</td>
<td>25.0</td>
<td>22.1</td>
<td>37.5</td>
<td>20.4</td>
</tr>
<tr>
<td>Having a good farm</td>
<td>30.0</td>
<td>19.0</td>
<td>14.8</td>
<td>6.8</td>
</tr>
<tr>
<td>Long-run profitability</td>
<td>31.0</td>
<td>22.7</td>
<td>21.1</td>
<td>12.0</td>
</tr>
<tr>
<td>Short-run profitability</td>
<td>62.7</td>
<td>54.1</td>
<td>37.1</td>
<td>37.0</td>
</tr>
<tr>
<td>You</td>
<td>34.1</td>
<td>26.3</td>
<td>19.5</td>
<td>13.6</td>
</tr>
<tr>
<td>Landcare[a]</td>
<td>17.9</td>
<td>15.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[a\] Smaller distances indicate more strongly held beliefs.

\[b\] Landcare belief measured in 1991 only.

Difference between years significant: * p < 0.05, ** p < 0.01, *** p < 0.001; T test (one tailed).

| Use of conservation technologies; 1988 to 1991 (per cent of farm land) |
|-----------------------------|-----------------|-----------------|--------|
|                             | 1988 | 1991 | Change |
| Deep-rooted perennial pasture | 15.8 | 20.2 | 4.4    |
| Trees\[a\]                  | 3.9  | 4.8  | 0.9    |

\[a\] Based on planting density of 200 trees per hectare.
establishment and management practicalities of phalaris. Despite this, pasture improvement was more attractive to landholders than planting trees. (The average landholder — represented by ‘You’ — associated much more closely with pasture improvement than with planting trees.) Both long-run and short-run profitability were more associated with pasture improvement than with tree planting. More complex inter-relationships among these belief systems are discussed in Cary et al. (1993).

Implementation of salinity control technologies

In the three years of the study 79 per cent of farmers planted trees. The distribution of tree planting was positively skewed, with most landholders planting a few trees and few farmers planting many trees (Figure 1). Landholders were not planting trees to control salt. Most trees were being planted along gullies and fences and around houses, not in recharge areas. Farmers who reported salt on their farm were planting no more trees than those farmers who reported their farms as salt-free. Only half the surveyed landholders had sown deep-rooted pasture but the average area sown was much greater than the average area planted with trees (Figure 2).

At the commencement of the study 78 per cent of farm land was improved pasture. Much of this was shallow-rooted pasture; deep-rooted perennial phalaris pasture comprised 16 per cent of farm land. Less than one percent of farm land comprised tree plantations and approximately four per cent was naturally timbered land. By 1991 the area of farm land under trees was still less than five per cent. The area of farm under perennial pasture had increased to 20 per cent. The relative magnitude of tree planting and phalaris pasture establishment between the two points of measurement in the study is shown in Table 4. The level of pasture sowing was about five times greater than the level of tree planting.

Influences on salinity control behaviour

How important were salinity perception, appraisal of salinity seriousness and beliefs of the proposed solutions in explaining tree planting and pasture sowing behaviour? We built four statistical models to investigate these influences. Included in these models were the additional variables of farm area and landcare group membership. A summary of the influence of these variables on the adoption of salinity control strategies is shown in Table 5. The first and third models show the relationship between the predictor variables and the binary adoption/non-adoption variable. The second and fourth variable show the relationship between the predictor variables and the extent of adoption for those farmers who had adopted the relevant salinity control practice. The findings of this modelling need to be treated with some caution due to the limited explanatory power of some of the statistical relationships found in the four models.

Recognition or concern over salinity is not related to either of the tree planting models. This should come as no surprise given the limited extent of tree planting in high recharge areas. The decision to plant trees is most accurately predicted by beliefs about the long term profitability of trees and the attitudes to tree planting as measured by the subjective distance between the concept pairs ‘tree planting’ and ‘you’. Beliefs about the long term profitability of tree planting were highly correlated with beliefs about the aesthetic and capital appreciation value of trees. These variables were not included in the model due to the high degree of inter-relationship.

Amongst those farmers who planted trees, the extent of tree planting was modelled with two variables: Landcare group membership and beliefs about the difficulty associated with the management of tree plantations.

The model to predict whether farmers chose to renovate pasture was built upon five variables. The most significant contribution came from beliefs about the long term profitability of pasture establishment. Recognition of salinity on the farm as the next most important variable. This was the only case where salinity related variables contributed to a model. This result is difficult to explain given that concern over salinity is insignificant in this model. One possibility may lay in a common relationship with a third intervening variable. A possible candidate is farm size. The other significant variables in this model are beliefs about the costs of pasture establishment, difficulties of pasture management and farm size.
The final model predicted the extent of pasture sowing amongst those farmers who had sown pasture in the study period. The extent of pasture sowing was measured as a logistic transform of the percentage of the farm sown to pasture. This removed the effect of farm size on behaviour. The only statistically significant variable in this model was that which measured beliefs about the difficulties of managing phalaris pasture.

In summary, variables which measured concern about salinity or beliefs about salinity control benefits of farm practices made no significant contribution to any model. The variable which measured awareness of salinity on the farm was one of five variables contributing to the binary pasture sowing model.

In contrast, beliefs about long term profitability and practicality made the most significant contributions to both the binary models. Beliefs about management difficulty made a significant contribution to models of the extent of pasture sowing and tree planting amongst adopters of each practice.

This set of relationships is mirrored in a similar analysis of lucerne sowing in the lower catchment. Beliefs about

| TABLE 5. Explanation of presence, and extent of, tree planting and deep-rooted pasture planting (standardised regression coefficients) |
|---|---|---|---|
| Explanatory Variable | Tree planting | Deep-rooted pasture |
| | PresenceA | ExtentB | PresenceA | ExtentC |
| **Salinity Appraisal** | | | |
| Salinity Recognition | | | 1.5 ** |
| Concern over salinity | | | |
| Evaluation of salinity control effectiveness | | | |
| **Instrumental beliefs** | | | |
| Long-term profit | -1.2 *** | -0.39 ** |
| Costly in the short-term | | 0.51 * |
| Risk of establishment failure | | |
| Difficulty of management | 0.265 * | 0.41 * | .32 * |
| **Attitudes** | | | |
| Attitude to tree planting/pasture improvement | 0.03 * | | |
| **Other variables** | | | |
| Landcare membership | 0.369 ** | | |
| Farm Area | 0.002 ** | Excluded prior to analysis. C |
| | | |
| Model $\chi^2 = 29.9$ | R$^2 = .23$ | Model $\chi^2 = 26.0$ | R$^2 = .10$ |
| 86% cases predicted | F = 6.97 ** | 74% cases predicted | F = 5.14 * |

A Dependent variable trees/pasture planted/not planted. Coefficients estimated using logistic regression (N = 111).

B Dependent variable number of trees planted. Significant independent variables identified using OLS backward elimination procedure (N = 64).

C Dependent variable logit transformation of proportion of farm planted to deep-rooted pasture. Significant independent variables identified using OLS backward elimination procedure (N = 56).

* prob. < .05   ** prob. < .01    *** prob. < .001
profitability predict the decision to sow lucerne, but beliefs about management practicalities predict the extent of sowing (Ransom and Barr, 1995).

Discussion

An assumption that conservation practices are intrinsically unprofitable, and that adoption-diffusion approaches are therefore irrelevant to the practice of conservation extension, has become entrenched in some branches of the environmental literature. Our findings suggest commercial technologies with complementary environment-enhancing characteristics are readily adopted. The level of adoption of deep-rooted pasture -- a commercial technology with complementary environmental attributes -- was considerably greater than the adoption of tree planting.

Dryland salinity control technologies do not produce immediate outcomes; the predicted benefits (which are mostly unverified) accrue after a considerable distance into the future. In contrast, this research shows that concern over salinity problems is often unstable over a relatively short time span. Therefore it is not surprising that this concern does not often translate into action. Concern over salinity was not a significant factor in most decisions to sow pasture.

It is worth contrasting the behaviour of dryland farmers with that of irrigation farmers in the Shepparton district. Where an irrigation farmers faces an existing salinity loss which may be recovered by groundwater pumping, there is rarely reticence to adopt this salinity control strategy. Unlike dryland salinity control, salinity mitigation investment offers immediate outcomes and tangible financial benefits in the short term. In dryland areas the causal sequence from problem recognition to action frequently breaks down because individuals do not see sufficient immediate benefit from altering their behaviours.

This does not imply a message of gloom. Some progress towards salinity control will be achieved where salinity control technologies offer more immediate benefits. The benefits driving tree planting have not needed to be in the form of immediate cash in the hand. Trees more generally are planted for shade and shelter, aesthetics and capital appreciation, rather than for reducing land degradation. Such purposes seem to be achieved by plantings which are relatively fixed in number rather than proportional to property size. Perceptions of cost were unrelated to the decision to plant trees. Most large property owners did not plant more trees than medium or small-sized property owners. The relationship between property size and the number of trees planted was weak and restricted to a difference between small and medium-sized properties (Barr et al., 1992; Cary 1992b).

In contrast, the decision to sow pasture is clearly based upon financial criteria. The extent of pasture sowing was strongly related to property size. Beliefs about the cost of pasture establishment were related to the decision to sow pasture. Owners of the smaller properties sowed not only a smaller proportion of their farm.

The extent of tree planting by Landcare group members is impressive. Landcare membership has provided peer group support for tree planting and is likely to have developed and reinforced positive environmental attitudes amongst those who joined the movement prior to 1988. However, there is little evidence to suggest that the peer pressure of landcare has developed these same attitudes, or a significant tree planting commitment, amongst those farmers who joined landcare groups after 1988. The tree planting behaviour of these farmers is much more similar to those who have never joined a Landcare group.

Conclusion

There is a widespread belief that the most important task to achieve a more sustainable agriculture is the raising of community awareness and changing of farmers' attitudes to their land. The evidence presented here indicates that the influence of problem recognition or awareness on conservation behaviour is relatively unimportant in the upper Loddon and Avoca catchment.

While changes in awareness and attitudes are clearly desirable prerequisites for social change, it is unrealistic to expect the majority of commercial farmers to be unresponsive to technical, economic, or risk aspects in decisions concerning the adoption of environmental technologies. To increase the adoption of environmental technologies specific practices or packages need to be developed that are technically feasible and economically profitable.

We suggest this is not a situation unique to salinity control or to the Loddon and Avoca catchments. In a study of the adoption of conservation cropping on the Liverpool Plains of N.S.W., Sinden and King concluded:

'SteWARDSHIP is an important reason for recognising a problem, but economics is the reason for resolving it.' (Sinden and King, 1988, 1990).

Findings consistent with this conclusion, establishing the importance of economic factors and technical feasibility in promoting adoption of conservation farming practices and the often ephemeral nature of environmental orientation, have been repeated in studies elsewhere in Victoria (Harvey and Hurley, 1990; Wilkinson and Cary, 1993; Cary, 1995), Queensland (Vancnay, 1992), Western Australia (Gorddard, 1993) and the United States (Fletcher and Seitz, 1986; Lynne et al., 1988; Napier and Forster, 1982). A wide ranging review of the research into the adoption of soil conservation measures in the United States concluded:

'reliance on awareness programs to bring about adoption of soil erosion control practices is inadequate to solve erosion problems. Programs must be built upon broader bases than simply creating favourable attitudes towards erosion control practices.' (Swanson, Camboni and Napier, 1986)

In the case of the Loddon and Avoca catchments, the broader base advocated by Swanson et al may well look very unlike a salinity control program. One form could be industry development programs for both the wool and sheep meat industry. Future rates of tree planting and pasture sowing in the upper catchments will be mediated by the state of the wool industry. Success in developing the export lamb market may in the end provide a far greater incentive for farmers in the lower Loddon catchment to sow lucerne than promotion of the uncertain future risk from salinity (Dakis, 1993; Barr, 1993).

Simple prescriptions to the more complex soil management problems are naive if they ignore the many factors linked to the adoption of soil management practices. Australian farmers have not been unresponsive to changing community values about appropriate land management (Barr and Cary, 1992). Such value changes have been observed in the changing belief systems of Australian farmers; but more positive environmental beliefs are often in conflict with, and
outweighed by, farmers' beliefs about the need for land
management systems to be profitable, simple to use and
reasonably assured in their outcome.

References

Australian Bureau of Statistics, Annual Farm Census data,

Barr, N.F. (1993). 'Why whole farm planning is only a small
beginning: What has sustainable agriculture got to do
with a seminar for butchers', proceedings of the 27th
annual conference of the Geography Teachers
Association of Victoria.

salting: appraisal of an insidious hazard. Parkville: School of
Agriculture and Forestry, University of Melbourne.

Australian search for sustainable land use. Melbourne:
Macmillan.

substantive influences on revegetation behaviour.
Catches of Green: A National Conference on Vegetation
and Water Management, Greening Australia, Canberra, pp.
85-93.

land management. Proceedings of 7th International Soil

to develop sustainable land use systems. Review of
Marketing and Agricultural Economics, 60, 57-64.

Cary, J.W. (1993). The nature of symbolic beliefs and
environmental behaviour in a rural setting. Environment
and Behaviour, 25, 555-576.

commercial technologies: a false dichotomy.
Unpublished paper.

Establishing the basis for effective care of rural land.
Australian Journal of Soil and Water Conservation, 6, 44-49.


Draft salinity control strategy: Ballarat region. Ballarat:
Department of Conservation, Forests and Lands.

Fletcher, J. R., & Seitz, W.D. (1986). Information needs for
conservation decisions. In Stephen B. Lovejoy and Ted
L. Napier (Eds.) Conserving the soil: insights from socioeconmic research. Soil Conservation Society of America, Ankeny, Iowa, pp. 108-120.

Gorddard, B.J. (1993). Beliefs, Attitudes and Conservation
Behaviour. Final report to the National Soil
Conservation Program of the Land and Water Research
and Development Corporation, School of Agriculture,
University of Western Australia.

Harvey, J.T. and Hurley, F.T. (1990) 'Cropping and
Conservation: Changes in cultivation practices in
Victorian grain growing areas 1984-89', Regional Studies
Unit, Ballarat University College.

salinity management plan. Bendigo: Department of
Conservation and Natural Resources.

and farmer conservation behaviour. American Journal of
Agricultural Economics 70, 2-19.

Napier, T.L., & Forster, D.L. (1982). Farmer attitudes and
behaviour associated with soil erosion control. In Harold
G. Halcrow, Earl O. Heady, and Melvin L. Cotter (Eds.)
Soil conservation policies, institutions, and incentives. Soil
Conservation Society of America, Ankeny, Iowa, pp. 137-150.

Ransom, K. and Barr, N. (1993) 'The adoption of dryland
lucerne in North Central Victoria, draft technical report,
Dept of Agriculture, Bendigo.

Swarson, L.E., Carboni, S.M. and Napier, T.L. (1986) 'Barriers
to Adoption of Soil Conservation Practices on Farms', in
Lovejoy, S.B. and Napier, T.L., Conserving Soil: Insights
from Socioeconomic Research. Soil Conservation Society of

Vanclay, F.M. (1992). The social context of farmers' adoption
of environmentally sound farming practices. In Geoffrey
Lawrence, Frank Vanclay and Brian Furze (Eds.)
Agriculture, Environment and Society. Macmillan,
Melbourne.

dryland soil salinity. School of Agriculture and Forestry,
University of Melbourne, Parkville.

central Victoria. Parkville: School of Agriculture and
Forestry, The University of Melbourne.

north east Victoria. Parkville: School of Agriculture and
Forestry, The University of Melbourne.