Personality, Objectives, Attitudes, Intentions and Behaviour: Modelling the Adoption of Current Recommended Practice by Farmers in the NSW Murray Catchment

Lin Crase,
Darryl Maybery

Contributed Paper presented to the 47th Annual Conference
Of the Australian Agricultural and Resource Economics Society
At
Fremantle,
February 12-14, 2003
Personality, Objectives, Attitudes, Intentions and Behaviour: Modelling the Adoption of Current Recommended Practice by Farmers in the NSW Murray Catchment

Lin Crase¹ and Darryl Maybery²

Abstract
The degradation of the natural resource base that derives from unsustainable farm practices is of major concern in Australia. Confronted with mounting evidence of the extent of this degradation, governments have employed a variety of policy instruments to induce change amongst the farming community. However, there remains a widely-held view that the rate of adoption of alternative practices falls well short of that required to avert disaster and additional measures are required to accelerate change. In this context, an understanding of the processes that lead particular farmers to adopt current recommended practices would provide valuable insights to assist policy formulation.

Whilst some work has been undertaken in this area, a major deficiency resides in the failure to acknowledge the important role of ‘with-person’ factors, like personality and values or objectives. This paper reports the results of a study that deliberately set about to measure these within-person variables to enable policy makers to focus on those attributes most susceptible to change. Data were collected from over 500 farmers in the NSW Murray catchment which enabled the isolation of the farmers’ personality, objectives and attitudes to different farming practices. The results provide a useful contrast to other studies in this field by highlighting those aspects of the farmers’ decision that are most malleable to policy intervention.

¹ School of Business, La Trobe University, Albury-Wodonga Campus
² Department of Behavioural Sciences, La Trobe University, Albury-Wodonga Campus
**1.0 Introduction**

The degradation of the natural resource base that derives from unsustainable landuse practices is of major concern in Australia. Confronted with mounting evidence of the extent of this degradation, governments have employed a variety of policy instruments to induce change amongst the farming community. However, predictions that it would cost about $65 billion over 10 years to repair existing land degradation and halt further environmental damage in Australia (Madden et al. 2000) stand as testament to the magnitude of the problem.

In this context altering the behaviour of landholders is now an imperative and actions that might assist in halting or reducing such problems as salinity, soil acidification and biodiversity loss have become major target for environmental policy-makers in many catchments (see, for instance, Murray Catchment Management Board 2001). However, to induce the quantum of change to significantly impact on these issues remains a challenge. There is considerable uncertainty about the biophysical impact of specific practices, our knowledge of landholder behaviour is incomplete and our understanding of the efficacy of different policy triggers on landholders is relatively imprecise.

To date, two broad approaches to the administration of environmental policies in Australia have been evident. The first approach is based on the use of economic mechanisms or instruments where the aim is to alter the distribution of private and community benefits/costs. Here financial incentives and/or risks are adjusted to make using a particular practice more (or less) attractive (Pannell 2001). Such mechanisms are largely grounded in the neo-classical assumptions of rational economic man where profit and utility maximisation are assumed paramount.

One of the major problems with this approach is that it is relatively imprecise insofar as it tends to regard individuals as largely homogenous and relies heavily on specific assumptions about the motivations of behaviour. These assumptions can, in turn, manifest themselves in policy intervention that is less than effective. At a theoretical level at least, these limitations are evident in the growing literature that emphasises the role of institutions and their impact on individuals as behavioural constraints. In this context North (1990, p. 20) observed over a decade ago that “individual utility functions are simply more complicated than the simple assumptions so far incorporated in neo-classical theory” and Herbert Simon has remarked that neoclassical economics solves problems by creating solution that are simply useless (Loasby 1989).

Whilst this mounting criticism of traditional economic instruments from the New and Old Institutional Economics is based on the gross simplification of the decision-making process, the second approach to environmental policy in Australia suffers similar flaws. This approach generally emphasises the role of raising awareness of the ‘common good’ and group action as vehicles for inducing behavioural change. The National Landcare Program is illustrative of this approach (Vanclay 1997) being largely based on the assumption that educating landholders will induce significant attitudinal and behavioural change towards the adoption of sustainable practices. However, not all individuals can be assumed to be similarly motivated and the vagaries of this motivating trigger are illustrated by Carey’s empirical review of the influence of community Landcare membership. In modelling the adoption of fifteen
different management practices he found that membership of Landcare groups was significant on only three occasions (2001, p.3). Again this points to the problem of assuming that landholders are relatively homogenous and will respond similarly to the same motivational triggers.

In this paper we contend that a way forward resides in developing policies that give greater credence to the role of the individual in the decision making process. These data might then be used to better target the intervention strategies likely to be required to produce significant behavioural change across a number of landholders and thereby deliver preferred environmental outcomes. The purpose of the paper is to detail a model of landholder behaviour that includes important within-person factors like personality, values or objectives and attitudes and then to demonstrate how this model was operationalised in the Murray catchment of NSW. The empirical data collected as part of this research are discussed in the context of landholder’s current recommended practice (CRP) in the management of remnant bush and revegetation. The results provide a foundation for developing intervention mechanisms that are more likely to induce behavioural change than policies that ignore the pervasive influence of with-person traits.

The paper itself is divided into six main parts. In part two we describe the behavioural model used to underpin this research and contextualise it within the wider conceptual framework provided by institutional economics. The data collection method and the salient features of the geographical area where the model was applied are briefly described in part three. The fourth section provides a summary of the statistical approach used to interpret data as well as describing the technique for measuring variables within the model. Results are reported and analysed in a policy context in section five whilst part six comprises some brief concluding remarks.

2.0 A Model of Landholder Behaviour

A central aim of this research was to develop and test a model of landholder behaviour which included key ‘within-person’ factors hitherto overlooked by much Australian research in this field. Most social research into land stewardship and CRP has focused on the variety of farmer attitudes and values/objectives towards undertaking a particular behaviour (see, for instance, Howden et al. 1998; Vanclay et al. 1998). Whilst this has provided some useful information, there has been only limited Australian research into the personality of farmers and how this might impact on the adoption of CRP. Recent research into Scottish farmer’s adoption of conservation practices has shown this to be an important but little examined influence on such behaviour (Willock et al. 1999; Austin et al. in press).

Social variables and their theoretical relationship to farming behaviour

In this instance four groups of variables thought to be important contributors to the adoption of CRP were considered. These were the landholder’s personality, their values and objectives, attitudes to particular activities and a range of factors external to the farmer. These variables and their hypothesised relationships are shown in Figure 1. Importantly, the figure also depicts the relative ease of changing each of these variables.
Ease of Change

Figure 1: Model and ease of change (of social) variables considered as important influences on land stewardship intent and behaviour (Adapted from Willock et al. 1999, p. 6).

This model of decision making suggests that farming behaviour and intentions are determined to some extent by external factors, [such as the physical location of the farm, information provided by agencies or other farmers and the like], the farmer’s attitudes, [eg attitudes towards a particular practice], the farmers overarching objectives [which encapsulate such aspects as job satisfaction, status and other quality of life matters (Willock et al. 1999)] and their personality traits. Figure 1 also highlights, that as we move from left to right within these factors, they become easier to influence and change. The more difficult to change are illustrated on the left of the model moving to the least difficult on the right with the most difficult to influence being a person’s personality or personal style.

Much previous research suggests that an individual’s personality has an important influence on their decision-making (including on-farm) but that these individual differences are almost impossible to change (Austin et al. In Press). For example, how conscientious or agreeable someone is today is unlikely to change tomorrow or to be influenced greatly by outside factors such as the media or policy instrument. In developing a model of the adoption of CRP this suggests we should view personality as an influence on behaviour but something that is not readily malleable. However, whilst personality is difficult to change it would be spurious to omit it form analysis given its pervasive influence in the model. Nevertheless, the personality of the landholder appears to be an essential variable missing from much of the recent
research, with the exception of Willock et al. (1999), where it was depicted as antecedent to other variables.

In addition, much psychological research has shown that (along with being relatively unchanging) personality attributes are related to the types of objectives, values and attitudes that people hold (Willock et al. 1999; Grube et al. 1994). Consequently, of interest here is not the personality information per se but the relationships accounted for by variables associated with personality within landholder decision-making models. As personality is thought to have a major, discernible influence on landholder decision making it is important to calculate its influence within CRP decision-making models. If a statistical model of Figure 1 was developed without accounting for personality, spurious relationships between the remaining social variables and behaviour and intention may be found. Consequently, to get a true indication of the significant relationships [including the significance of relationships] it is important to first account for the covariation of personality within the research model.

Accounting for the role of personality in an effort to understanding what many regard as economic behaviour is nothing new. John Stewart Mill observed over a century ago that “the laws of phenomena of society are, and can be, nothing but the actions and passions of human beings” (cited in Hodgson 1988, p. 71). Similarly, Veblen writing at the turn of the 20th century proffered a form of instinct psychology as a primary determinant of economic actions. More generally, one of the central tenets of old institutionalism is that much of the behaviour of economic agents can be traced to psychological origins (Wolozin 20002, p. 49). In this context the present research represents a practical extension of this theoretical tradition.

3.0 Applying the Model of Landholder Behaviour in the NSW Murray Catchment

The Study Area

This research sought to apply the model described in Figure 1 and uncover the social framework that underpins farmer behaviour in the Murray Catchment of NSW. The NSW Murray Catchment is shown in Figure 2 and extends for 37,000 square kilometres along the northern side of the Murray River.

---

3 Austin, Deary and Willock (in press, p.1) found that the personality factors, Extraversion, Conscientiousness, Openness and Neuroticism play a substantial role in landholder environmentally-oriented behaviour.
Almost 77% of the land in the NSW Murray catchment is occupied by agriculture. The catchment itself can be divided into five subregions on the basis of differing landscapes, distinctions between irrigated and pastoral lands, and the division between the riparian/floodplain zones of the Murray River and other lands. There is also considerable cultural diversity within the catchment. For example, urban settlement varies from cities, like Albury with a population in excess of 40,000, to small hamlets that comprise only a few souls. Similar dispersions are apparent in other attributes such as education and income.

The agricultural sector is the penultimate employer in the area. The vitality of the agricultural sector [and implicitly the other major employment sector, retail/wholesale.] is inextricably linked to the health of the natural environment. Moreover, the deleterious consequence of the erosion of natural capital within the catchment stands to undermine both the social and economic well being of the resident communities. In this context the Murray Catchment Management Board identified three major areas of concern; namely soil acidity, salinity and biodiversity.

The extent of each of these problems is inequitably distributed across the catchment. Similarly, the responsiveness of individual farmers to these issues varies considerably. It is against this backdrop that the Murray catchment’s agencies are examining notions of land stewardship and the adoption of CRP with the aim of determining the principal motivations of landholders that might induce appropriate changes in behaviour.
Several behaviours are of interest to the catchment’s resource managers. For example, the Blueprint identifies specific targets for maintaining and expanding key areas of remnant bush and revegetation. Similarly, specific practices such as applying lime have been ascribed targets. In order to make the application of the model on Figure 1 more manageable within the constraints of this paper we focus attention specifically on the adoption of CRP in the context of remnant bush and revegetation. The definition of CRP and its relationship to the Blueprint are discussed in section 4.

**Data Collection**

Approximately 250 detailed questions were put to Murray catchment landholders via a mail survey. The purpose of the survey was to define the model variables from Figure 1 and to examine the relationships of the four key areas in relation to actual and intended land stewardship behaviour. Focus interviews and focus groups including a piloting of the final questionnaire preceded the survey directed to a stratified random sample of approximately 1200 landholders in the region.

Ratepayer lists were obtained from Shire Councils within the Murray Catchment region. Information regarding property owner’s names, addresses, and property size was obtained from the ratepayer’s lists. To be eligible for inclusion in the study, participants were required to own or manage a property of at least 40 hectares within the Murray Catchment. A list of potential participants was constructed by selecting every third eligible property owner from the ratepayer’s list for each of the relevant shires.

Telephone numbers were obtained from Telstra White Pages for each of the potential participants. Potential participant’s were then contacted by phone and invited to participate in the study. As part of this invitation respondents were given details of the purpose of the study and the processes used for data collection. Those who agreed to participate were included in the questionnaire mail out. Those who did not wish to participate were removed from the phone list. An attempt was made to repeat this process for all shires although some problems were encountered in several instances.

One of the major concerns raised by those contacted by telephone prior to the survey distribution was the timing of the data collection. This issues was also prominent in many of the discussions that were conducted via the toll-free telephone help line after the survey had been mailed. The principal concern of participants was that the timing of the survey ‘clashed’ with perhaps the busiest time on farms (ie. during harvest and the establishment of rice crops). This led to considerable time demands on the part of the farmers. Clearly, this issue has impacted, in part on the response rate to the survey. Nevertheless, the overall response rate to the survey of over 30% was sufficient to provide a robust data set for analytical purposes.

**4.0 Modelling Adoption of CRP for Remnant Bush and Revegetation in the NSW Murray Catchment**

*Measuring CRP*

One of the principal challenges of this research was to assemble data that enumerates the level of CRP by farmers across the catchment. Presently, no alternative, comprehensive data are available to judge the extent to which farmers have adopted different practices. The methodology adopted to reveal this information was to offer respondents a variety of management practices and then asking them to indicate the
extent to which they had applied this technology on their farms. The ‘extent’ of adoption was measured using a Likert scale that ranged from ‘nil/not applicable’ [coded 0] to ‘applied to more than 75% of the area under question’ [coded 4]. The questions put to respondents were also divided amongst three principal activities, namely, pasture, cropping and remnant bush/revegetation management. Respondents were asked to indicate the extent to which they had applied a management technology, such as applying lime, in the past five years as well as indicating the extent to which a technology was likely to be applied by 2007.

Several measurement dilemmas arise from converting these data to a suitable measure of CRP. Firstly, the management practices offered to respondents for pasture and cropping comprised a large number of technologies; fourteen in the case of pasture management and sixteen for cropping activities. Whilst some of these technologies were considered essential to CRP, [such as undertaking soil tests], others were considered less significant and more likely to be influenced by site specific issues. Accordingly, the list of measures of CRP was reduced by a committee of ‘experts and practitioners’ convened for this research. His reduced these measures to those technologies considered widely practiced and critical to attaining CRP. All technologies appertaining to remnant bush and revegetation were included to form a scale of CRP and are detailed in Table 1. Whilst some of these activities might be regarded as mutually exclusive, the committee was of the view that earnest adopters of CRP would be inclined to have applied a range of technologies according to differences in landscape across their holding.

Table 1: Individual Measures of CRP

<table>
<thead>
<tr>
<th>CRP Cropping Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled weeds and pests</td>
</tr>
<tr>
<td>Fenced area and direct seeded trees and /or shrubs</td>
</tr>
<tr>
<td>Fenced area to exclude stock then planted trees</td>
</tr>
<tr>
<td>Fenced area to exclude stock then planted shrubs</td>
</tr>
<tr>
<td>Excluded stock completely to allow regeneration</td>
</tr>
<tr>
<td>Reduced stocking rate/changed stock rotation to allow regeneration</td>
</tr>
</tbody>
</table>

A second issue that must be resolved to develop a measure of CRP adoption relates to the interpretation of the responses of farmers to these technologies. One approach adopted by Carey (2001) and Llewelyn et al. (2002) employs a logit measure of CRP. In this instance the data are used to develop a ‘yes’ or ‘no’ measure of adoption. For example, Llewelyn et al. (2002) examined the CRP for weed management in Western Australia where six technologies were identified as representing best practice. Those respondents recording the use of three or more technologies were adjudged to have adopted best practice whilst those scoring fewer than three were considered non-adopters. One of the limitations of this approach is that it takes no account of the extent to which a practice has been applied on farm.

An alternative is to consider the area over which a practice has been adopted. The data collected as part of this survey could be manipulated to measure the area over which a particular technology had been applied. However, significant biases within the measure of CRP are likely to arise from the substantial variation on farms size across the study area. For example, a single farmer adopting a practice in the Northern region of the catchment, where the average farm size is four times that of the
South West Slopes, could produce a distorted measure of the adoption of CRP in that region. Moreover, since the motivation of this research was to understand individual farmer behaviour, such a measure of adoption would reveal little from a policy perspective.

In light of these weaknesses, an alternative measure of adoption of best practice was developed which both focussed on individual behaviour and provided for a gradation of adoption. The respondent’s score that showed the extent to which they had applied (or intended to apply) each CRP technology were used to develop an average adoption score for the particular enterprise. The results were then rounded for each individual to provide a discrete measure of adoption of CRP, ranging from 0 [implying nil adoption] to 4 [implying adoption over more than 75% of the land under the farmer’s control]. Not surprisingly, this measurement technique results in scores being clustered at the lower range of estimates since a score of 4 could only be recorded if a farmer had adopted every preferred technology on more than 75% of the farm area dedicated to that enterprise. This is highly unlikely given the nature of the technologies identified. Nevertheless, it was expected that the variation in these data would be sufficient to provide useful information from a policy perspective.

Measuring Personality
Having established a suitable measure of actual and intended adoption of CRP, the application of the model in Figure 1 requires the development of variables that adequately quantify the personality, values or objectives and attitudes of landholders. Personality has been defined as “...a construct referring to the characteristic qualities of a person as well as his or her characteristic way of differing from others” (Krahe, 1992, p.56). Personality traits or styles are the ways that individuals differ “...in their enduring emotional, interpersonal, experiential, attitudinal, and motivational styles” (McCrae & John, 1992, p.175). It is widely recognised that personality traits are hierarchically arranged (Costa & McCrae, 1995) and in recent times, many researchers have settled on the following five highest order factors; Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness (Costa & McCrae, 1995; Krahe, 1992; McCrae & John, 1992,) as representing individual differences.

Sixty items of the NEO-FFI were designed by Costa and McCrae (1992) to measure these five personality constructs using 12 items per factor. Each of the 12 items was included in the data collection of landholders in the Murray catchment and summed to complete the five personality factors. These factors were subsequently used in two ways. Firstly, they were employed as covariates to remove the relationship of the landholder’s personality when completing the attitude and CRP behaviour/intentions questions. Secondly, they were included in regression analysis to account for the relationships between personality and dependent variables in the model.

Measuring Values/Objectives
A review of the extant sociological and psychological literature was initially used to develop item measures for the values or objectives of landholders. Overall, it was considered that three overarching farmer categories of values/objectives were plausible; namely, economic, conservation and lifestyle. Following the experimental design processes described in part 3, the economic/conservation/lifestyle measure were refined into 15 items, five for each prospective sub-scale. The economic items included such statements as "Dollars and cents is what farming is all about", the
conservation items "Managing environmental problems on my farm is a very high priority" and lifestyle items "The lifestyle that comes with being on the farm is very important to me". They were included at the end of the NEO-FFI questionnaire (Costa & McCrae, 1992) and utilised the instructions of that measure.

**Measuring Attitudes**

Although there is a large and diverse literature on farmer’s attitudes, few tools are available to actually measure attitudes to land stewardship and the adoption of CRP (Willock et al., 1999). While Willock et al., (1999) developed a general attitude measure of Scottish farmers, this measure only included four items specifically related to CRP. Others have focused on specific types of conservation behaviour (eg. soil conservation, Lynne & Rola, 1987) but not in relation to general conservation attitudes. One exception is the recent Australian Social Land Care attitude variables of Reeve (2001) which was used in this research as a starting point for the development of unique attitude variables that were likely to be relevant in the NSW Murray Catchment.

In addition, the psychological literature was examined in an effort to uncover attitudinal categories that may be theoretically absent from conservation attitude research. Special attention was given to the psychology literature regarding social cognition models in this regard\(^4\). Social cognition models are concerned with how individuals make sense of social situations and provide a basis for understanding the determinants of behaviour and behavioural change. They assume that social behaviour is best understood as a function of people’s perceptions of reality (Conner & Norman, 1996). This approach was employed to develop focus interview questions. This process resulted in 41 attitudinal statements that respondents then ranked on a 7-point Likert scale.

Both the value/objective and attitude items were analysed and refined using principal component analysis and Pearson correlations to ensure that a coherent, relatively independent set of sub-scales described key variables (Tabachnick & Fidell, 1983). In the case of the attitude items this was done whilst controlling for the personality of the respondent, thereby partially accounting for the pervasive influence of this variable in the data and assisting in the reduction in the large number of attitude items. Whilst personality is presumed to influence the landholder’s values or objectives, these are considered relatively more enduring and derivation of value measures was conducted without holding personality constant. The methodology used to retain factors was eigenvalues of one (Rummel, 1970; Stevens, 1986), and “...smaller factors [were] retained only if they have sufficient substantive meaning to be interpretable” (Rummel, 1970, p.362). Two further attitude items Long terms plans and the Liming were included in later analyses due to their perceived practical importance (as determined by the committee of experts and practitioners). In sum, this analysis generated three independent measures of an individual’s values/objectives and seven attitudinal variables. A comprehensive description of the development and refinement of these measures is offered in Maybery et al.(In Press) and a summary of the variables used in the modelling process is provided in Table 2.

---

\(^4\) For an overview of social cognition models in relation to predicting and changing health-related behaviours see Conner and Norman (1996).
Table Two: Summary of variables derived from data reduction analyses.

<table>
<thead>
<tr>
<th>Variable in Model (Figure 1)</th>
<th>Variables Emerging from Analysis (Sub-Scales)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality</td>
<td>Neuroticism</td>
</tr>
<tr>
<td></td>
<td>Extraversion</td>
</tr>
<tr>
<td></td>
<td>Openness</td>
</tr>
<tr>
<td></td>
<td>Agreeableness</td>
</tr>
<tr>
<td></td>
<td>Conscientiousness</td>
</tr>
<tr>
<td>Values/Objectives</td>
<td>Economic</td>
</tr>
<tr>
<td></td>
<td>Lifestyle</td>
</tr>
<tr>
<td></td>
<td>Conservation</td>
</tr>
<tr>
<td>Attitudes</td>
<td>Financial and production concerns with CRP</td>
</tr>
<tr>
<td></td>
<td>Promoters of land stewardship and adoption of CRP</td>
</tr>
<tr>
<td></td>
<td>Discouragers of CRP</td>
</tr>
<tr>
<td>Actual and Intended</td>
<td>Enticements of CRP</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Aesthetics and practical importance of CRP</td>
</tr>
<tr>
<td></td>
<td>Liming is important in managing soil health</td>
</tr>
<tr>
<td></td>
<td>Long term (5-10 year) farm planning</td>
</tr>
<tr>
<td>Actual and Intended</td>
<td>CRP on pastures over past 5 years</td>
</tr>
<tr>
<td>Behaviour</td>
<td>CRP intended on pastures in next 5 years</td>
</tr>
<tr>
<td></td>
<td>CRP on crops over past 5 years</td>
</tr>
<tr>
<td></td>
<td>CRP on crops next 5 years</td>
</tr>
<tr>
<td></td>
<td>CRP on remnant bush and revegetation past 5 years</td>
</tr>
<tr>
<td></td>
<td>CRP on remnant bush and revegetation next 5 years</td>
</tr>
</tbody>
</table>

The model depicted in Figure 1 indicates that ‘external factors’ (ie. not within-person variables) can also impact on the adoption of CRP. A range of variables were available within the data including sources of information used by the landholder, the proportion of the farm devoted to different enterprises or activities, the location of the farm, whether the landholder had a farm plan, evidence and type of land degradation, income and age[^5]. All of these variables were included in the initial modelling approaches.

### 5.0 Results and Analysis of CRP Adoption

**Modelling Approach**

Ordered probit models were chosen as an appropriate technique for analysing the relationships between the variables in Table 2 and other external factors that *a priori* were expected to play a significant role in the adoption of CRP. The ordered probit model provides a practical solution where the dependent variable is expressed as an ordinal ranking. That is, the variable of interest (in this case the extent to which CRP employed) takes on a value of ‘1’, ‘2’, ‘3’ etc. to represent the rank of adoption. However, ‘2’ is not necessarily twice the value of ‘1’. Put differently, there is no significance to the unit distance between the sets of observed values.

[^5]: Age was considered as an external variable rather than a within-person variable insofar as it is not influenced by personality and the like.
The ordered probit model is attributed to Zanoina and McElvey (1975) and is commonly specified as:

\[ y_i = \beta' x_i + \varepsilon_i \]  

where \( y_i = \begin{cases} 0 & \text{if } y_i^* \leq \mu_0, \\ 1 & \text{if } \mu_0 < y_i^* \leq \mu_1, \\ 2 & \text{if } \mu_1 < y_i^* \leq \mu_2, \\ \vdots \\ J & \text{if } y_i^* > \mu (j-1) \end{cases} \]  

The error term \( (\varepsilon_i) \) is assumed normally distributed with a mean of 0 and variance 1 and estimates are obtained by maximum likelihood. The probabilities that underpin the log-likelihood are \( \text{Prob} [y_i = j] = \text{Prob} [y_i \text{ is in the } j\text{th range}] \).

In this instance models were estimated using a statistical computer software program called \( \text{LIMDEP} \). Output from the generated models was used to identify variables of statistical significance in predicting the extent of CRP adoption. However, care needs to be taken when interpreting the coefficients associated with each of the independent variables. The coefficients alone cannot be taken as measures of the extent to which they might influence the adoption of best practice as they are not always measures of marginal effects. Rather, it is the relative significance and sign of each variable that is considered informative in a policy context.

With this in mind, models were progressively developed to ascertain those variables that significantly influenced the extent of CRP adoption. Separate models were developed for past behaviour and future behaviour across the catchment. Additional models were developed for particular segments of the catchment and other enterprise activities but these are not reported here\(^6\). Model development occurred over several iterations by progressively removing those variables with low significance\(^7\) and considering the impact of variables on the overall goodness of fit\(^8\). Details of the resulting two models are provided in Table 3.

---

\(^6\) For a description of all models developed as part of this project see Crase and Maybery 2002.
\(^7\) This was originally assessed at the 10% level and gradually refined to the 5% level.
\(^8\) The overall goodness of fit for these models can be assessed by comparing the log-likelihood function with a log-likelihood computed assuming that all slopes on the non-constant regressors are 0. The resulting chi-squared statistic is then a valid test for the hypothesis that the non-constant regressors indeed have zero slope.
Table 3: Significant Variables in Ordered Probit Models for Remnant Bush and Revegetation CRP in Murray Catchment of NSW.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>CRP for Remnant Bush and Revegetation in Past 5 Years</th>
<th>CRP for Remnant Bush and Revegetation Intended for Next 5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality</td>
<td>Openness</td>
<td>Coefficient: 0.3013, Standard Error: 0.0496, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Agreeableness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values</td>
<td>Economic</td>
<td>Coefficient: -0.2571, Standard Error: 0.07442, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Financial and production concerns about land stewardship</td>
<td>Coefficient: -0.1175, Standard Error: 0.0496, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Aesthetics and practical importance of land stewardship</td>
<td>Coefficient: 0.2810, Standard Error: 0.0683, P[</td>
<td>Z</td>
</tr>
<tr>
<td>Attitudes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of Farm Remnant Bush and Revegetation</td>
<td>Coefficient: 0.0146, Standard Error: 0.0048, P[</td>
<td>Z</td>
</tr>
<tr>
<td>Actual Behaviour</td>
<td>CRP on pastures over past 5 years</td>
<td>Coefficient: 0.1588, Standard Error: 0.0748, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>CRP on crops over past 5 years</td>
<td>Coefficient: 0.2551, Standard Error: 0.0564, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>CRP on remnant bush and revegetation past 5 years</td>
<td>Coefficient: 1.2943, Standard Error: 0.0723, P[</td>
<td>Z</td>
</tr>
<tr>
<td>External Factors</td>
<td>Evidence of dieback</td>
<td>Coefficient: 0.1507, Standard Error: 0.0370, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Evidence of total degradation</td>
<td>Coefficient: 0.0313, Standard Error: 0.0110, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Farm plan</td>
<td>Coefficient: 0.2509, Standard Error: 0.1277, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>Coefficient: -2.4589, Standard Error: 0.4750, P[</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Observations</td>
<td>552</td>
<td>552</td>
</tr>
<tr>
<td></td>
<td>Log Likelihood</td>
<td>-449.3305</td>
<td>-341.7236</td>
</tr>
<tr>
<td></td>
<td>Restricted Log Likelihood</td>
<td>-503.4576</td>
<td>-492.9643</td>
</tr>
<tr>
<td></td>
<td>Chi-squared</td>
<td>108.2543</td>
<td>302.4813</td>
</tr>
<tr>
<td></td>
<td>Degrees of Freedom</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Model Significance Level</td>
<td>0.0000000</td>
<td>0.0000000</td>
</tr>
</tbody>
</table>
The model of previous behaviour for the adoption of CRP for remnant bush and revegetation provides several insights to the motivating forces driving adoption. The model itself is highly significant and contains seven explanatory variables significant at the 5% level, three of these at much higher levels of significance. Firstly, the significance of the CRP variables for the other enterprises examined as part of this study (ie, pastures and cropping) suggests that adoption of CRP for one activity occurs in concert with higher rates of adoption in others. From a policy perspective, an encouraging interpretation that can be drawn from this is that best practice would appear to be transferable between activities within landholders. Put simply, farmers that can be persuaded to adopt best practice in one activity are likely to be relatively easily swayed into adopting preferred techniques in others. However, the corollary of this is that those choosing not to adopt best practice in one activity are unlikely to be easily swayed into adopting best practice for others.

Secondly, the model indicates that the proportion of the landholding occupied by remnant bush and revegetation is positively related to the level of CRP adopted to date. This could reflect economies of scale in the management technologies themselves or increased interest/incentive driven by the prominence of the activity on the landholders property. It must also be acknowledged that this result may also have been influenced by the way CRP was measured in the data. Landholders with more remnant bush and revegetation would have more scope for applying all of the technologies in Table 1 and therefore would score higher than those with less remnant bush or revegetation.

Thirdly, evidence of degradation in the form of vegetation dieback is positively and significantly related to the level of CRP that has taken place in the last 5 years. This provides at least a prima facie case for suggesting that landholders are responding to the landscape problems that confront them. However, tracing the motivational trigger for this is more problematic. For example, an alternative interpretation could be that landholders’ recognition of degradation is enhance by higher participation in CRP. Thus, formulating specific policy responses to this issue requires more detailed investigation.

Fourthly and perhaps not surprisingly, those landholders that had a significant and positive attitude towards the aesthetic and practical aspects of CRP displayed a higher rate of adoption. In a policy context, (and since attitudes or more malleable than say personality), this implies that promotional materials and communication strategies and the like should be designed with this in mind. More specifically, these findings can be used to determine how loss or gain-framed messages could be employed to promote adoption (see, for instance, Rothman and Salovey 1997).

Fifthly, the attitude measure of ‘financial and production concerns’ showed a negative and significant relationship to adoption. Put differently, those landholders that were principally concerned with the financial impacts of remnant bush and revegetation on their landholding were less inclined to have invested in CRP for this activity. This finding supports other research which has indicated that few remnant vegetation and revegetation scenarios are capable of generating positive financial returns or returns that meet the opportunity costs associated with change (see, for instance, Reynolds 1997; RIRDC 1999). From a policy perspective this could be used to provide support for expanding programs like the Victorian Bush Tender trail (or similar) that provide financial payments for the establishment and maintenance of remnants.

---

9 This issue is given greater attention in Crase and Maybery 2002.
Finally, the model of past behaviour reveals that an individual’s openness is positively and significantly related to the level of CRP for remnant bush and revegetation. A person’s level of openness indicates the number and depth of interests to which they are attracted. Those high in openness have more interests and relatively less depth within each and those with low openness have relatively few interests but with greater depth. Whilst we have argued that there is little policy-makers can (or should attempt to) do about this, the results suggest that those willing to try a wide range of new ideas are more inclined to have adopted higher CRP for this activity.

The model of intended future behaviour was also highly significant and produced six variables warranting detailed discussion. Three of these variables have been explained, in part, by the previous discussion of the model of past behaviour. More specifically, the significance of the CRP on pastures over the past 5 years is again illustrative of the propensity of CRP to spread across activities on the one landholding (or within the one landholder). The negative ‘economic’ values variable might be explained by similar arguments emerging from the significance of the ‘financial and production concerns’ attitude variable and provides further weight for considering credible financial inducements that give regard to the opportunity cost of remnant bush and revegetation. The third variable with synergies in the earlier model is the significance of the ‘total degradation’ variable. This variable was developed by summing the landholders stated evidence of a range of environmental/landscape problems (including vegetation dieback) but caution again needs to be applied in interpreting this as a strictly causal relationship. Combined with the significance of the farm planning variable a range of interactions are feasible. For instance, having a farm plan may induce greater awareness of problems and simultaneously encourage adoption of CRP. To comprehensively address this issue alternative techniques that allow for higher levels of covariation between variables need to be employed.

One of the most significant predictors of future behaviour in this context was past behaviour. Much research in other fields has found that the strongest predictor of future behaviour is often past behaviour (see, for instance, Norman and Connor 1996). In the context of designing policies to encourage CRP for remnant bush and revegetation there are again two conflicting interpretation. From a positive perspective it is likely that farmers with a track record of using CRP will continue and expand those practices with relatively little encouragement from agencies. Alternatively, farmers with a poor track record are unlikely to alter their level of CRP without substantial inducements that reduce switching costs and the like. Thus, having identified a landholder as a non-adopter, serious consideration needs to be given to the likely costs of inducing significant change before incurring the costs associated with designing and providing the requisite incentives.

The model of intended future behaviour also reveals that an individual’s agreeableness is negatively related to the adoption of CRP. To re-emphasis, it is our contention that policy-makers can do little about such within-person traits and should instead focus on issues that are more conducive to influence. Nevertheless, the results may be instructive for ‘front-line’ practitioners dealing with individual landholders. Agreeableness refers to the level of cynicism, scepticism, straightforwardness, and willingness to help others exhibited by an individual. Highly agreeable people defer to a great many others while those low in agreeableness are more likely rely on their own point of view. The results of the model suggest that a landholder may need to be prepared to ‘swim against the tide’ of the opinions of their peers to become adopters of CRP in the context of remnant bush and revegetation.

6.0 Concluding Remarks

10 Crase and Maybery 2002 make some preliminary progress on this issue by employing structural equation modelling.
Australian resource managers are confronting numerous formidable challenges. Amongst the most pressing of these is the need to develop the types of policies and institutional triggers that will induce significant numbers of landholders to either extend and expand their uptake of CRP or move from non-adopter to adoption. Whilst the existing approaches used to engender change have made laudable progress, there would appear to be scope for better targeting the intervention mechanisms of agencies. In particular, there is a wealth of literature to support the view that some aspects of the landholder cannot be easily altered and greater efficiencies can be achieved by focusing on what is truly malleable. To this end this study makes further progress by attempting to isolate the least malleable factor of landholder decision making, personality.

Results from attempting this approach in the NSW Murray catchment have proved encouraging. Testing this methodology in the context of the uptake of CRP for the management of remnant bush and revegetation has provided some useful policy insights to the decision-making psyche of landholders. Arguably, it allows us to focus attention on those aspects of behaviour that are most conducive to suasion and narrows the range of triggers required to induce change. This provides a significant dichotomy from more generalist, instinctive approaches that emphasises broader attitudinal change or invoke universal assumptions of maximising behaviour.

Notwithstanding the apparent scope for this technique, there are numerous areas that require more attention. The process of translating this data into policies and actions is not always straight forward. More sophisticated techniques to interrogate this type of data and allow for greater covariance need to be explored. Applying this model to other landholder activities and in different locales would assist in establishing the wider validity of the approach. And finding ways of collecting and analysing the data of a large number of landholders within confined budgets will always be a challenge. Hopefully however, the wider consideration of similar techniques will result in the a more effective and efficient use of the limited public funds dedicated to encouraging landscape change.
Bibliography


Madden, B. Hayes, G. & Duggan, K. 2000, National Investment in Rural Landscapes, Virtual Consulting Group, Albury.


Rural Industries Research and Development Corporation 1999, Determining the Effectiveness of Vegetation Management Programs, RIRDC, Canberra.


