BushTender Participation in First Bidding Round: What are the Characteristics of Rural Landholders who Participated?

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Abstract
In this paper we present results of a statistical analysis of 380 landholders in the North Central and North East regions in Victoria that were interviewed after the first bidding round of the BushTender scheme. This survey asked questions about the economic, attitudinal and demographic factors that influenced their awareness and participation in BushTender. We use logit regression techniques to investigate awareness and participation behaviour of these landholders in BushTender.

Keywords: biodiversity, auctions, logit and tree models.
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Disclaimer: the opinion herein is that of the authors and not the Department of Primary Industries nor the Government of Victoria.

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1. Introduction

In this paper we analyse landholders' reactions to a conservation scheme called BushTender©, which is a scheme where landholders are asked to bid a price at which they would be willing to supply biodiversity services (ie, an auction). The focus of BushTender was to encourage landholders to protect native vegetation on their property. We examine the factors that affect landholders' awareness and decision to participate.

BushTender was first trialed in Victoria, Australia in 2000. BushTender is designed to encourage private landholders to undertake management activities to preserve and enhance native vegetation on private land. This scheme provides eligible landholders with a financial incentive to supply services, given that they are successful in the auction (see Stoneham *et al.*, 2002).

Bids in BushTender were ranked according to an index. Officers from the then Victorian Department of Natural Resources and Environment (NRE) visited landholders who had submitted an expression of interest, and scored their sites based on two key variables: (i) the value of the site in its current state, from a biodiversity perspective (the Biodiversity Significance Score, or BSS); and (ii) the amount of work that the landholder promised to undertake to improve the site (the Habitat Services Score, or HSS). These were combined, with information about the bid, to form the biodiversity benefits index (BBI), which allowed NRE to rank bids according to value for money[2]. During the site visits, landholders were informed of their HSS value, but not their BSS value[3].

The rationale for using an auction was proposed by Latacz-Lohmann and Van der Hamsvoort (1997). They argue that in some circumstances an auction will provide government with a cost-effective means of procuring environmental goods from landholders. Latacz-Lohmann and Van der Hamsvoort (1997) modelled landholders' bidding decision as a function of their financial opportunity cost of participation.

In previous literature, authors have attempted to identify the factors that affect landholders' opportunity cost of participation by analysing their participation in fixed price schemes (see for eg, Crabtree et al 1998 and Wynn *et al.* 2001). This method is indirect because in a fixed price scheme landholders reveal their participation decision jointly with their calculation of

[2] A BBI index was used to sort the most desirable bids from the least desirable. It was calculated as follows:

$$BBI = \frac{BSS \times HSS}{\$}$$

Where, $ is gross bid. The most desirable bids were those that had a higher BBI. See Stoneham *et al.* (2002) for more information.

opportunity cost; when landholders reveal that they are willing to participate, they also reveal that their calculation of opportunity cost is less than the fixed price on offer. In these situations, modelling participation is the same as modelling opportunity cost.

This is not the case in BushTender: landholders can participate, and they can *subsequently* decide on a bid value. Hence, we can look at the factors determining landholders' decisions to participate, separately from their calculation of opportunity cost (bid value).

NRE commissioned an extensive survey — from Sweeney Research (2002) — of participants and non-participants in BushTender. The survey was conducted after the submission of bids but before the awarding of contracts. Hence, we are also able to examine which factors affected whether landholders were aware of BushTender. Finding out which landholders were aware of BushTender has implications for the overall effectiveness of the scheme. If we know which type of landholders are being made aware and those that are not, we may be able to (say) tailor future BushTender communication strategies towards landholders from a broader cross-section of eligible landholders. However, our findings need to be tempered by the fact that NRE's communication strategy focused on environmental groups, hence, we would expect awareness to be greater amongst these groups.

1.1 Plan of the Paper

The rest of this paper is organised into six sections: in Section 2, we develop an analytical framework and briefly review the literature; in Section 3, we describe the data; in Section 4, we explain our statistical methodology; in Section 5, we present the results of our modelling of awareness and participation; in Section 6, we discuss the results from Section 5; and, finally in Section 7, we conclude this paper with some observations.

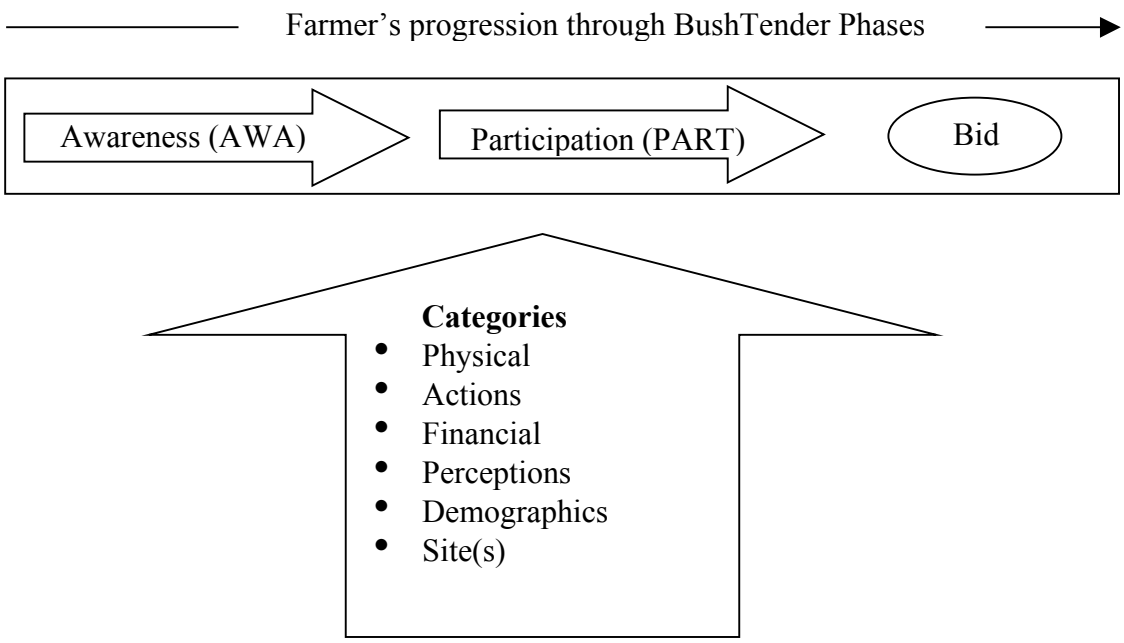
2. Analytical Framework and Review

We do two things in this section. First we provide a framework to simplify our exposition of the modelling results in later sections. Second, we review some of the empirical literature on entry into agri-environmental schemes.

2.1 Framework

[3] See Cason *et al.* (forthcoming) for a possible rationale.

Figure 1 Schematic Overview of Model looking at BushTender Reactions



In Figure 1, BushTender is described in terms of three 'phases'. First, a landholder becomes aware of BushTender, or not. Second a landholder decides to participate, or not. And third, if the landholder participates, he submits a bid, which is the price at which he would supply an agreed set of actions, if he were successful in the auction.

Many variables impact upon each phase of this process. We have placed these variables into six categories, which are shown in the arrow pointing up towards the phase section of the diagram. A list of the variables that we discuss in this paper is given in Appendix 1.

The schematic in Figure 1 is quite general in that a given category may impact differently on the different phases.

Figure 1 does not closely follow a particular behavioural model about human decision making (see for example, Luzar and Diagne 1999). Further, it does not make a concrete distinction between economic, and attitudinal factors, as is common in the literature (Lynne and Rola 1988; Van Kooten and Schmitz 1992). Rather we have taken the approach of collecting data on a large number of variables, and using statistical techniques to determine their importance (this is more of a data-mining exercise).

In the next section we will describe these categories in a bit more depth, and we will provide examples of how they have affected landholders' entry to agri-environmental schemes in the past. As stated in Section 1, most of the previous literature has focused on entry into fixed price schemes. Hence, the authors in this literature have focused on the 'participation' phase,

and implicitly on the landholder's measurement of opportunity cost (which is captured in the 'bid' phase in the diagram above). Mostly, past studies have used a logit/probit modelling approach, where the dependent variable has been defined as follows: unity if a landholder participated in a fixed price scheme; and zero otherwise.

2.2 Variables and Previous Literature

Physical variables describe a landholding, for example total size (in hectares) and enterprise types, if any (eg, grains, beef, etc.). Several previous studies have found that farm size affects entry, or stated willingness to participate, into agri-environmental schemes (Vanslembrouck *et al.* 2002; van Kooten and Schmitz 1992; and Crabtree *et al.* 1998). The amount of land dedicated to certain uses has also been found to be important (Wynn et al 2001; Bell *et al.* 1994; van Kooten and Schmitz 1992). This category also includes a regional dummy variable that is used to capture any regional-specific differences between the North Central and North Eastern target areas.

Action variables describe a landholder's behaviour, such as whether he has joined an environmental group, or whether he fences out creek lines. Our data on Actions is quite extensive, covering things such as production/environmental-protection activities (rabbit control, managing erosion), types of information gathered (eg, industry journals), and the membership of a variety of groups (environmental or industry). Previous studies have had a much more limited range of Action variables, focusing mostly on whether landholders are members of environmental groups, or whether they have participated in previous environmental schemes. These variables have generally increased the probability that a landholder will be involved in an agri-environmental scheme (Wynn *et al.*, Vanslembrouck *et al.* 2002, Luzar and Diagne 1999).

Perception variables are those that describe a landholders response to a question about his perception on an issue, or reason for doing something. For example, the reason the landholder ascribes to native vegetation decline in his area, or whether the landholder thinks BushTender is a good idea. Like the Action variables, our range of Perception variables is much more extensive than has generally been used in previous studies. In previous literature, Perception has often been examined using one variable called 'attitude' that captures whether a landholder has a positive attitude to conservation/environment. A positive attitude has often been associated with a higher probability of entry into agri-environmental schemes (Vanslembrouck *et al.* 2002; Luzar and Diagne 1999; van Koohan and Schmitz 1992; Lynne and Rola 1988; Bell *et al.* 1994).

Financial variables are income, or revenue of landholders. We have very limited financial data in our data set. In fact, we have only the percentage of total income from farming[4]. Mostly, previous authors have focused on the level of income. Lynne and Rola (1988) find that higher income, in conjunction with stronger conservation attitudes, raises the probability of soil conservation. Bell *et al.* (1994) find that an income level above a certain threshold increases the probability of participation in a forest stewardship scheme. Luzar and Diagne (1999) find the same for entry into a wetland conservation scheme.

Demographic variables are data on the landholder such as age and sex. Almost every study has included some Demographic features. Luzar and Diagne (1999) found the larger the number of dependents, the less likely is involvement in a wetland conservation scheme. They also found that education had a negative impact on willingness to enrol. Wynn *et al.* (2001) found that older people are less likely to ever be involved in a Scottish ESA scheme.

Site variables are those that describe the site being nominated for BushTender, in terms of both its score (eg, HSS, which was revealed to a landholder) and other characteristics (eg, size in hectares). Luzar and Diagne (1999) found that landholders with larger wetland areas were more likely to participate in a wetland conservation scheme. In terms of this study, we only have Site information about landholders that received a site visit. Hence, we cannot use Site variables to discriminate between aware and unaware landholders, or between participants and non-participants. However, the Site category should be useful for future work that analyses bidding behaviour.

3. The Data

Sweeney Research Pty Ltd conducted a survey on behalf of the then Victorian Department of Natural Resources and Environment in the North Central and North East regions to collect data on the BushTender scheme. The survey was aimed at collecting several factors: attitudinal data about participation and non-participation in BushTender; attitudes towards general environment issues; landholder characteristics; comments on improving the BushTender expression of interest phase; demographic and economic data. In total, there were 371 possible variables for each respondent. Of these variables, 27 were continuous while the remaining 344 were binary variables.

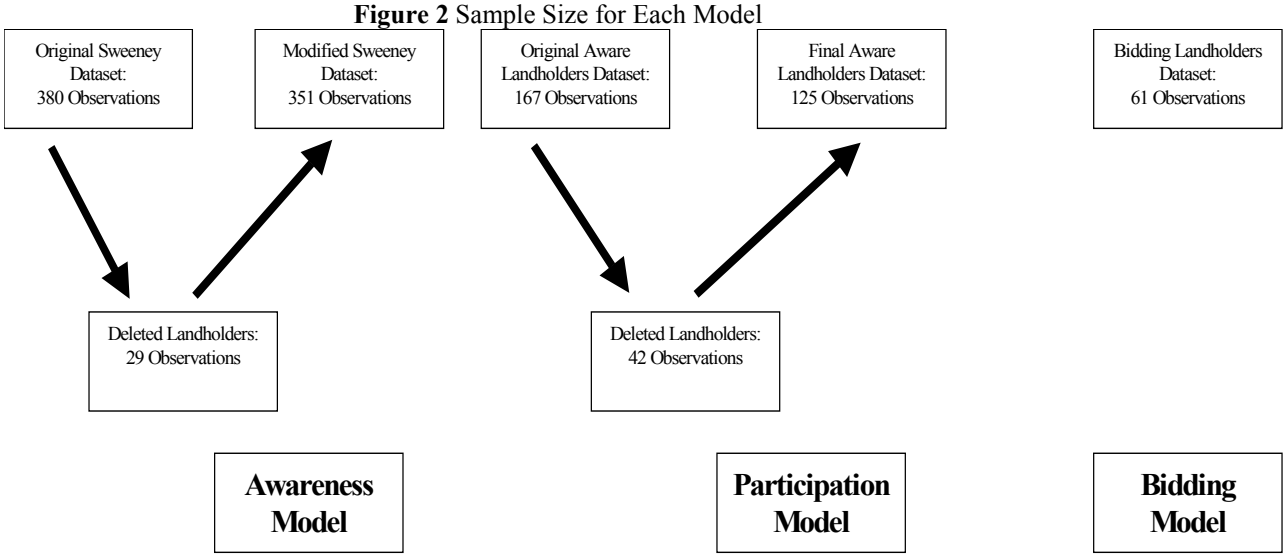
The Sweeney survey was conducted after the first bidding round of BushTender in early 2002 but before conservation contracts were rewarded to successful tenderers; partly to prevent

[4] We do not have a variable measuring income or revenue level in our study due to the fact that we considered respondents would react negatively to such a question. However, we have a variable measuring the proportion of income from farming. The Sweeney Survey contains several questions on physical farm characteristics such as size, stocking rates and grain yields, that should be correlated to farm income. However, many of these data were not provided by respondents.

biases influencing interviewees' responses if they were unsuccessful, or successful, in BushTender. The target respondents were private landholders in the North Central and North Eastern regions. 70 were landholders that expressed an interest in the scheme (out of a total of 126), of these 38 were from North Central and 32 from the North East. There may be some bias towards landholders that expressed an interest in BushTender because of the sampling process. Once all such landholders were contacted, the rest of the sample was selected randomly. 310 were randomly selected respondents (191 from North Central and 189 from the North East). In total, there were 380 respondents. That means there are 380 x 371 = 140,980 data points.

Figure 2 is a graphical summary of how many observations we deleted from each data set in order to estimate a robust model for awareness and participation. Some observations were deleted from the data set to deal with multicollinearity (see Section 4.2 for more information). For the Awareness model, we started with 380 observations but deleted 29 for estimation. For the Participation model, we started with 167 landholders but deleted 42.

Figure 2 Sample Size for Each Model



3.1 Profile of Landholders

Table 1 Profile of Landholders

Variable	*Total*	*Aware*	*Unaware*	*Participant*	*Non-Participant*
Observations (no.)	380	167	213	70	97
Physical					
Beef Enterprise (%)	41	42	41	37	45
Cropping Enterprise (%)	14	14	15	16	12
No Enterprise (%)	16	18	15	24	13
Sheep Enterprise (%)	34	31	36	43	23
Action					
Member of Environmental Organization (%)	47	66	31	81	55
Actively Increasing Native Vegetation (%)	41	49	35	67	35
Managing Native Vegetation (%)	40	38	41	29	45
Perceptions					
Believe Local Native Vegetation is Good Condition (%)	31	23	37	16	29
Believe BT is a Good Idea (%)	38	87	Not Applicable	97	79
Demographics					
Age less than 50 (%)	43	35	49	31	37
Age 50-59 (%)	30	33	27	33	33
Age greater than 60 (%)	28	32	24	36	30
Tertiary Educated (%)	37	46	29	54	40

Table 1 contains information about respondents using five types: Total; Aware; Unaware; Participant; and Non-Participant. These types are arrayed in columns with the profiling variables arranged in rows. The profiling information is presented in percentages of the type's sample.

In summary, Aware landholders were more likely than Total types to be a member of an environmental organisation, to be actively increasing native vegetation, to believe that local vegetation was not in a good condition, to believe that BushTender was a good idea, to be

older and to be tertiary educated. Participant landholders are similar to Aware types except they are more likely to be operating a sheep or no enterprise.

4. Methodology

We use logistic regression techniques to model awareness (AWA) and participation (PART). The software package we use is the *S-PLUS 6 for Windows* ©. First, we will explain our basic regression methodology. Then we will explain how we modified this basically methodology to deal with multicollinearity.

4.1 Logistic Regression Models

As explained in section 3, there are 371 potential variables we can use to explain participation and awareness. Given the large number of potential explanatory variables, we screen each potential explanatory variable against the dependent variable using a Chi-square significance test. Our objective is to construct models for participation and awareness that are the best fits of the data. We do this by constructing a null model[5] for the dependent variable than comparing this model against a univariate regression with the dependent variable regressed against the potential variable. We then test the null hypothesis that the univariate regression is not significantly different from the null regression at the 90 per cent level. We fail to reject variables that have a univariate regression that is significantly different from the null regression at the 90 per cent level. Conversely, we reject variables that have a univariate regression that is not significantly different from the null regression.

We then use all the significant variables to construct an initial model. This model is usually large in terms of how many explanatory variables are included and therefore the initial model does not represent the best fit of the data. By minimising the number of variables used to construct the model, we seek to maximise the degrees of freedom the model has. We use a two step process to further reduce the number of explanatory variables included in the model. First we use a step-wise regression procedure that tests how a modified form of the initial model compares against other models using the Akaike Information Criterion (AIC) statistic. The step-wise procedure in *S-PLUS* © compares the initial model against models that drop one explanatory variable. The lower the AIC statistic of a given model, the greater the probability of acceptance of that model. The acceptance of a model is dependent on its AIC statistic relative to competing models' AIC statistics. The model with the lowest AIC statistic is chosen. This process is repeated until no model can improve on the model's AIC statistic.

This step-wise procedure can be summarised as follows. Let the models be indexed by $i = 0, 1, 2, 3, \ldots, n$ where $i = 0$ represents the initial model Y_0:

[5] Null models are regression models that regress the dependent variable versus the intercept only.

$$Y_0 = X\beta \quad (1)$$

Where X is the matrix of variables in the initial model and β is the associated vector of coefficients. The models $i = 1, \ldots, n$ are represented by Y_i such that:

$$Y_i = X\beta - x_i\beta_i \quad (2)$$

Where, x_i represents the variable from Y_0 that is dropped and β_i is the associated coefficient of the dropped variable. Note x_i and β_i are both scalars. Let $j = 1, \ldots, m$ where j is the number of iteration. We can re-write equations 1 and 2 likeso:

$$Y_{0j} = [X\beta]_j \quad (1')$$

$$Y_{ij} = [X\beta]_j - [x_i\beta_i]_j \quad (2')$$

With,

$$[X\beta]_j = [X\beta]_{j-1} - [x_i\beta_i]_{j-1} \quad (3)$$

Equation 1' is the initial model for iteration j. Equation 2 is potential model i in iteration j. Equation 3 is the model chosen in iteration j - 1. Each j has an associated AIC statistic called AIC_j. This represents the AIC statistic of the model chosen in the previous iteration. If $j = 1$ then AIC_j is the AIC statistic of Y_{01}. Each Y_{ij} also has an associated AIC statistic called AIC_{ij}. This statistic is used to compare each model of iteration j. The Y_{ij} that has the lowest AIC_{ij} is then chosen. The new model may involve dropping some variables. This deletion procedure can be summarised algebraically as follows:

$$\begin{aligned} &For \quad j = 1,\ldots,l \\ &If \quad AIC_s = \min(AIC_i), \quad s,i \in n, \forall i \\ &Then \quad x_i = x_s \end{aligned} \quad (4)$$

This step-wise procedure continues as long as AIC_j decreases. If it increases then the procedure stops and the final model is:

$$Y = Y_{i(m-1)} \quad (5)$$

Where, $Y_{i(m-1)}$ is the Y_{ij} such that $AIC_{i(m-1)} = \min(AIC_{ij})$ for all j.

With Y we have a model that is based purely on the primary effects of the screened variables. However, we can improve the explanatory power of Y' by including two-way interaction terms. Adding interaction terms is similar to the step-wise regression procedure. In fact, adding interaction terms is a higher order step-wise regression. In the context of this paper we limit ourselves to constructing models of 2nd order magnitude. This is because of

computational limitations and interpretation reasons. The construction of a 3rd order step-wise regression model increases the complexity of estimation exponentially with dubious value in terms of interpretation.

Adding interaction terms works by simultaneously adding an interaction term and deleting terms for every j. The AIC statistic is used to choose interactions for addition and deleting terms. This process continues until the AIC statistic for the model cannot be further decreased. Let $i = 0, \ldots, n$ be the index for each potential model considered during iteration j, $j = 1, \ldots, m$, $k = 1, \ldots, l$ is the index of potential models containing the interaction term z_k and x_i is the dropped variable for potential model i. The initial model for each j is similar to 1'. The initial model when $j = 0$ is Y. However, equations 2' and 3 are respectively rewritten as:

$$Y_{ij} = [X\beta]_j - [x_i\beta_i]_j + [z_k\beta_k]_j \qquad 6$$

$$[X\beta]_j = [X\beta]_{j-1} - [x_i\beta_i]_{j-1} + \sum_{j=1}^{m-1}[z_k\beta_k]_j \qquad 7$$

Where, β_j is the coefficient of z_k. The deletion of variable is done in the same fashion as 1st order step-wise regressions. In other words, delete those terms from the model that has the lowest AIC statistic. Interaction terms can also be deleted if this criteria is satisfied. The addition of interaction terms is similar to deletion of terms. Interaction terms are added if the k model associated with z_k in iteration j has the minimum AIC statistic out of all possible k models. Algebraically, the decision rule for addition of interaction terms z_k is:

$$\begin{aligned} &For \quad j = 1,\ldots,l \\ &If \quad AIC_t = \min(AIC_k), \quad t,k \in l, \forall k \\ &Then \quad z_k = z_t \end{aligned} \qquad 8$$

Equation 8 is used to update equation 7 which in turn updates equation 6 for all j. This updating continues until the AIC statistic of Y_j no longer declines. Rewriting 4, the final model of the 2nd order step-wise procedure is:

$$Y^* = Y_{i(m-1)} \qquad 5'$$

Where, $Y_{i(m-1)}$ is the Y_{ij} such that $AIC_{i(m-1)} = \min(AIC_{ij})$ for all j.

The next step to refining this model is by testing each variable in Y using a Chi-square test. We reject any variable that does not pass a 90 per cent significance test. The reason why we use Chi-square tests in conjunction with the AIC is because the latter tends to err on the side of acceptance. And the reason why we do not just use a Chi-square test is for a purely computational reason: step-wise regressions use AIC and not the Chi-square test. We are able to construct models faster using step-wise regressions. However, to refine the models we use

the Chi-square test to prevent over-specification. Using the Chi-square test is a labour-intensive and iterative process whereas using a step-wise regression procedure is automated in *S-PLUS* ©. This testing continues until no more variables can be rejected. The refined model of Y^* is called Y^{**}.

4.2 Multicollinearity

Estimation of appropriate models for participation and awareness of BushTender may not be as straightforward as implied above. Multicollinearity was a problem in estimating both these models. If there was perfect multicollinearity between the dependent variable and a variable for a subset of respondents, we removed these respondents. This resulted in us deleting landholders from the dataset. If there was imperfect multicollinearity between explanatory variables, these variables are found by generating a table of correlation coefficients. Variables are then removed that are causing multicollinearity.

The specific methodology for the AWA model is as follows. We dealt with multicollinearity by deleting landholders from the initial data set of both random and non-random selected landholders from 380 observations to 351. Some landholders were removed because their responses placed them in a category that is perfectly correlated with AWA.

There were two 'rounds' of deletion of categories of landholders that were perfectly correlated with AWA. The first round involved the deletion of 25 landholders from the data set. The second round involved the deletion of 4 landholders. These categories were perfectly correlated because if a landholder belonged to any of these categories, a perfect prediction could be made regarding their awareness of the BushTender scheme.

Deleting these 29 landholders leaves us with 351 landholders in the data set. We can then estimate the primary effects only model. However, in order to avoid further multicollinearity problems we had to refine this model to a high degree. This was done by testing each variable using a Chi-square significance tests at the 95 per cent level after the initial model had been refined by a step-wise regression.

Estimating the 2^{nd} order step-wise regression was complicated by multicollinearity. This was initially dealt with by testing each variable with Chi-square significance test at the 95 per cent level. However, multicollinearity still persisted after this refinement. Less precise techniques were used. We further refined the model by eliminating any variables that had a coefficient correlation of 0.7. Again we applied a Chi-square test (at the 95 per cent significance level) and rejected variables that were not significant. After this, we eliminated any variables that had a correlation coefficient greater than 0.7. Finally, we were able to produce a 2^{nd} order step-wise regression model with two-way interactions without multicollinearity.

Now we turn to the methodology of the PART model. We use a subset of the total data set to estimate a model of an aware landholder's participation in the BushTender expression of interest phase. The subset reduced the total number of respondents from 380 landholders to 167 (AWARE data set). However, due to multicollinearity problems, more observations had to be deleted in order to estimate a numerically stable model of BushTender participation. We had to modify our methodology to deal with multicollinearity.

The first difference in methodology was the use of Chi-square tests to screen each variable after the construction of the 1st order step-wise regression. This Chi-square test was at the 90 per cent significance level. We included these Chi-square tests to reduce the probability of over-specifying the model.

The second difference in methodology is the removal of any variable that had a correlation with the intercept of more than 0.9. This removal allows us to reduce numerical instability but not to necessarily enable us to estimate a stable model.

For us to estimate a numerically stable model, we have to delete landholders from the AWARE data set to remove landholders who are members of a category that is perfectly correlated with the dependent variable. This deletion was done in two steps. First, we remove those landholders that had ACTIM.NAT=1 and ID.FUT=1. This was because these variables were perfectly correlated with PART in the AWARE data set. Deletion of landholders who have either ACTIM.NAT=1 or ID.FUT=1 removes 27 landholders. Not 29 because there are two landholders who are members of both categories. In the second round of deletion, landholders who have DL.CAT=1 or READ.CAST=1 were removed. These variables were causing instability with the AWARE data set but were not perfectly correlated with PART. With the removal of the 27 landholders in the first round, the variables DL.CAT and READ.CAST are now perfectly correlated with PART. The refined AWARE data set has 125 landholders in it. The removal of the 15 landholders who have either DL.CAT=1 or READ.CAST=1 allow us to estimate a numerically stable model of an aware landholder's decision to participate in the BushTender process.

We discuss the analytical implications of deleting these landholders in Section 5.

5. Results

In this section, we will present results of the regression for AWA and PART. First, we present results for the AWA regression, then we present results for the PART regression.

5.1 AWA modelling results

Table 2 Perfectly Correlated Variables with AWA (Deleted in Screening Process)

Variable	*Prediction‡*	*Number of Landholders*
Physical Variables		
LU.CREEK	AWA=1	2
LU.PLANT	AWA=0	4
LU.VINE	AWA=1	2
Action Variables		
ACTIM.VERM	AWA=1	4
ACTN.OTH	AWA=0	4
ACTN.USE	AWA=0	5
ACTIM.BIRD†	AWA=0	4
Perception Variables		
DL.SHOOT	AWA=1	2
DL.SPRAY	AWA=1	2

Note: '†' denotes category of landholders that was deleted in the second round of deletion. ‡ AWA=1 means that landholder is aware of the BushTender scheme while AWA=0 means a landholder is not aware. Light grey shading is for negative variables.

Table 2 gives the results from our screening process (described in Section 4), that led us to delete several landholders from the dataset, in order to get more robust regression estimates (provided later in this section). Some of the results from Table 2 are unexpected, in those cases we provide some cross tabulation with other variables in the dataset to assist with interpretation.

In our dataset, landholders that are concerned with wildlife (either vermin or decline of native wildlife) are aware of BushTender. This is shown by the fact that *all* those who undertake vermin control for native vegetation protection (ACTIM.VERM=1), or are conscious of the decline of native wildlife — due to either illegal shooting (DL.SHOOT=1) or excessive spraying (DL.SPRAY=1) — are aware of BushTender[6].

Landholders that have a creek or vineyard present on their property are more aware of the BushTender scheme. All landholders in our dataset who have a vineyard on their property (LU.VINE=1) are members of an environmental organisation.

In our dataset, those landholders who have a creek on their property (LU.CREEK=1) are also increasing native vegetation on their property (ACT.INC), which perhaps indicates more interest in environmental schemes, such as BushTender.

From Table 2 we can also see that there are several variables that imply landholders will be unaware of BushTender: those who manage their native vegetation for firewood or grazing (ACTN.USE=1); those that manage it for other reasons (ACTN.OTH=1); those that have a plantation present on their property (LU.PLANT=1); or those constructing bird habitats (ACTIM.BIRD=1).

Landholders who manage native vegetation for production (such as firewood and grazing) or other reasons, or those that have a plantation, will be less likely to be aware of BushTender perhaps because they are more interested in profitable uses of their land.

In our dataset, landholders that construct bird habitats are not aware of BushTender. This is surprising because these landholders would appear to be more favourably disposed towards conservation, and hence we would expect them to be more aware of environmental programs. However, none of the landholders who construct bird habitats are members of a group concerned with environmental matters (Table 3) which (as we shall see soon) is an important determinant of awareness of the BushTender scheme. Alternatively, these landholders may not be aware of BushTender because they have constructed bird habitats for hunting, rather than conservation, purposes.

Table 3 Cross-tabulation between Landholders with ACTIM.BIRD=1 and MEMBER.ENV

	MEMBER.ENV=1	MEMBER.ENV=0
ACTIM.BIRD=1	0	4

We will now discuss the results of the AWA model (Table 4, see Table A2.1 for a more detailed Table). Concentrating on the primary effects model first, there are two sub-categories, of our Action category, that help explain awareness of BushTender: management actions; or interest in environmental issues.

In terms of management actions, there are five variables that increase the likelihood of BushTender awareness. These all pertain to landholders' actions on their native vegetation: cleaning or maintaining (ACTIM.CLEAN=1); establishing soil erosion measures (ACTIM.EROS=1); controlling rabbits (ACTIM.RAB=1); weed control (VEG.WEED=1); and good farm practices (ACTIM.GFP=1). These variables are likely to increase awareness of BushTender probably because landholders who are undertake management actions, either as part of another program or at their own initiative, are actively seeking new information.

[6] This is further illustrated form the results of our regression model, given later in this section.

Table 4 Results of AWA Logistic Regression Model

Dependent Variable: AWA		
	Primary Effects Model	*Primary Effects and Two-way Interactions Model*
Observations	351	351
Action Variables		
ACTIM.CLEAN	0.881*	0.874*
ACTIM.EROS	1.688**	1.519*
ACTIM.GFP	2.925**	2.632*
ACTIM.RAB	1.668*	1.476*
MA.OTH	1.413**	0.704^
MEMBER.ENV	1.132**	1.212**
PROG.OTHER	1.069**	0.807*
READ.CHRON	-2.139**	-1.903*
VEG.GRAZE	-0.728**	-0.684**
VEG.WEED	0.965**	0.85**
Perception Variables		
LOC.VEG	-0.799**	-0.737**
DL.HAB	1.177^	1.234*
Demographic Variables		
MALE	0.822**	#
SP.AGE.60TOGT69	1.098**	0.935**
Two-way Interactions		
MA.OTH:PROG.OTHER	#	6.363^
Intercept	-1.838**	-1.231**
Cross-validated Error Rate (%)	28.2	28.8

Note: t statistics are shown in brackets below the coefficient estimate in parentheses. All estimates rounded to the nearest third decimal place unless otherwise shown. '*' denotes estimate is significant at the 95 per cent level. '**' denotes estimate is significant at 99 per cent level. '-' denotes estimate was negative. '#' denotes variable was not included in the model. '^' denotes the estimate was insignificant at the 95 per cent level. Light grey shading is for negative variables.

In terms of interest in environmental issues, membership of several types of environmental groups positively affect BushTender awareness: MEMBER.ENV=1; MA.OTH=1; or PROG.OTHER=1 (see the Appendix for definitions). Membership of an environmental organisation provides a conduit to new ideas and programs that are relevant to landholders. The BushTender communication strategy also consciously targeted such organisations to inform and engage landholders about the scheme. These results suggest that: (i) NRE's communication strategy was effective in raising awareness of the program; and (ii) landholders positively predisposed towards learning more about the environment are more likely to be aware of BushTender.

Two Action variables that are associated with of BushTender are whether a landholder reads the Chronicle (READ.CHRON=1) or whether a landholder uses his native vegetation for livestock grazing (VEG.GRAZE=1)[7].

By cross-tabulation, we found that landholders who read the Chronicle are less likely to be members of an environmental organisation (Table 5). These landholders are less likely to have access to information on BushTender or other native vegetation management programs.

Table 5 Cross-tabulation between Landholders with READ.CHRON=1 and MEMBER.ENV

	MEMBER.ENV=1	MEMBER.ENV=0
READ.CHRON=1	5	18

Those landholders that use native vegetation for grazing are less likely to be aware of BushTender, probably because they would they are more focused on productive (profit-oriented) activities, rather than conservation.

Perception variables were also important in determining awareness. Landholders who perceive that native vegetation in their local area was of generally very good quality (LOC.VEG=1) are less likely to be aware of BushTender. Landholders who think native vegetation is in good condition may have a lower level of environmental awareness generally, or they may be less inclined to seek information about such matters.

If a landholder thinks that habitat loss has caused a decline in local wildlife (DL.HAB=1), then this landholder is more likely to be aware of BushTender. This greater awareness of the ecological links between wildlife and vegetation may indicate landholders that have actively sought out information about the environment.

Demographic variables also help to explain why some landholders are aware of BushTender. Male landholders (MALE) and landholders with a spouse aged 60 or above (SP.AGE.60TOGT69) are more likely to be aware. Male landholders are generally older than female landholders (Table 6). This suggests an 'inter-generational equity' argument: older landholders are more aware of BushTender because they have a desire to preserve the productive capacity of the land for the next generation of landholders. Another reason why older landholders may be more likely to be aware of BushTender is that some of these landholders use their land less intensively (eg, run livestock at a lower stocking rate than younger landholders). These landholders may be open to conserving native vegetation if there is a financial incentive because this allows them to reduce production intensity and still earn income from conserved land. Younger landholders instead seek to maximise the short-term financial gains from agriculture activities. Older landholders may be more active in seeking out information on conserving their land's condition whereas younger landholders

[7] The Chronicle is a paper from Wangaratta, which is the North East BushTender region.

seek to extract as much value from their land as they can. Similarly, the spouse age variable is correlated with the respondent age variable so an older spouse implies an older respondent. Generally, we conclude that older respondent's are likely to be more aware of BushTender.

Table 6 Distribution of Age and Gender

	Age Less than 50 (%)	Age Between 50 to 59 (%)	Age Greater than 60 or Above (%)
Total	43	30	28
Male	41	29	30
Female	49	30	20

The second awareness model we estimated — is the primary effects model that includes interactions — does not provide results very different from those reported above (see Table 4). Most variables have similar estimates and are still significant at the 95 per cent level. However, MA.OTH is insignificant, MALE was deleted and DL.HAB became significant. A two-way interaction was added, MA.OTH:PROG.OTHER but is insignificant at the 95 per cent level.

In summary, those landholders undertaking a native vegetation management activity, are older (or have an older spouse) or have an interest in managing the environment are more likely to be aware of BushTender. On the other hand, those who have no native vegetation on their property, believe that the local vegetation in their area is in very good condition or those that use native vegetation as a productive input are less likely to be aware of BushTender.

5.2 PART modelling results

Table 7 Perfectly Correlated Variables with PART (Deleted in Screening Process)

Variable	*Prediction‡*	*Number of Landholders*
Action Variables		
ACTIM.NAT	PART=0	13
READ.CAST†	PART=1	6
Perception Variables		
DL.CAT†	PART=1	9
ID.FUT	PART=0	16

Note: '†' denotes category of landholders that was deleted in the second round of deletion. ‡ AWA=1 means that landholder is aware of the BushTender scheme while AWA=0 means a landholder is not aware. Light grey shading is for negative variables.

As with our AWA model, we first discuss the results from the screening process in the PART model (see Section 4). Table 7 reveals the number of landholders that were removed in order to reduce multicollinearity, and hence improve the robustness of the regression model. Recall Table 1, that our analysis of the participation model includes only aware landholders.

As can be seen from Table 7, Action and Perception characteristics can be used to provide some initial predictions about the factors that affect participation in BushTender. In our dataset, landholders that planted native vegetation (ACTIM.NAT=1) did not participate in BushTender. This could be because BushTender was relatively focused on the management of *existing* remnants, rather than revegetation.

In our dataset, aware landholders that thought BushTender dealt with future problems (ID.FUT=1) did not participate. By cross-tabulations, we found that these landholders tend to operate an enterprise (Table 8). Perhaps these landholders did not participate because they have higher opportunity costs, and hence feel that they would be relatively unlikely to be successful in the auction.

In our dataset, we would expect a landholder who attributed the decline in wildlife to feral cats (DL.CAT=1) to participate in BushTender. This is probably because such landholders are concerned about the perceived loss of biodiversity.

An aware landholder who regularly reads the Castlemaine Mail (READ.CAST=1) is also more likely to participate. This is because such landholders typically operate non-mainstream (ie, not broadacre or dairy) agriculture enterprises (ENT.OTHER=1) or no enterprises at all

(ENT.NO=1) (Table 9). We can say that such landholders have a low opportunity cost of participation compared to broadacre and dairy operators.

Table 8 Cross-tabulation between Landholders with ID.FUT=1 and Operate an Enterprise

	Operate an Enterprises	Do Not Operate Enterprises
ID.FUT=1	12	4

Table 9 Cross-tabulation between Landholders with READ.CAST=1 and ENT.NO and ENT.OTHER

	ENT.NO=1 and ENT.OTHER=1	ENT.NO=0 and ENT.OTHER=0
READ.CAST=1	5	1

Table 10 contains the estimates of the primary effects model (see Table A2.2 for a more detailed version); two-way interactions did not improve the explanatory power of this model.

Table 10 Results of PART Logistic Regression Model

Dependent Variable: PART	
	Primary Effects Model
Observations	125
Action Variables	
HEARD.RADIO	-2.823**
MEMBER.ENV	1.129**
READ.IND	-2.207*
VEG.PLANT	1.084**
Perception Variable	
PROP.IGNORE	-0.957*
Intercept	-0.96*
Cross-validated Error Rate (%)	29.6

Note: t statistics are shown in brackets below the coefficient estimate in parentheses. All estimates rounded to the nearest third decimal place unless otherwise shown. '*' denotes estimate is significant at the 95 per cent level. '**' denotes estimate is significant at 99 per cent level. '-' denotes estimate was negative. Light grey shading is for negative variables.

Action variables explain most of an aware landholder's decision to participate. Two Action variables make landholders less likely to participate in BushTender: if they became aware by listening to the radio (HEARD.RADIO=1); or if they regularly read industry journals (READ.IND=1). If an aware landholder relied on these communication media for information, we predict they are less likely to participate. Or these action variables could be a proxy for missing variables.

Two Action variables are consistent with higher probability of participation: membership of an environmental organisation (MEMBER.ENV=1); and planting trees and shrubs in native vegetation (VEG.PLANT=1).

Members of a group concerned with land protection or the environment may face lower transaction costs of entry: participation may entail the completion of forms and questionnaires, which may be easier for group members to comprehend. By being a member of an environmental group, these landholders are able to draw on other people's experiences or expertise when dealing with government. Non-members are unlikely to have such a network to draw on, and hence they may face relatively higher transaction costs of participation.

Aware landholders that had already revegetated their land (VEG.PLANT=1), have a higher probability of participation. These landholders have experience in conservation, and this perhaps signals willingness to undertake further environmental conservation. Hence, they are more willing to participate in BushTender.

One Perception variable was significant in explaining landholders participation decisions: landholders that do not think much about native vegetation or biodiversity (PROP.IGNORE=1) are less likely to participate in BushTender. This is to be expected because landholders that do not incorporate the property's native vegetation, or biodiversity, into land use decisions are less likely to be willing to allocate time and resources to undertaking management actions.

In summary, landholders' participation in the BushTender expression of interest phase is dependent upon their being members of environmental groups, undertaking management activities, perceptions about the condition of native wildlife, the media through which they discovered BushTender, and which newspapers they regularly read. These results suggest that the first round of the BushTender program engaged a subset of eligible landholders; specifically, it engaged landholders that were actively seeking more information on environmental issues, and/or were undertaking native management actions on their property. Some positively predisposed landholders did not participate because they were more passive in how they received information on environmental issues. Transaction costs in participating may be a key impediment in engaging these passive landholders. These passive landholders may be an important source of new entrants in a future BushTender bidding round.

6. Discussion

Revisiting our results using the schema from Figure 1, we can examine the variable categories that affected each phase of BushTender. This is shown in Figure 3.

Figure 3 Revisited Analytical Framework

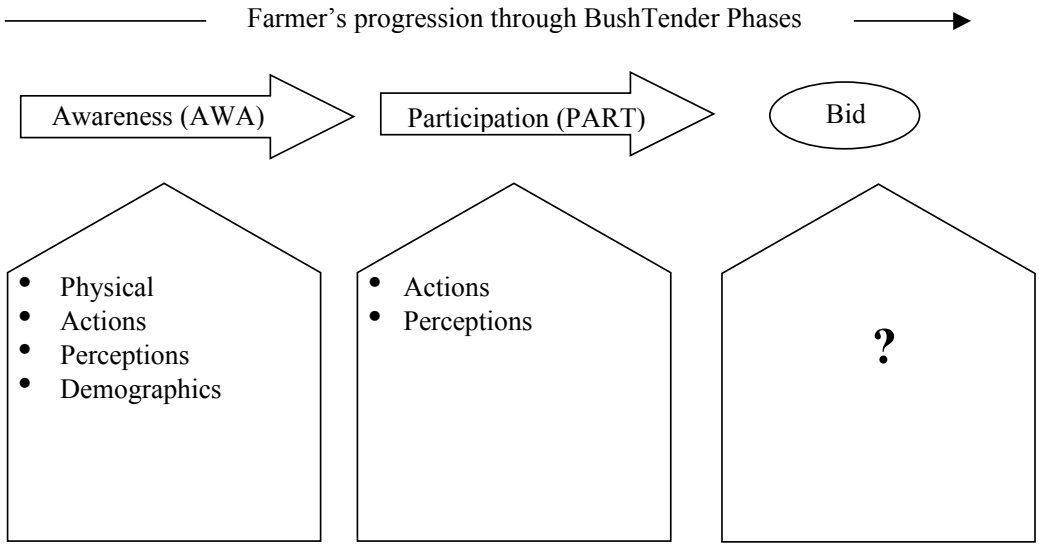


Figure 3 shows that Actions and Perceptions — two variables for which we had much more extensive data than many previous studies — are important in the awareness and participation phases of BushTender. The Action variable, membership of an environmental group, affected awareness and participation.

Site characteristics were not important for awareness or participation because we only have this data for landholders who bidded in BushTender. However, preliminary analysis suggest they may be important for the bid phase.

In previous literature, authors have argued that landholding characteristics affect participation in agri-environmental schemes. For BushTender, participation is not affected by Physical characteristics of the landholding. Perhaps, BushTender engaged a broader cross-section of landholders than a fixed price subsidy would have.

There are some variables that were in our data set, but did not survive the statistical discrimination process. Some of these are worthy of note.

First, although BushTender was held in two regions, the regional dummy variable (NC) was not significant in our awareness or BushTender model. This suggests that there were no

significant differences across the two regions, for awareness and participation phases of the program.

Second, our general education variable, ME.EDUC (respondent has been tertiary educated), did not play a role in the awareness or participation models. Rather, variables associated with information about the environment specifically — such as environmental organisation membership — seem to be more important.

Lastly, our Financial variable, proportion of income from farming, does not appear in the awareness or participation models. In other words, landholders that participate in BushTender do not derive less of their income from agriculture than other landholders. Perhaps income *level*, as used in other studies, is a better variable for measuring the capacity or flexibility of landholders to participate.

7. Concluding Comments

In this paper, we have made three small additions to the empirical literature on landholder entry into agri-environmental schemes.

First, due to the fact that BushTender is an auction mechanism, we have been able to analyse a relatively less-studied form of agri-environmental scheme; many previous studies have been about fixed-price schemes.

Second, since BushTender was a relatively new scheme, we were able to examine how landholders became aware of the scheme, and what factors affected them becoming aware, or otherwise.

Third, since we had an extensive number of variables from a survey of participants, and non-participants, we were been able to use relatively sophisticated statistical techniques to choose the most appropriate models.

We found that two categories of variables for which we had relatively plentiful data — Actions and Perception of landholders — were very important in all phases of the BushTender trial. A key variable in this regard is environmental organisation membership; a variable found to be statistically significant for both models presented here. In terms of awareness, this is logical since NRE disseminated information about BushTender via environmental groups.

These facts, combined with fact that general education variables were insignificant, suggests that it is specific information/knowledge about the environment that is important, not the level of education, or ability to learn, generally.

Together, these observations suggest that raising awareness/concern for environmental issues does affect landholders' ability to engage in an auction mechanism. The key point is that knowledge of environmental issues is an important determinant of engaging landholders in an incentive instrument program such as BushTender. Landholders who are more conscious of the environment are likely to be engaged by an incentive instrument program such as BushTender. Given this, if the goal is to encourage native vegetation conservation on private property, an education/suasion campaign to raise awareness and incentive instrument program in isolation should be used to complement each other rather than be seen as substitutes for each other in a policy-makers suite of options. By doing so, we expect that environmental goals can be achieved at a lower cost than in running an education/suasion campaign or incentive instrument in isolation.

However, there is scope for further research. We have yet to complete study of the overall BushTender process. The estimation of a bidding model, both analysing the bidding decision and what factors affect the level of the bid submitted would complete the analysis. One possibility could be the study of the characteristics of potential future BushTender participants. The current data set will be augmented by the completion of the Gippsland BushTender round due to be held later this year. This will allow us to study if there is any difference between the Gippsland round and the initial bidding round. Given the breadth and depth of the data set at our disposal, it is possible that there are other areas of research.

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Appendix 1

Variable	Type of Variable	Description[8]
ACT.INC	Action	Actively increasing the amount of native vegetation on property.
ACTIM.BIRD	Action	Planting bird corridors or nesting areas.
ACTIM.CLEAN	Action	Cleaning up or maintaining area.
ACTIM.EROS	Action	Establishing soil erosion measures.
ACTIM.GFP	Action	Undertakes good farm practices.
ACTIM.NAT	Action	Planting native vegetation.
ACTIM.RAB	Action	Controlling and/or monitoring rabbits.
ACTIM.VERM	Action	Destroys vermin.
ACTN.OTH	Action	Other reason for not managing native vegetation.
ACTN.USE	Action	Use native vegetation for firewood/grazing or other activities.
AWA	Perception	Is aware of BushTender scheme.
BBI	Site	Continuous variable. Biodiversity Benefits Index.
BSS	Site	Continuous variable. Biodiversity Significance Score.
DL.CAT	Perception	Decline of wildlife due to feral cats.
DL.HAB	Perception	Decline of wildlife due to habitat loss.
DL.SHOOT	Perception	Decline of wildlife due to illegal shooters.
DL.SPRAY	Perception	Decline of wildlife due to too much spraying.
ENT.NO	Physical	Do not operate an enterprise from property.
ENT.OTHER	Physical	Operate a tourist, fodder crop, goat, poultry, plantation, bee, lavender/herbs/seeds, nuts, potato, vegetable or other enterprise.
GOODIDEA	Perception	Think BushTender is a good idea.
GROSS.BID	Site	Continuous variable. The dollar amount of bid submitted.
HEARD.RADIO	Action	Heard about BushTender from a radio program.
HSS	Site	Continuous variable. Habitat Service Score.
ID.FUT	Perception	Think BushTender is a good/bad idea because planning in anticipation of future problems.
LOC.VEG	Perception	The amount and quality of native vegetation within 10-15 km of property is very good.
LU.CREEK	Physical	Creek is present on property.
LU.PLANT	Physical	Plantations are present on property.
LU.VINE	Physical	Vineyards are present on property.
MA.OTH	Action	Member of either Alpine Valley, Land for Wildlife, VSS, Grasslands Society, Meat and Livestock Corp., Target 10, Women in Agriculture, Landcare, Sustainable Grazing Systems, North Eastern Stud Breeders, Olive Growers Association, Agricultural Society and other agricultural groups.
MA.VFF	Action	Member of the Victorian Farmers Federation.
MALE	Demographic	The respondent is male.
ME.AGE.50TO59	Demographic	Respondent's age is from 50 years to 59 years.
ME.AGE.60TOGT69	Demographic	Respondent's age is from 60 years and above.
ME.AGE.LT30TO49	Demographic	Respondents' age is 49 years or below.
ME.EDUC	Demographic	Respondent has a tertiary education qualification.
MEMBER.ENV	Action	Respondent or spouse is a member of an organisation concerned with land protection or the environment.
NC	Physical	Respondent is located in the North Central Catchment Management Area.
PART	Action	Respondent participated in BushTender's expression

[8] All variables are binary unless otherwise noted.

Variable	Type of Variable	Description[8]
		of interest phase.
PROG.OTHER	Action	In the past three years, participated in either a Heartlands, Country Fire Authority, 20/20, fencing, soil erosion, salinity control, native planting, Bushcare, Project Platypus, Hindmarsh Biolink, duck boxes, organic farming, Murray River Action Group, wildlife monitoring/rescue, local groups, Target 10, roadside management, other or unknown environmental programs.
PROP.IGNORE	Perception	Respondent does not think about native vegetation management and biodiversity very much.
READ.CAST	Action	Regularly reads the Castlemaine Mail.
READ.CHRON	Action	Regularly reads the Chronicle.
READ.IND	Action	Regularly reads industry journals.
SP.AGE.60TOGT69	Demographic	Spouse is aged 60 years or older.
VEG.GRAZE	Action	Native vegetation, bushland or unimproved pasture is used for grazing.
VEG.PLANT	Action	Native vegetation, bushland or unimproved pasture is used for planting trees or shrubs.
VEG.WEED	Action	Native vegetation, bushland or unimproved pasture is used for weed control.

Appendix 2

Table A2.1 Results of AWA Logistic Regression Model

Dependent Variable: AWA		
	Primary Effects Model	*Primary Effects and Two-way Interactions Model*
Observations	351	351
Action Variables		
ACTIM.CLEAN	0.881*	0.874*
	(2.232)	(2.28)
ACTIM.EROS	1.688**	1.519*
	(2.55)	(2.233)
ACTIM.GFP	2.925**	2.632*
	(2.379)	(2.101)
ACTIM.RAB	1.668*	1.476*
	(1.996)	(1.777)
MA.OTH	1.413**	0.704
	(2.707)	(1.201)
MEMBER.ENV	1.132**	1.212**
	(4.167)	(4.511)
PROG.OTHER	1.069**	0.807*
	(2.922)	(2.128)
READ.CHRON	-2.139**	-1.903*
	(-2.4)	(-2.176)
VEG.GRAZE	-0.728**	-0.684**
	(-2.669)	(-2.537)
VEG.WEED	0.965**	0.85**
	(3.463)	(3.135)
Perception Variables		
LOC.VEG	-0.799**	-0.737**
	(-2.67)	(-2.521)
DL.HAB	1.177	1.234*
	(1.877)	(2.02)
Demographic Variables		
MALE	0.822**	
	(2.759)	
SP.AGE.60TOGT69	1.098**	0.935**
	(3.044)	(2.685)
Two-way Interactions		
MA.OTH:PROG.OTHER		6.363
		(0.971)
Intercept	-1.838**	-1.231**
	(-5.078)	(-4.379)
Cross-validated Error Rate (%)	28.2	28.8

Note: t statistics are shown in brackets below the coefficient estimate in parentheses. All estimates rounded to the nearest third decimal place unless otherwise shown. '*' denotes estimate is significant at the 95 per cent level. '**' denotes estimate is significant at 99 per cent level.

Table A2.2 Results of PART Logistic Regression Model

Dependent Variable: PART	
	Primary Effects Model
Observations	125
Action Variables	
HEARD.RADIO	-2.823**
	(-2.567)
MEMBER.ENV	1.129**
	(2.459)
READ.IND	-2.207*
	(-1.847)
VEG.PLANT	1.084**
	(2.462)
Perception Variable	
PROP.IGNORE	-0.957*
	(-1.82)
Intercept	-0.96*
	(-2.143)
Cross-validated Error Rate (%)	29.6

Note: t statistics are shown in brackets below the coefficient estimate in parentheses. All estimates rounded to the nearest third decimal place unless otherwise shown. '*' denotes estimate is significant at the 95 per cent level. '**' denotes estimate is significant at 99 per cent level.