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ABSTRACT *Most of Australia's native forest vegetation is located on private land, and conservation success often depends on landholders' participation in bush management programs. To understand landholders' preferences for these programs' attributes, we surveyed 251 landholders within historical deforestation hot spots across Queensland, Australia. Landholders were asked to make pairwise comparisons of 10 nonfinancial incentives and one financial compensation scheme. Based on a latent class analysis, we identify three distinct landholder classes. We discuss the implication of our results for the future design of native vegetation management and conservation policy instruments.* (JEL Q15, Q57)

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1. Introduction

Australia has a long and tumultuous history with native vegetation management dating back to colonization by European settlers in the early nineteenth century (Bradshaw 2012). Demand for agricultural products has led to large-scale changes in the landscape, as landholders have cleared native forests and bushland to make way for pasture and cropland. This historical trend is particularly evident in the northern Australian state of Queensland.

Appendix materials are freely available at http://le.uwpress.org and via the links in the electronic version of this article.

Over the last 20 years, land-clearing rates in Queensland have fluctuated dramatically, largely due to a politically charged environment (Seabrook et al. 2006; Bradley et al. 2010; Simmons, Law, et al. 2018). Currently, many ecosystems are severely threatened or overexploited. Furthermore, relationships and trust between Queensland landholders and the Queensland state government have deteriorated (Dale 2018). Generally, there is pressure on policy makers to restrain budgetary expenses. Hence, policy mechanisms that have been heavily used in the past—involving direct payments to landholders to compensate them for changes in regulation or as part of environmental extension programs—are now seen as unaffordable, even as pressure to regulate increases. In Australia and globally, these pressures have led to a growing interest in how policies and environmental schemes can be designed to increase conservation outcomes without relying on financial incentives. This interest has led to a need to better understand the potential effectiveness of nonfinancial incentives in terms of increasing participation in agri-environmental schemes. Despite some research efforts reported in the literature, the effectiveness of nonfinancial incentive mechanisms remains poorly understood relative to financial incentive mechanisms, which have been the focus of much of the conservation-related economic research to date.

We contribute to this knowledge gap by evaluating the preferences of landholders in Queensland, Australia, for financial and nonfinancial incentives to participate in bush management schemes. The main aim of this study was to investigate how landholders rank nonfinancial incentives compared to financial incentives. We designed and implemented a survey to identify the relative importance of these financial and nonfinancial attributes and their relevance for designing more effective bush management schemes. We further examined whether a link can be established between key sociodemographic characteristics of landholders and their preferences for nonfinancial incentives. Finally, we discuss the implications of our findings for future design and targeting of bush management programs with the aim of increasing their conservation effectiveness.

2. Background

Designing Agri-environmental Schemes

Agri-environmental schemes are used in many countries to encourage landholders to protect biodiversity or environmental assets on their private lands. A common feature of these programs is their reliance on financial payment mechanisms to compensate landholders for undertaking conservation activities (Uthes and Matzdorf 2013). The rate of payment is often a predetermined fixed payment or dynamically determined through a competitive bidding process (e.g., a conservation tender scheme). While designing these programs, it is generally expected that higher financial payments would encourage more landholders to participate in such programs (Shogren et al. 1999; de Vries and Hanley 2016). However, evidence suggests that agri-environmental schemes relying on financial instruments often fail to attract sufficient numbers of participants to make such programs effective. For example, a review by Rolfe et al. (2018) found that participation rates in conservation tenders varied from 1% to 50% in developed countries, with most cases obtaining less than 20%. This begs the question of how to design such programs to make them more attractive to landholders and ultimately more efficient in terms of environmental protection.

While it has been demonstrated that financial motivations are the major driver of landholder decisions regarding environmental protection, a number of studies have shown that landholders also engage for nonfinancial reasons (Knowler and Bradshaw 2007). Further, there is a considerable gray area between purely financial and purely nonfinancial incentives. Examples of incentives in this gray area include certification or regulation (Raedeke, Rikoon, and Nilon 2001). Both imply a potential impact on the landholder's economic circumstances, though this impact occurs indirectly through market mechanisms, rebates, taxes, or management options. Landholders may have key values and beliefs about the conditions and threats that affect what they individually value. These key values and beliefs may motivate their sense of moral obligation (Stern 1999) to undertake appropriate

action to preserve values on their land. Values and beliefs may be influenced by landholders' fundamental beliefs, attitudes, and the decision context (Guagnano, Stern, and Dietz 1995). In the absence of ongoing financial incentives, nonmonetary reinforcement with social approval or personal commitments may encourage behavior maintenance and long-term durability of the conservation scheme (Cook and Berrenberg 1981). Asking participants to make visible, personal commitments, such as signing a pledge, has appeared to create longer-lasting behavior change in some circumstances (Jacquemet et al. 2017).

Understanding Preferences for Financial and Nonfinancial Incentives

Research into incentive mechanisms within agri-environmental schemes is not new (Morris and Potter 1995). The studies on participation in these schemes may be grouped into two approaches. The first applies information about landholders' actual participation (revealed behavior) in existing environmental programs. This typically involves investigating the link between participation choice and landholder characteristics (e.g., Knowler and Bradshaw 2007; Rolfe, Windle, and McCosker 2009). Participation in agri-environmental schemes has been found to correlate with landholder and farm-household characteristics, farm biophysical characteristics, farm financial/management characteristics, and exogenous factors (Knowler and Bradshaw 2007). The second approach relies on stated participation (stated behavior) in hypothetical programs. This approach often employs stated choice experiments designed to assess the importance of financial compensation and other nonfinancial aspects of contract design (e.g., duration, flexibility, monitoring, feedback) on landholders' decisions to enter into voluntary environmental payment contracts (Nagubadi et al. 1996; Langpap 2004; Layton and Siikamäki 2009; Matta et al. 2009; Broch et al. 2013; Vedel, Jacobsen, and Thorsen 2015).

Despite substantial research efforts to understand sociodemographic drivers of heterogeneity in landholders' participation decisions, there is limited consensus within the literature regarding directions or magnitudes of impacts related to specific landholder and farm-household characteristics. Although some studies have found positive or no influence of age, most studies concluded age to be negatively correlated with agri-environmental scheme uptake (Lehtonen et al. 2003; Duke et al. 2012). Other studies have found female owners are more likely to be concerned about the environment (van Ingrid et al. 2011). Higher education levels (Duke et al. 2012) and increased habitat availability (Nielsen, Jacobsen, and Strange 2018) have also been found to increase the probability of selecting a preservation contract. Farm size may play a role in how important an area is for generating financial outcomes. Small-scale farms may be relatively more motivated to own and manage land for nonpecuniary benefits such as aesthetics, nature protection, bequest, and privacy (Creighton, Baumgartner, and Blatner 2002; Urquhart and Courtney 2011; Maes et al. 2012; Petucco, Abildtrup, and Stenger 2015), compared to large-scale owners. Further, biophysical factors such as soil fertility and terrain may be correlated with the potential opportunity cost of conservation and therefore may reduce the likelihood of participation in conservation (Mohebalian and Aguilar 2016). Contract characteristics such as increased flexibility, reduced monitoring, and reduced contract length have been found to increase participation (Christensen et al. 2011; Kaczan and Swallow 2013; Greiner 2016). Several studies have also found improved communication and feedback to correlate positively with participation (Cary and Webb 2001; Braga and Starmer 2005; Gsottbauer and Van den Bergh 2011; Bernedo, Ferraro, and Price 2014). Psychosocial characteristics may also play an important role. For instance, some landholders might choose to participate in conservation schemes either to conform to their self-image, if they believe others expect them to participate if other landholders also participate (conditional participation), or if they trust management authorities (Thøgersen 1994; Valbuena, et al. 2010; Christensen et al. 2011; Tesfaye and Brouwer 2012; Comerford 2014;). Finally, large uncertainty regarding future income and cost flows as well as governmental uncertainty regarding schemes and policies has been found to deter participation

(Page and Bellotti 2015). Notwithstanding all this, the findings are often case specific, and the cumulative literature is inconclusive in terms of identifying generally valid drivers of participation in agri-environmental schemes.

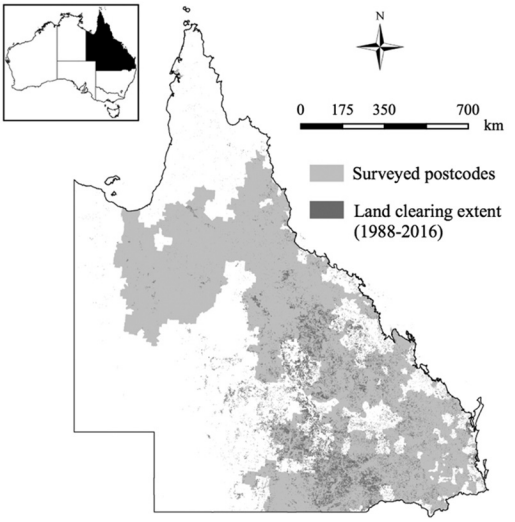
Study Area and Land-Clearing Context

Queensland represents the most ecologically diverse state in Australia, encompassing 2.04 million km^2 of tropical, temperate, and desert bioregions (Figure 1). Despite only 2.8% of the population being employed in the agricultural industry (Queensland Government Statistician's Office 2019), 82% of the state is managed as pasture for livestock grazing (ABARES 2016). Consequently, historic land clearing for pasture development has reduced native vegetation cover by at least 50% over the last 200 years and accounts for more than 60% of total clearing in Australia in the last 40 years (Evans 2016). To combat high clearing rates, the Queensland government enacted the Vegetation Management Act (VMA) 1999, which protected remnant (i.e., old growth) vegetation on private lands throughout the state (Simmons, Law, et al. 2018). However, policy uncertainty caused by subsequent regulatory changes—which either strengthened, weakened, or removed protection for remnant vegetation—led to "panic clearing" by landholders. Panic clearing describes clearing undertaken in anticipation of changes (usually a strengthening) to regulatory protection for remnant vegetation. This clearing has undermined the effectiveness of the VMA and of a subsequent ban on broad-scale clearing that was implemented in 2007 (Simmons, Marcos-Martinez, et al. 2018; Simmons, Wilson, et al. 2018). Remnant vegetation management has remained a debated topic in Parliament, as landholders continue to protest further land-clearing restrictions on their property and environmental advocates argue for stronger protection of Queensland's natural resources.

3. Methods

To assess the preferences for financial and nonfinancial incentives to participate in bush management schemes in the study area, we use a quantitative survey-based approach involving surveys with relevant stakeholders: farmers/graziers, landholders, and members of farming families who live in Queensland.

Figure 1
Location of Surveyed Landholders' Primary Postcode of Residence in Relation to Recent Land-Clearing Extent in Queensland, Australia



Data Collection

Survey participants were recruited by a social research company to complete an anonymous survey over the telephone or online during May 2018. Initially, participants within historical clearing hot spots were targeted for recruitment, and once participant telephone numbers were exhausted in these postcodes, recruitment was expanded into more moderate clearing postcodes throughout the state (Figure 1). In total, 251 participants completed the relevant survey questions for this study. The majority of participants were male (71%), currently managed a production property (82%), and were the primary decision-maker in the family (72%). The average age was 61, and there was a relatively equal representation of all education and income levels (Appendix Table A1) Most participants only managed one production property and had been managing this land for 34 years, on average. All aspects of data collection, use,

and analysis received ethical clearance prior to commencement.

Survey Construction

Incentives

Based on a literature review, four anonymous interviews with social scientists and experts in land management behavior and one focus group interview with Queensland stakeholders, we identified a total of 10 incentives of particular relevance for the decision to engage in bush management contracts (Table 1). These included a direct financial incentive (*financial*), two indirect financial incentives (*certify* and *funding*), and seven nonfinancial incentives—chosen to represent a variety of potential characteristics of bush management contracts.

We used a paired comparisons approach for eliciting incentive preferences (David 1988), resulting in 45 unique pairwise comparisons. As noted by Louviere, Flynn, and Marley (2015), this approach to "object-based" choice has largely been superseded by balanced incomplete block designs that generate sets of k (> 2) objects where participants select both "best" and "worst" items. A constraint on our adoption of this approach was the reliance on telephone interviews: it was perceived as too difficult for participants to compare more than two objects if they were not presented on paper. To reduce the time and cognitive demands on participants, each participant received a random subsample of 10 of the pairwise comparisons. For each pair of incentives, participants were asked, "Which option is most important to you when considering bush management schemes?," and they could select only one option. Owing to the random presentation of incentive pairs, some incentives may have been presented more than once to a participant or not at all.

Descriptive Variables

For an in-depth description of all variables included in the survey and their measurement, see Appendix Table A1 and Simmons, Wilson, and Dean (2020). The following demographic variables were recorded: age, gender, income, education, land manager status, primary decision-maker status, number of years managing their current property, and the postcode(s) of their main place of residence and their property (if applicable). Participants identifying as a current land manager were asked about their clearing behaviors, including if they have trees on their property, how often they have cleared for relevant (i.e., permitted) and nonrelevant (i.e., not permitted) purposes in the last five years (as defined by the 2018 version of the VMA), the amount of trees cleared in the last five years, their clearing amount relative to other landholders in their community, factors influencing their clearing decisions, and their intentions to clear in the next six months.

The following psychosocial variables were measured for land managers only: values (economic, lifestyle, and conservation values; see Table 2 for full description), place attachment, farmer self-identity, loss aversion, and social capital. The remaining psychosocial variables were measured for all survey participants: sense of security, attitudes (anticlearing and antiregulation), "good farmer" definition, perceived threat of regulation, trust in the government, emotions about regulation, perceived behavioral control, social norms (tree clearing and regulatory disobedience), awareness of norms, financial strain, life satisfaction, and perceived barriers to and incentives for participating in extension-based land management programs (e.g., conservation covenants). Us-

Table 1
Incentives of the Hypothetical Bush Management Scheme Presented to Participants

Description (as Presented to Participants)	Abbreviation
Option to certify produce as "bush friendly"	Certify
Most farmers in the region being involved	Popular
Extra public funding for community-based projects	Funding
Regular updates on the scheme's outcomes	Updates
Training in best management practices	Training
Flexibility to choose the length of the program	Duration
Flexibility to choose the areas of land to be included	Land area
Low compliance monitoring	Monitor
Low paperwork	Paperwork
Financial compensation per hectare	Financial

Table 2
Average Responses from Landholders for Select Variables

Variable	Item	Scale	Mean (SD)	*n*
Values				
Economic[a]	When planning future farming activities I only focus on how profitable they will be	[1, 6]	4.00 (1.30)	206
	A maximum annual return from my property is my most important aim			
Lifestyle[a]	The lifestyle that comes with being on the farm is very important to me	[1, 6]	5.10 (1.05)	206
	We do not make a fortune from farming but the lifestyle is great			
Conservation[a]	The most important thing is leaving my property in better shape than I found it	[1, 6]	5.53 (0.79)	206
	Managing environmental problems on my farm is a very high priority			
Attitudes				
Anticlearing[a]	I am concerned about the rate of tree clearing in Queensland	[1, 6]	2.42 (1.27)	251
	Tree clearing should be stopped			
	People are clearing too many trees			
	People who clear trees from their property do not care about the environment			
Anti-VMA[a]	In my opinion, vegetation management regulations . . .	[1, 6]	4.57 (1.11)	251
	Are a burden to me			
	Are fair to farmersb			
	Are necessaryb			
	Should be more strictb			
Trust in the Government[a]	The Queensland government has my best interests in mind	[1, 6]	1.49 (0.93)	251
	I can trust the Queensland government to always do what is right			
Sense of Security[a]	I am confident that I can still enjoy a comfortable lifestyle while following vegetation management regulations	[1, 6]	3.05 (1.44)	248
	Vegetation management regulations are a threat to my business or livelihoodb			
Perceived Behavioral Control[a]	How much personal control do you feel you have over tree clearing decisions on your property?	[1, 6]	2.42 (1.26)	251
	Following the vegetation management regulations set forth by the Queensland government is . . . [difficult to easy]			
Social Norms				
Tree clearing	Most of the farmers in my community clear trees	[1, 6]	3.05 (1.74)	242
Obeying regulations	Most of the farmers in my community follow the vegetation management regulations	[1, 6]	4.78 (1.27)	225
Financial Strain[a]	Within the last four weeks, how often have you . . .	[1, 5]	2.53 (1.19)	251
	Had serious financial worries?			
	Not been able to do the things you like to do because of shortages of money?			
	Not been able to do the things you need to do because of shortages of money?			
Voluntary Program Participation[a]	Have you participated in any of these programs?	[1, 5]	2.27 (0.75)	251
	Landcare grants for private land conservation (e.g., sustainable agriculture, restoration)			
	Land management agreements (e.g., land for wildlife)			
	Conservation covenant (e.g., the Nature Refuges Program)			
	Other projects or programs			

(table continued on following page)

Table 2
Average Responses from Landholders for Select Variables *(continued)*

Variable	Item	Scale	Mean (SD)	*n*
Incentives for Participation (% Yes)	Which of the following factors are the main reasons why you have participated in one or more of these programs?			
Importance	The intrinsic value or importance of nature	Yes/No	71.3%	101
Environmental	The environmental benefits for my property or my community	Yes/No	91.1%	101
Risk aversion	To minimize environmental threats or risks to my property or family	Yes/No	80.2%	101
Community influence	My neighbors or other farmers in my community have benefited from them	Yes/No	53.5%	101
Financial	The financial benefits for my property or my community	Yes/No	58.4%	101
Barriers to Participation (% Yes)	Which of the following factors are the main reasons why you have not participated in one or more of these programs?			
Exposure	Lack of exposure or knowledge of the programs	Yes/No	50.5%	214
Loss aversion	Loss of autonomy or control over my property	Yes/No	39.7%	214
Financial	Loss of income or market value of my land	Yes/No	32.7%	214
Community influence	My neighbors or other farmers in my community regret participating in them	Yes/No	14.0%	214
Importance	I do not think nature needs to be protected on my property	Yes/No	22.9%	214

Note: See Appendix Table A1 for responses to all items included in the survey. A value of 1 represents the lowest possible score for each question, such as the strongest disagreement of a statement, or the lowest frequency or value pertaining to the variable item.
[a]Scores for individual items averaged for a single score.
[b]Scores reversed for analysis.

ing an explorative approach, we tested the explanatory power of each of these descriptive variables on the participants' choices in the pairwise comparisons.

Econometric Model

We analyzed the survey data using a logit specification with Latent Gold v5 (Vermunt and Magidson 2016). Latent class models do not rely on assumptions traditionally required in the analysis of discrete choice data (e.g., normal distributions, preference homogeneity); hence, they are less subject to bias (Magidson and Vermunt 2002). We assume a latent utility function v for person n described over the 10 incentive items J such that

$$v_{jn}^{*} = \beta_j X_j + \varepsilon_{jn}, \quad [1]$$

where $\boldsymbol{X}_j$ is a vector of dummy variables describing the presence of an item, $\boldsymbol{\beta}_j$ is a vector of the associated utility weights, and ε is a random error term assumed to be type II extreme value distributed. The probability that individual n selects incentive j as the preferred option compared to incentive k is given by

$$P_n(Y=j) = \frac{\exp(\lambda\beta_j X_j)}{\exp(\lambda\beta_j X_j) + \exp(\lambda\beta_k X_k)}, \quad [2]$$

where λ is the scale coefficient, conventionally normalized to 1 for identification. To allow for heterogeneity, we employ a latent class approach assuming heterogeneous preferences between classes but homogeneous within a class. We restrict the role of the observable characteristics of the participant in explaining class membership.

In the latent class model, the probability of selecting incentive j as best compared to k when there are M possible latent classes becomes (Train 2009)

$$P_n(Y=j) = \sum_{m=1}^{M} s_m \left(\frac{\exp(\lambda\beta_{jm} X_j)}{\exp(\lambda\beta_{jm} X_j) + \exp(\lambda\beta_{km} X_k)} \right), \quad [3]$$

where s_m is the probability that the respondent belongs in class m. These shares can be parameterized and made a function of individ-

ual characteristics, using a multinomial logit model:

$$s_l = \frac{\exp(\alpha_l \mathbf{Z}_n)}{\sum_{m=1}^{M} \exp(\alpha_m \mathbf{Z}_n)}, \quad [4]$$

where $\mathbf{Z}$ is a vector of individual-specific characteristics. For identification, some restriction has to be imposed: we employ $\sum_{m=1}^{M} \alpha_m = 0$.

Although the estimated utility parameters give an estimate of the relative weight and hence the ranking of the items, they can be difficult to interpret. A proposed representation of the relative weights is to calculate relative-scaled probability scores (Sawtooth Software 2013) that range from 0 to 100. We define the ratio-scaled probability score for incentive j for class m as

$$R_{jm} = \frac{\exp(\bar{\beta}_{jm})}{\exp(\bar{\beta}_{jm}) + 1}, \quad [5]$$

where $(\bar{\beta}_{jm})$ is the zero centered raw logit parameter estimates for incentive j in class m. This can be interpreted as the probability that incentive j will be selected as best when compared to an incentive that has the average weight. For convenience, the probability scores for the set of incentives within a class are rescaled so they sum to 100. Note that these scores are not independent of error scale: if a class has a very high level of random noise in their choice process, these probability scores will tend toward $1/J$. It is useful to get some idea of the precision of the estimates of the ratio scores. We do this by simulation, conditional upon class membership. We take the variance-covariance matrix of the vector of estimated utility weights, $\boldsymbol{\beta}_{jm}$, and draw a sample of 2,000 observations from a multivariate normal distribution using this matrix, for all parameters. We then calculate the simulated probability scores and calculate the 95% confidence intervals.

4. Results

Most land managers strongly identified with lifestyle and conservation values (mean and SD are 5.10 ± 1.05 and 5.53 ± 0.79, respectively). High values indicate agreement with statements such as "The lifestyle that comes with being on the farm is very important to me" and "Managing environmental problems on my farm is a very high priority" (lifestyle and conservation values, respectively; see Table 2). By contrast, most land managers identified less strongly with economic values (4.00 ± 1.30); for instance, they expressed moderate agreement with statements such as "When planning future farming activities I only focus on how profitable they will be" (Table 2). There was a large variation in perceived social norms, but the majority believed most landholders in their community are obeying the regulations and refraining from clearing trees. Overall, landholders held weak anticlearing attitudes and strong antiregulation attitudes. Their sense of trust in the government and sense of control were very low, and their sense of security was moderately low, despite a low degree of reported financial strain. Past participation rates in various voluntary conservation programs were typically low, with most landholders citing lack of knowledge and perceived losses of autonomy and income/market value of land as the main reasons for not participating in the programs. Those that had participated in one or more of the programs primarily cited environmental benefits, threat mitigation, and intrinsic values of nature as the main reasons for participating. Additional characteristics of landholders can be found in Appendix Table A1.

Table 3 reports the results from a search over the number of classes to include in the latent class model. Conventionally, the model choice is determined through an appropriate statistical information criterion—here we report BICs and Consistent Akaike's Information Criterion (Bozdogan 1987)—although some additional judgment on the interpretability of coefficients can be required (Ruto, Garrod, and Scarpa 2008; Scarpa and Thiene 2011). All results here are for the model with *security* as the single explanatory variable for class membership, since this was the only descriptive variable that was significant in the class membership function (Table 4). Wald test p-values for other variables included in

Table 3
Measures of Model Fit, as Number of Classes Changes

	LL	BIC(LL)	CAIC(LL)	No. Parameters
1-Class choice	–1,589.12	3,227.87	3,236.87	9
2-Class choice	–1,531.72	3,173.70	**3,193.70**	20
3-Class choice	–1,498.74	**3,168.40**	3,199.40	31
4-Class choice	–1,477.87	3,187.30	3,229.30	42
5-Class choice	–1,455.61	3,203.44	3,256.44	53

Note: Bold values represent the optimal choice for each measure of fit. LL, log-likelihood; BIC, Bayesian information criterion; CAIC, Consistent Akaike's Information Criterion

Table 4
Results from Latent Class Discrete Choice Model of Preferences for Land-Clearing Contracts

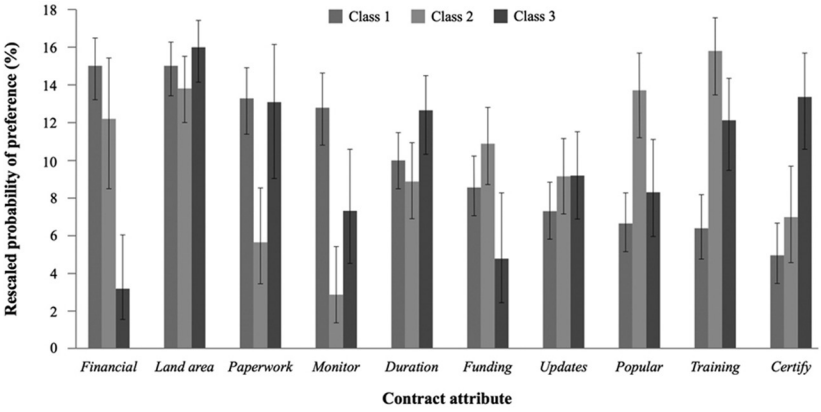
	Class 1	SE	Class 2	SE	Class 3	SE
Model for preferences						
Certify	–1.11***	0.22	–0.61**	0.30	0.72**	0.42
Popular	–0.70***	0.18	0.81***	0.28	–0.33	0.40
Funding	–0.29*	0.17	0.19	0.22	–1.14***	0.32
Updates	–0.56***	0.16	–0.16	0.22	–0.15	0.27
Training	–0.76***	0.20	1.37***	0.32	0.45	0.39
Duration	–0.01	0.15	–0.21	0.22	0.56**	0.25
Land area	1.09***	0.18	0.83***	0.21	1.43***	0.27
Monitor	0.57***	0.22	–1.77***	0.40	–0.54	0.24
Paperwork	0.68***	0.20	–0.93***	0.33	0.65	0.26
Financial	1.09***	0.21	0.47	0.38	–1.65***	0.35
Model for classes						
Intercept	1.00***	0.28	–0.36	0.38	–0.64	0.39
Security	–0.25***	0.08	0.11	0.09	0.14	0.09
Class size	0.4254		0.3112		0.2633	
Log-likelihood = –1,498.74						
$N = 248$						
$R\text{-squared}_{entropy} = 0.63$						
$R\text{-squared}_{standard} = 0.65$						

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

the model are reported in Appendix Table A2. The security variable was constructed from two items capturing participants' sense of security regarding the perceived threat of the VMA to their lifestyle and livelihood, scored on a six-point scale (1 = "strongly disagree" to 6 = "strongly agree"): "I am confident that I can still enjoy a comfortable lifestyle following vegetation management regulations" and "Vegetation management regulations are a threat to my business or livelihood," the latter of which was reverse-scored to align with the former during analysis. Responses to both items were averaged to form a single measure of security, where 1 = "very low sense of security" and 6 = "very high sense of security." The sample size drops to 248 participants as a result of a few missing values for the security variable. The total number of choice occasions is 2,426, owing to some respondents not completing all questions. The CAIC measure suggests two classes, while the BIC suggests three. In the results that follow, we report the three-class model, as the number of classes, in either case, is not large.

Table 4 reports the estimation results for the three-class model. Note that both the preference parameters and the class membership model are estimated simultaneously. The categorical variable representing the set of 10 incentives is effect coded (i.e., reported coefficients represent deviations from the mean of all effects). Although for identification one variable must be dropped in estimation (in this

Figure 2
Rescaled Probability Score Representation of Preferences, by Class, with Simulated 95% Confidence Interval

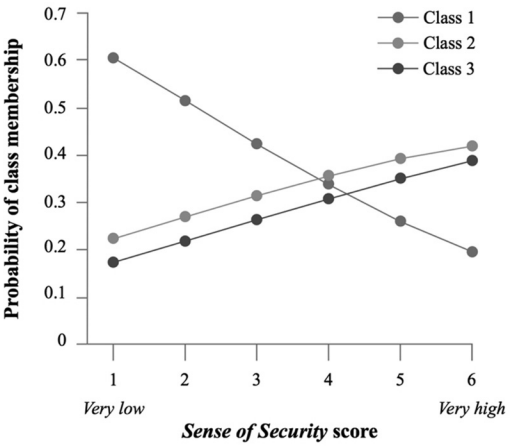


case, *financial*), it is possible to retrieve the coefficient by reestimating the model dropping a different attribute. Hence, we report all 10 coefficients for each class. Although some key results can be identified from the primary estimates, comparisons across classes are complicated by the conflation with error variance/scale. Instead, we report the probability score results (see equation [5]) for each class, with 95% confidence intervals (Figure 2).

In the estimation of the models, only *security* is found to be significant in explaining class membership. Interpretation of marginal effects in multinomial logit models is complex (Greene 2003), with the signs of marginal effects not necessarily the same as the estimated coefficients. With only one variable, a more transparent way of indicating the impact of the variable on class membership is to plot the probabilities as *security* changes (Figure 3). The proportions of class 2 and 3 are very similar, and they increase together as *security* increases. The probability of being in class 1 falls as *security* increases, with a relatively large marginal effect—the probability ranging from 0.6 to 0.2 across the range of *security*.

Given that landholders' sense of security is the primary driver of class membership, where two groups are distinguished (class 1, classes 2 and 3), we can assume that *security* has a greater effect on the key contrasts in preferences between these two groups and negligible effects on any similarities between

Figure 3
Evolution of Class Membership Probabilities as *Security* Changes



them. Overall, there are some consistent preferences for all landholders. All classes ranked *flexibility to choose the areas of land to be included* highly. There were also similar rankings for *flexibility to choose the length of the program* and *regular updates on the scheme's outcomes*, which were moderately preferred. The greatest difference between the classes is their ranking of nonfinancial incentives relative to the financial incentive. Where the two groups contrast the most, and where increasing landholders' sense of security may have the greatest impact, is in landholders' prefer-

ence for *training in best management practices* and *low compliance monitoring*.

For class 1, no nonfinancial incentives were preferred over the financial incentive, with an *option to certify produce as "bush friendly"* and *training in best management practices* ranking the lowest. The only nonfinancial incentives to be ranked relatively equal to the financial incentive were the *flexibility to choose the areas of land to be included*, *low paperwork*, and *low compliance monitoring*. These roughly equivalent preferences highlight class 1 landholders' low sense of security, as all of these incentives enhance their level of autonomy and control and diminish the level of bureaucracy and government/top-down influence on their property. This is in stark contrast to landholders in class 3, who rank the financial incentive lowest of all incentives presented to them. While they also rank *flexibility to choose the areas of land to be included* highly, they differ most from class 1 in their high ranking of *option to certify produce as "bush friendly"* and *training in best management practices*. The only nonfinancial incentive to be ranked nearly on a par with the financial incentive was the indirect financial incentive, *extra public funding for community-based projects.*

Landholders in class 2 are more moderate in their overall ranking of nonfinancial incentives relative to the financial incentive. Their preference for financial incentives did not differ from the average landholder in the surveyed sample, likely due to the high level of variation in its ranking. While the expansive confidence interval of financial preference makes it difficult to distinguish strong deviations in the ranking of nonfinancial incentives, some notable rankings can be identified. *Low compliance monitoring* and *low paperwork* were ranked the lowest of all incentives, which may be a product of these landholders' enhanced sense of security. Class 2 landholders differed most from class 3 landholders in their greater preference for *most farmers in the region being involved* and their lesser preference for the *option to certify produce as "bush friendly,"* though they had similarly high rankings for *training in best management practices* and *flexibility to choose the areas of land to be included*.

5. Discussion

The Importance of Program Flexibility and Communication

In this study, we investigate landholders' preferences for financial and nonfinancial incentives to enroll in bush management programs. Given the generally low capacity of governments to enforce clearing legislation or provide financial incentives to prevent land clearing around the world, our aim was to identify whether nonfinancial incentives could be sufficient to change landholder behavior. After surveying 251 landholders across Queensland, Australia, we found that landholders have heterogeneous preferences for financial versus nonfinancial incentives. This heterogeneity was identified using latent class methods, which specified three landholder classes. Membership in the three classes was primarily driven by landholders' sense of security. This has important implications for state vegetation management policy, as incentivizing landholders to conserve remnant vegetation will be more costly if regulatory controls continue to be perceived as a threat to landholders' lifestyle and livelihood.

Among the three latent classes, there was some agreement in the incentives that landholders preferred, as well as some notable differences. Three incentives were highly ranked across all classes: (1) flexibility to choose the areas of land to be included, (2) flexibility to choose the length of the program, and (3) regular updates on the scheme's outcomes. This reflects landholders' historical complaints regarding autonomy, controllability, trust, and transparency of policy instruments (Productivity Commission 2004; Australian Senate Inquiry 2010). Throughout the survey, most landholders expressed a feeling of injustice. This was believed, by both the landholders and the industry representatives, to be one of the largest roadblocks to any engagement between regulating bodies and landholders. Several participants commented on a perceived indecisiveness by regulating bodies with respect to clearing regulation and, ultimately, feelings of betrayal. Thus, incorporating more of these nonfinancial incentives that place a greater amount of control in the hands of

landholders and provide regular and transparent updates on the instrument's effects would be an advantageous approach for private land management initiatives (Sorice et al. 2013).

The greatest difference among the classes was in how they ranked financial versus nonfinancial incentives. The preferred options of class 1 were all financial, with training in best management practices ranking last. This could reflect more conservative values toward land management on their property and a reluctance to change their traditional on-farm practices. By contrast, class 3 exclusively preferred nonfinancial incentives. Given their greater sense of security, class 3 landholders may place greater value on enhancing the sustainability of their own land management practices and are more open to outside influences, provided they have their say in where this influence occurs on their property. This reflects important heterogeneities in the types of landholders that exist in agricultural landscapes, where landholders with inherently different styles, motivations, and approaches to land management will also differ in their likelihood of implementing proenvironmental practices on their farm (Darnhofer, Schneeberger, and Freyer 2005; Burton and Wilson 2006; Guillem et al. 2012).

Class 2 appears to represent an important nuance in the potential effects of a sense of security on preferences for financial incentives. Landholders can still have a moderate preference for financial incentives even with a greater sense of security, but this preference can be influenced by the right nonfinancial incentives to encourage normative behaviours. For instance, if more secure landholders believe there is a wider social shift in land management behaviors in their region, provoked by greater community involvement in bush preservation schemes and the emphasis these schemes place on the adoption of new land management practices, this could be more effective in garnering their participation than the use of financial incentives alone (Michel-Guillou and Moser 2006; Selinske et al. 2016). Without these particular program attributes, however, class 2 landholders may defer to financial incentives, even if they do not see vegetation management regulations as a threat to their livelihood.

These mixed (and relatively high) preferences for financial payments and several nonfinancial incentives, such as flexibility in land management and regular updates on program outcomes, are consistent with the literature. For example, using a discrete choice model of responses from farmers in northern Italy, Defrancesco et al. (2008) found that the expectation of income (compensation) from a scheme and the flexibility of implementing the scheme are major influencing factors in participation decisions. The importance of financial compensation is often ascribed to the "missing market" hypothesis, which suggests that it might be necessary to compensate for the gap in expected income from participation in a scheme (Hanley et al. 2012). Financial incentives, however, should be implemented with caution. Despite the importance of using monetary incentives to increase uptake for some of the most resistant types of landholders (Kabii and Horwitz 2006; Kusmanoff et al. 2016), the interactions of multiple financial incentives can affect environmental outcomes (Bryan and Crossman 2013) and may crowd out the intrinsic, environmental motivations for conservation (Agrawal, Chhatre, and Gerber 2015). This may be especially true considering class 2 landholders in this study, who are likely to be more susceptible to crowding-out effects than class 3 landholders.

Nonfinancial incentives pertaining to flexibility in implementing bush management schemes are strongly preferred by the participants. Similar findings were made by Blackmore and Doole (2013) in their survey of participants in Victorian conservation tenders. They suggested that higher flexibility reduces the transaction costs of participation and implementation of the schemes, which attracts more landholders. A number of studies have also highlighted the importance of providing information on the programs and opportunities available to landholders as a key factor influencing participation rates (Schenk, Hunziker, and Kienast 2007; Blackmore and Doole 2013). However, regular updating of the program outcomes has not previously been identified as a major factor. This highlights potentially a large gap in the implementation of such programs. Conservation programs are rarely monitored, and if they are, the results

are often not publicly available. Australia, in particular, suffers from a lack of long-term monitoring of impacts from voluntary and incentive-based programs; what little evidence does exist on these various natural resource management programs indicates that they may build community support and social capital yet fail to deliver real conservation benefits (Curtis, Robrtson, and Race 1998; Lockie and Higgins 2007; Hajkowicz 2009).

Limitations and Recommendations

The difficulty of reaching landholders in remote agricultural areas, like in rural Queensland, imposes financial and logistical limitations on any study's ability to infer preferences that are representative statewide. Despite exhaustive telephone recruitment efforts, the final sample size is small relative to the spatial distribution of landholders surveyed across the state. According to the Australian Bureau of Statistics (2018), there are approximately 9,046 agriculture, forestry, and fishing businesses in the greater Darling Downs area of the state, where the majority of our survey participants reside. Our sample also has a relatively high median age (62 years) compared to the most recent census data on the area (41 years; Australian Bureau of Statistics 2018). This may have been influenced by the higher likelihood that older landholders would be home to answer the phone and have the time to answer the questions. Some bias in the sample may exist due to our preferential targeting of postcodes where clearing has been highest in the state, but these regions are the most relevant to identifying incentive preferences for habitat conservation. While these sampling characteristics limit our ability to fully characterize the most active, younger clearers in the region (Simmons, Wilson, and Dean 2020), our study includes a sample of landholders representing a broad range of ages, income levels, and years of experience (see Appendix Table A2), which facilitates more generalizable conclusions for a larger pool of potential program participants.

While some correlation between class membership and clearing hot spots/cold spots might exist, we expect that much of this interaction is captured by the measures of past clearing behaviors and clearing norms—of which we found no significant effect on preferences. The survey was implemented shortly after new amendments to the controversial vegetation management policy were passed in Parliament, and thus it is possible that some degree of participation bias may exist, where landholders who were strongly proregulation or antiregulation would be most inclined to express their opinions. Similarly, responses to some survey questions may also be biased due to the heated political environment at the time, potentially provoking more reactionary responses (Proudfoot and Kay 2014). Finally, a number of factors that were not included in the survey may also significantly affect landholders' incentive preferences, such as assets or capital (Arriagada et al. 2015), property size (Seabrook et al. 2008), income reliance on farming (Comerford 2013), career goals or motivations (Farmar-Bowers and Lane 2009), and political or occupational identity (Groth et al. 2014; Unsworth and Fielding 2014).

It will be important for future research to consider the potential drivers of participation in a number of policy instruments available to landholders, like direct payment schemes for conservation (Hajkowicz 2009), conservation covenants (Fitzsimons 2015), and heritage agreements (Leaman and Nicolson 2014), as well as their potential usefulness for curbing rising deforestation rates. This could come from a series of full choice experiments, where preferences for these different instrument options would be measured under various social, political, and economic contexts. Similar strategies have been employed to understand (1) the effects of regulatory crowding-out on optimal economic decision-making (Cardenas, Stranlund, and Willis 2000); (2) what types of motivations drive willingness to participate in conservation programs (Greiner 2015); and (3) how attitudes affect landholders' willingness to pay for conservation benefits (Hoyos, Mariel, and Hess 2015). This would also present more opportunities to investigate how landholders perceive and cope with varying levels of risk (Levin, Schneider, and Gaeth 1998; Mase, Cho, and Prokopy 2015), which could provide a more direct measure of the effects of, for example, policy uncertainty, droughts, and message framing

on regulatory compliance, landholders' interaction with different policy instruments, and overall tree-clearing decision-making.

Land clearing is a highly contentious political and cultural issue, and the primary reliance on command-and-control instruments to curb rising clearing rates is viewed unfavorably by landholders (Cocklin, Mautner, and Dibden 2007). While voluntary price-based or community-based programs are viewed more favorably, and the uptake of conservation covenants has experienced dramatic increases in the last decade (Fitzsimons 2015), these instruments often lack the political "teeth" to achieve significant land-clearing changes in practice, largely because of issues stemming from poor communication (Morrison et al. 2015), a property-centric focus of land management (Cooke and Moon 2015), and strengthening resistance to top-down interventions (Lockie and Higgins 2007).

Our results provide a more nuanced understanding of how land-clearing behavior could be managed and of how policy design/implementation could be approached. This understanding is centered on heterogeneous preferences toward financial and nonfinancial incentives, which are driven by landholders' sense of security. Designing policy that can address and capture this heterogeneity remains a major challenge to improving land-clearing outcomes. If intervention efforts continue with a business-as-usual approach, creating large-scale changes in clearing behaviors will require large financial incentives to encourage or ensure participation in private land conservation from the landholders feeling most threatened by regulation; still, perverse outcomes may arise if more financial incentives crowd out the intrinsic preferences of other landholders for nonfinancial incentives for private land conservation.

Based on the findings in this study, we propose a number of recommendations for the design and implementation of policy instruments for voluntary bush preservation on private lands. First, these programs must be designed to increase landholders' sense of security as it pertains to the perceived threat of land-clearing regulations on their livelihood. This can take the form of several nonfinancial incentives, such as those offering greater flexibility in terms of the area under contract and the duration of the contract, as well as greater transparency and updates regarding the impacts of the program after enrollment. Second, these programs should place greater emphasis on communicating the emerging social norm of private land conservation in agricultural communities. This will be especially important for reducing class 2 landholders' proclivity for demanding financial incentives, as these landholders are uniquely attracted to popular programs that offer training in best management practices. This can be achieved both within the design of programs as well as their implementation through the use of strategic social marketing. Finally, there must be a concerted effort to strengthen landholders' sense of security surrounding vegetation management policy in general. Less emphasis on command-and-control policies and greater funding for extension-based approaches to reduce land clearing would be prudent for changing landholder perceptions of conservation interventions. The most promising pathway could involve targeted communication strategies that reinforce landholders' sense of security during ongoing top-down regulation, potentially through message framing (Crompton 2010), disseminating information via local champions (Torabi et al. 2016), and strengthening relationships between landholders and extension officers (Blackmore and Doole 2013).

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References

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences). 2016. *The Australian Land Use and Management Classification Version 8*. Canberra: Australian Bureau of Agricultural and Resource Economics and Sciences.

Agrawal, Arun, Ashwini Chhatre, and Elisabeth R. Gerber. 2015. "Motivational Crowding in Sustainable Development Interventions." *American Political Science Review* 109 (3): 470–87.

Arriagada, Rodrigo A., Erin O. Sills, Paul J. Ferraro, and Subhrendu K. Pattanayak. 2015. "Do Payments Pay Off? Evidence from Participation in Costa Rica's PES Program." *PloS One* 10 (7): e0131544.

Australian Bureau of Statistics. 2018. *Darling Downs: Maranoa (Sa4) (307)*. Canberra: Australian Bureau of Statistics.

Australian Senate Inquiry. 2010. *Native Vegetation Laws, Greenhouse Gas Abatement and Climate Change Measures*. Canberra: The Senate Finance and Public Administration References Committee.

Bernedo, María, Paul J. Ferraro, and Michael Price. 2014. "The Persistent Impacts of Norm-Based Messaging and Their Implications for Water Conservation." *Journal of Consumer Policy* 37 (3): 437–52.

Blackmore, Louise, and Graeme J. Doole. 2013. "Drivers of Landholder Participation in Tender Programs for Australian Biodiversity Conservation." *Environmental Science & Policy* 33: 143–53.

Bozdogan, Hamparsum. 1987. "Model Selection and Akaike's Information Criterion (AIC): The General Theory and Its Analytical Extensions." *Psychometrika* 52 (3): 345–70.

Bradley, Melanie, Alan House, Michael Robertson, and Clyde Wild. 2010. "Vegetation Succession and Recovery of Ecological Values in the Southern Queensland Brigalow Belt." *Ecological Management & Restoration* 11 (2): 113–18.

Bradshaw, Corey J. A. 2012. "Little Left to Lose: Deforestation and Forest Degradation in Australia since European Colonization." *Journal of Plant Ecology* 5 (1): 109–20.

Braga, Jacinto, and Chris Starmer. 2005. "Preference Anomalies, Preference Elicitation and the Discovered Preference Hypothesis." *Environmental and Resource Economics* 32 (1): 55–89.

Broch, Stine Wamberg, Niels Strange, Jette B. Jacobsen, and Kerrie A. Wilson. 2013. "Farmers' Willingness to Provide Ecosystem Services and Effects of Their Spatial Distribution." *Ecological Economics* 92: 78–86.

Bryan, Brett Anthony, and Neville David Crossman. 2013. "Impact of Multiple Interacting Financial Incentives on Land Use Change and the Supply of Ecosystem Services." *Ecosystem Services* 4: 60–72.

Burton, Rob J. F., and Geoff A. Wilson. 2006. "Injecting Social Psychology Theory into Conceptualisations of Agricultural Agency: Towards a Post-productivist Farmer Self-Identity?" *Journal of Rural Studies* 22 (1): 95–115.

Cardenas, Juan Camilo, John Stranlund, and Cleve Willis. 2000. "Local Environmental Control and Institutional Crowding-Out." *World Development* 28 (10): 1719–33.

Cary, John, and Trevor Webb. 2001. "Landcare in Australia: Community Participation and Land Management." *Journal of Soil and Water Conservation* 56 (4): 274–78.

Christensen, Tove, Anders Branth Pedersen, Helle Oersted Nielsen, Morten Raun Mørkbak, Berit Hasler, and Sigrid Denver. 2011. "Determinants of Farmers' Willingness to Participate in Subsidy Schemes for Pesticide-Free Buffer Zones: A Choice Experiment Study." *Ecological Economics* 70 (8): 1558–64.

Cocklin, Chris, Naomi Mautner, and Jacqui Dibden. 2007. "Public Policy, Private Landholders: Perspectives on Policy Mechanisms for Sustainable Land Management." *Journal of Environmental Management* 85 (4): 986–98.

Comerford, Emma. 2013. "The Impact of Permanent Protection on Cost and Participation in a Conservation Programme: A Case Study from Queensland." *Land Use Policy* 34: 176–82.

———. 2014. "Understanding Why Landholders Choose to Participate or Withdraw from Conservation Programs: A Case Study from a Queensland Conservation Auction." *Journal of Environmental Management* 141: 169–76.

Cook, Stuart W., and Joy L. Berrenberg. 1981. "Approaches to Encouraging Conservation Behavior: A Review and Conceptual Framework." *Journal of Social Issues* 37 (2): 73–107.

Cooke, Benjamin, and Katie Moon. 2015. "Aligning 'Public Good' Environmental Stewardship with the Landscape-Scale: Adapting MBIs for Private Land Conservation Policy." *Ecological Economics* 114: 152–58.

Creighton, Janean H., David M. Baumgartner, and Keith A. Blatner. 2002. "Ecosystem Management and Nonindustrial Private Forest Land-

owners in Washington State, USA." *Small-Scale Forest Economics, Management and Policy* 1 (1): 55–69.

Crompton, Tom. 2010. *Common Cause: The Case for Working with Our Cultural Values*. London: World Wildlife Foundation.

Curtis, Allan, Alistar Robertson, and Digby Race. 1998. "Lessons from Recent Evaluations of Natural Resource Management Programs in Australia." *Australian Journal of Environmental Management* 5 (2): 109–19.

Dale, Allan P. 2018. "From Conflict to Collaboration: Can Better Governance Systems Facilitate the Sustainable Development of the Northern Pastoral Industry, Communities and Landscapes?" *The Rangeland Journal* 40 (4): 331–40.

Darnhofer, Ika, Walter Schneeberger, and Bernhard Freyer. 2005. "Converting or Not Converting to Organic Farming in Austria: Farmer Types and Their Rationale." *Agriculture and Human Values* 22 (1): 39–52.

David, H. A. 1988. *The Method of Paired Comparisons*. London: Charles Griffin.

de Vries, Frans P., and Nick Hanley. 2016. "Incentive-Based Policy Design for Pollution Control and Biodiversity Conservation: A Review." *Environmental and Resource Economics* 63 (4): 687–702.

Defrancesco, Edi, Paola Gatto, Ford Runge, and Samuele Trestini. 2008. "Factors Affecting Farmers' Participation in Agri-environmental Measures: A Northern Italian Perspective." *Journal of Agricultural Economics* 59 (1): 114–31.

Duke, Joshua M., Allison M. Borchers, Robert J. Johnston, and Sarah Absetz. 2012. "Sustainable Agricultural Management Contracts: Using Choice Experiments to Estimate the Benefits of Land Preservation and Conservation Practices." *Ecological Economics* 74: 95–103.

Evans, Megan C. 2016. "Deforestation in Australia: Drivers, Trends and Policy Responses." *Pacific Conservation Biology* 22 (2): 130–50.

Farmar-Bowers, Quentin, and Ruth Lane. 2009. "Understanding Farmers' Strategic Decision-Making Processes and the Implications for Biodiversity Conservation Policy." *Journal of Environmental Management* 90 (2): 1135–44.

Fitzsimons, James. 2015. "Private Protected Areas in Australia: Current Status and Future Directions." *Nature Conservation* 10: 1–23.

Greene, William H. 2003. *Econometric Analysis*. Dehli: Pearson Education India.

Greiner, Romy. 2015. "Motivations and Attitudes Influence Farmers' Willingness to Participate in Biodiversity Conservation Contracts." *Agricultural Systems* 137: 154–65.

———. 2016. "Factors Influencing Farmers' Participation in Contractual Biodiversity Conservation: A Choice Experiment with Northern Australian Pastoralists." *Australian Journal of Agricultural and Resource Economics* 60 (1): 1–21.

Groth, Theresa M., Allan Curtis, Emily Mendham, and Eric Toman. 2014. "Farmer Identity in Multifunctional Landscapes: Using a Collective Identity Construct to Explore the Nature and Impact of Occupational Identity." *Australian Geographer* 45 (1): 71–86.

Gsottbauer, Elisabeth, and Jeroen C. J. M. Van den Bergh. 2011. "Environmental Policy Theory Given Bounded Rationality and Other-Regarding Preferences." *Environmental and Resource Economics* 49 (2): 263–304.

Guagnano, Gregory A., Paul C. Stern, and Thomas Dietz. 1995. "Influences on Attitude-Behavior Relationships: A Natural Experiment with Curbside Recycling." *Environment and Behavior* 27, 699–718. https://doi.org/10.1177/0013916595275005.

Guillem, Eleonore E., Andrew P. Barnes, Mark D. A. Rounsevell, and Alan Renwick. 2012. "Refining Perception-Based Farmer Typologies with the Analysis of Past Census Data." *Journal of Environmental Management* 110: 226–35.

Hajkowicz, Stefan. 2009. "The Evolution of Australia's Natural Resource Management Programs: Towards Improved Targeting and Evaluation of Investments." *Land Use Policy* 26 (2): 471–78.

Hanley, Nick, Simanti Banerjee, Gareth D. Lennox, and Paul R. Armsworth. 2012. "How Should We Incentivize Private Landowners to 'Produce' More Biodiversity?" *Oxford Review of Economic Policy* 28 (1): 93–113.

Hoyos, David, Petr Mariel, and Stephane Hess. 2015. "Incorporating Environmental Attitudes in Discrete Choice Models: An Exploration of the Utility of the Awareness of Consequences Scale." *Science of the Total Environment* 505: 1100–11.

Jacquemet, Nicolas, Alexander James, Stephanie Luchini, and Jason F. Shogren. 2017. "Referenda under Oath." Environmental and Resource Economics 67: 479–504. https://doi.org/10.1007/s10640-016-0023-5.

Kabii, Thomas, and Pierre Horwitz. 2006. "A Review of Landholder Motivations and Determinants for Participation in Conservation Covenanting Programmes." *Environmental Conservation* 33 (1): 11–20.

Kaczan, David, and Brent M. Swallow. 2013. "Designing a Payments for Ecosystem Services (PES) Program to Reduce Deforestation in Tanzania: An Assessment of Payment Approaches." *Ecological Economics* 95: 20–30.

Knowler, Duncan, and Ben Bradshaw. 2007. "Farmers' Adoption of Conservation Agriculture: A Review and Synthesis of Recent Research." *Food Policy* 32 (1): 25–48.

Kusmanoff, Alexander M., Mathew J. Hardy, Fiona Fidler, Georgina Maffey, Christopher Raymond, Mark S. Reed, James A. Fitzsimons, and Sarah A. Bekessy. 2016. "Framing the Private Land Conservation Conversation: Strategic Framing of the Benefits of Conservation Participation Could Increase Landholder Engagement." *Environmental Science & Policy* 61: 124–28.

Langpap, Christian. 2004. "Conservation Incentives Programs for Endangered Species: An Analysis of Landowner Participation." *Land Economics* 80 (3): 375–88.

Layton, David F., and Juha Siikamäki. 2009. "Payments for Ecosystem Services Programs: Predicting Landowner Enrollment and Opportunity Cost Using a Beta-binomial Model." *Environmental and Resource Economics* 44 (3): 415.

Leaman, Greg, and Clare Nicolson. 2014. "Protected Areas on Private Land: Shaping the Future of the Park System in Australia." In *Protected Areas in a Changing World: Proceedings of the George Wright Society Conference on Parks, Protected Areas, and Cultural Sites*, edited by Samantha Weber, 69–76. Hancock, Michigan: George Wright Society.

Lehtonen, Emmi, Jari Kuuluvainen, Eija Pouta, Mika Rekola, and Chuan-Zhong Li. 2003. "Non-Market Benefits of Forest Conservation in Southern Finland." *Environmental Science & Policy* 6 (3): 195–204.

Levin, Irwin P., Sandra L. Schneider, and Gary J. Gaeth. 1998. "All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects." *Organizational Behavior and Human Decision Processes* 76 (2): 149–88.

Lockie, Stewart, and Vaughan Higgins. 2007. "Roll-out Neoliberalism and Hybrid Practices of Regulation in Australian Agri-environmental Governance." *Journal of Rural Studies* 23 (1): 1–11.

Louviere, Jordan J., Terry N. Flynn, and Anthony Alfred John Marley. 2015. *Best-Worst Scaling: Theory, Methods and Applications*. Cambridge, UK: Cambridge University Press.

Maes, Joachim, Benis Egoh, Louise Willemen, Camino Liquete, Petteri Vihervaara, Jan Philipp Schägner, Bruna Grizzetti, Evangelia G. Drakou, Alessandra La Notte, and Grazia Zulian. 2012. "Mapping Ecosystem Services for Policy Support and Decision Making in the European Union." *Ecosystem Services* 1 (1): 31–39.

Magidson, Jay, and Jeroen K. Vermunt. 2002. A" Nontechnical Introduction to Latent Class Models." White Paper. Belmont, MA: Statistical Innovations.

Mase, Amber S., Hyunyi Cho, and Linda S. Prokopy. 2015. "Enhancing the Social Amplification of Risk Framework (SARF) by Exploring Trust, the Availability Heuristic, and Agricultural Advisors' Belief in Climate Change." *Journal of Environmental Psychology* 41: 166–76.

Matta, Jagannadha R., Janaki R. R. Alavalapati, and D. Evan Mercer. 2009. "Incentives for Biodiversity Conservation beyond the Best Management Practices: Are Forestland Owners Interested?" *Land Economics* 85 (1): 132–43.

Michel-Guillou, Elisabeth, and Gabriel Moser. 2006. "Commitment of Farmers to Environmental Protection: From Social Pressure to Environmental Conscience." *Journal of Environmental Psychology* 26 (3): 227–35.

Mohebalian, Phillip M., and Francisco X. Aguilar. 2016. "Additionality and Design of Forest Conservation Programs: Insights from Ecuador's Socio Bosque Program." *Forest Policy and Economics* 71: 103–14.

Morris, Carol, and Clive Potter. 1995. "Recruiting the New Conservationists: Farmers' Adoption of Agri-environmental Schemes in the UK." *Journal of Rural Studies* 11 (1): 51–63.

Morrison, M., J. Greig, D. M. Y. Read, D. S. Waller, and R. McCulloch. 2015. "Communicating Information to Difficult-to-Reach Landholders: Perspectives of Natural Resource Management Communication Practitioners." *Australasian Journal of Environmental Management* 22 (3): 315–28.

Nagubadi, Venkatarao, Kevin T. McNamara, William L. Hoover, and Walter L. Mills. 1996. "Program Participation Behavior of Nonindustrial Forest Landowners: A Probit Analysis."

Journal of Agricultural and Applied Economics 28 (2): 323–36.

Nielsen, Anne Sofie Elberg, Jette Bredahl Jacobsen, and Niels Strange. 2018. "Landowner Participation in Forest Conservation Programs: A Revealed Approach Using Register, Spatial and Contract Data." *Journal of Forest Economics* 30: 1–12.

Page, Girija, and Bill Bellotti. 2015. "Farmers Value on-Farm Ecosystem Services as Important, but What Are the Impediments to Participation in PES Schemes?" *Science of The Total Environment* 515: 12–19.

Petucco, Claudio, Jens Abildtrup, and Anne Stenger. 2015. "Influences of Nonindustrial Private Forest Landowners' Management Priorities on the Timber Harvest Decision: A Case Study in France." *Journal of Forest Economics* 21 (3): 152–66.

Productivity Commission. 2004. *Impacts of Native Vegetation and Biodiversity Regulations*. Melbourne, Australia: Productivity Commission.

Proudfoot, Devon, and Aaron C Kay. 2014. "Reactance or Rationalization? Predicting Public Responses to Government Policy." *Policy Insights from the Behavioral and Brain Sciences* 1 (1): 256–62.

Queensland Government Statistician's Office. 2019. *Queensland Regional Profiles: Resident Profile for Queensland*. Brisbane, Australia: Queensland Treasury.

Raedeke, Andrew H., J. Sanford Rikoon, and Charles H. Nilon. 2001. "Ecosystem Management and Landowner Concern about Regulations: A Case Study in the Missouri Ozarks." *Society & Natural Resources* 14 (9): 741–59.

Rolfe, John, Jill Windle, and Juliana McCosker. 2009. "Testing and Implementing the Use of Multiple Bidding Rounds in Conservation Auctions: A Case Study Application." *Canadian Journal of Agricultural Economics* 57 (3): 287–303.

Rolfe, John, Steven Schilizzi, Peter Boxall, Uwe Latacz-Lohmann, Sayed Iftekhar, Megan Star, and Patrick J. O'Connor. 2018. "Identifying the Causes of Low Participation Rates in Conservation Tenders." *International Review of Environmental and Resource Economics* 12 (1): 1–45.

Ruto, Eric, Guy Garrod, and Riccardo Scarpa. 2008. "Valuing Animal Genetic Resources: A Choice Modeling Application to Indigenous Cattle in Kenya." *Agricultural Economics* 38 (1): 89–98.

Sawtooth Software. 2013. *The CBC System for Choice-Based Conjoint Analysis*. Version 8. Orem, UT: Sawtooth Software.

Scarpa, Riccardo, and Mara Thiene. 2005. "Destination Choice Models for Rock Climbing in the Northeastern Alps: A Latent-Class Approach Based on Intensity of Preferences." *Land Economics* 81 (3): 426–44.

———. 2011. "Organic Food Choices and Protection Motivation Theory: Addressing the Psychological Sources of Heterogeneity." *Food Quality and Preference* 22 (6): 532–41.

Schenk, Anita, Marcel Hunziker, and Felix Kienast. 2007. "Factors Influencing the Acceptance of Nature Conservation Measures: a Qualitative Study in Switzerland." *Journal of Environmental Management* 83 (1): 66–79.

Seabrook, Leonie, Clive McAlpine, and Rod Fensham. 2006. "Cattle, Crops and Clearing: Regional Drivers of Landscape Change in the Brigalow Belt, Queensland, Australia, 1840–2004." *Landscape and Urban Planning* 78 (4): 373–85.

———. 2008. "What Influences Farmers to Keep Trees? A Case Study from the Brigalow Belt, Queensland, Australia." *Landscape and Urban Planning* 84 (3-4): 266–81.

Selinske, Matthew, Benjamin Cooke, Nooshin Torabi, Mathew Hardy, Andrew Knight, and Sarah Bekessy. 2016. "Locating Financial Incentives among Diverse Motivations for Long-Term Private Land Conservation." *Ecology and Society* 22 (2): 1–10.

Shogren, Jason F., John Tschirhart, Terry Anderson, Amy Whritenour Ando, Steven R. Beissinger, David Brookshire, Gardner M. Brown, Jr., Don Coursey, Robert Innes, and Stephen M. Meyer. 1999. "Why Economics Matters for Endangered Species Protection." *Conservation Biology* 13 (6): 1257–61.

Simmons, B. Alexander, Elizabeth A. Law, Raymundo Marcos-Martinez, Brett A. Bryan, Clive McAlpine, and Kerrie A. Wilson. 2018. "Spatial and Temporal Patterns of Land Clearing during Policy Change." *Land Use Policy* 75: 399–410.

Simmons, B. Alexander, Raymundo Marcos-Martinez, Elizabeth A. Law, Brett A Bryan, and Kerrie A Wilson. 2018. "Frequent Policy Uncertainty Can Negate the Benefits of Forest Conservation Policy." *Environmental Science & Policy* 89: 401–11.

Simmons, B. Alexander, Kerrie A. Wilson, and Angela J. Dean 2020. "Landholder Typologies Illuminate Pathways for Social Change in a De-

forestation Hotspot." *Journal of Environmental Management* 254: 109777.

Simmons, B. Alexander, Kerrie A. Wilson, Raymundo Marcos-Martinez, Brett A. Bryan, Oakes Holland, and Elizabeth A. Law. 2018. "Effectiveness of Regulatory Policy in Curbing Deforestation in a Biodiversity Hotspot." *Environmental Research Letters* 13 (12): 124003.

Sorice, Michael G., Chi-Ok Oh, Todd Gartner, Mary Snieckus, Rhett Johnson, and C. Josh Donlan. 2013. "Increasing Participation in Incentive Programs for Biodiversity Conservation." *Ecological Applications* 23 (5): 1146–55.

Stern, Paul C. 1999. "Information, Incentives, and Proenvironmental Consumer Behavior." *Journal of Consumer Policy* 22 (4): 461–78.

Tesfaye, Abonesh, and Roy Brouwer. 2012. "Testing Participation Constraints in Contract Design for Sustainable Soil Conservation in Ethiopia." *Ecological Economics* 73: 168–78.

Thøgersen, John. 1994. "Monetary Incentives and Environmental Concern: Effects of a Differentiated Garbage Fee." *Journal of Consumer Policy* 17 (4): 407–42.

Torabi, Nooshin, Luis Mata, Ascelin Gordon, Georgia Garrard, Wayne Wescott, Paul Dettmann, and Sarah A. Bekessy. 2016. "The Money or the Trees: What Drives Landholders' Participation in Biodiverse Carbon Plantings?" *Global Ecology and Conservation* 7: 1–11.

Train, Kenneth E. 2009. *Discrete Choice Methods with Simulation*. New York: Cambridge University Press.

Unsworth, Kerrie L., and Kelly S. Fielding. 2014. "It's Political: How the Salience of One's Political Identity Changes Climate Change Beliefs and Policy Support." *Global Environmental Change* 27: 131–37.

Urquhart, Julie, and Paul Courtney. 2011. "Seeing the Owner behind the Trees: A Typology of Small-Scale Private Woodland Owners in England." *Forest Policy and Economics* 13 (7): 535–44.

Uthes, Sandra, and Bettina Matzdorf. 2013. "Studies on Agri-environmental Measures: A Survey of the Literature." *Environmental Management* 51 (1): 251–66.

Valbuena, Diego, Arnold K. Bregt, Clive McAlpine, Peter H. Verburg, and Leonie Seabrook. 2010. "An Agent-Based Approach to Explore the Effect of Voluntary Mechanisms on Land Use Change: A Case in Rural Queensland, Australia." *Journal of Environmental Management* 91 (12): 2615–25.

van Ingrid, E. Putten, Sarah M. Jennings, Jordan J. Louviere, and Leonie B. Burgess. 2011. "Tasmanian Landowner Preferences for Conservation Incentive Programs: A Latent Class Approach." *Journal of Environmental Management* 92 (10): 2647–56.

Vedel, Suzanne Elizabeth, Jette Bredahl Jacobsen, and Bo Jellesmark Thorsen. 2015. "Forest Owners' Willingness to Accept Contracts for Ecosystem Service Provision Is Sensitive to Additionality." *Ecological Economics* 113: 15–24.

Vermunt, Jeroen K., and Jay Magidson. 2016. *Technical Guide to Latent Gold 5.1: Basic, Advanced, and Syntax*. Belmont, MA: Statistical Innovations.