Highlights

• Pastoralists demonstrated strong willingness to participate in biodiversity AES. • There was significant preference heterogeneity for contract attributes. • Including motivations and attitudes as covariates improved model fit. • AES uptake can be improved if contract attributes are negotiable. • Suasion measures are needed to increase knowledge about biodiversity.

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Agricultural Systems ■■ (2015) ■■–■■

Contents lists available at ScienceDirect

Agricultural Systems

journal homepage: www.elsevier.com/locate/agsy

Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts

Romy Greiner [a,b,1,*]

[a] River Consulting Pty Ltd, Townsville, Qld 4810, Australia
[b] The Cairns Institute and College of Science, Technology and Engineering, James Cook University, Townsville, Qld, Australia

ARTICLE INFO

Article history:
Received 24 December 2014
Received in revised form 9 April 2015
Accepted 11 April 2015
Available online

Keywords:
Payments for environmental services
Stewardship
Empirical research
Northern Australia
Tropical savannas
Rangelands

ABSTRACT

Increasingly, voluntary conservation programs are targeted at farmers to contribute to biodiversity conservation through tailored on-farm conservation activities. Such programs are part of a growing suite of agri-environmental or payment-for-environmental services schemes, which can be an effective and efficient way of complementing the formal nature reserve system, provided they attract sufficient participation. In countries with little or no experience with such schemes there is an absence of observable participation behaviour and the use of stated choice methods is required to inform program design. This research employs the theory of planned behaviour to help explain attitudinal and motivational influences on farmers' choices to participate in conservation contracts. The paper reports the findings of a choice experiment involving farmers – more specifically pastoralists and graziers – across north Australia's rangelands. The experiment gauged their willingness to participate in conservation contracts and estimated the influence of contract attributes, business characteristics and personal aspects. Personal aspects included motivations and attitudes, for which constructs were derived from Likert-type scales through factor analysis. Latent class modelling was used to illustrate the various influences of motivations, attitudes and preferences on stated contract participation. The findings assist in tailoring the design, negotiation and roll-out of PES-style conservation initiatives for farmers in northern Australia to incentivise participation. The research highlights the opportunity for paid-for private conservation on parts of large pastoral stations and the need for contract tailoring to biodiversity requirements while responding to the motivations and attitudes of landholders and land managers. It also emphasises the key role that suasion measures play in shaping biodiversity-relevant attitudes and consequently participation by landholders in private conservation.

1. Introduction

The expansion and intensification of agriculture is a root cause of biodiversity decline worldwide (Wood et al., 2000). Agriculture triggers fundamental changes in ecosystems, affecting in particular plant species composition, vegetation structure, soil chemistry, and consequently the fauna depending on these ecosystem fundamentals. To safeguard some ecosystems and associated biodiversity, governments in many countries have set aside land for the purpose of biodiversity conservation and designated a system of protected areas and national parks, thus limiting the expansion of agriculture and other forms of development. While successful in the preservation of some species at the local and regional scales, this strategy by itself, however, is generally unable to provide systematic biodiversity conservation because of inadequate size and connectivity of conservation areas, and coverage of ecosystems (Margules and Pressey, 2000; Mora and Sale, 2011; Rands et al., 2010). In recent decades, some countries have started to enlist the help of farmers in the biodiversity conservation effort, by encouraging and subsidising the re-creation and restoration of farmland habitats and land use practices that enhance biodiversity on private land (Morris and Potter, 1995). Such agri-environmental schemes (AES) have been particularly prevalent in Europe and northern America (e.g. Baylis et al., 2008; Primdahl et al., 2003). Conceptually, AES are payments-for-environmental-services (PES) schemes, which have also gained widespread traction in developing countries (Pattanayak et al., 2010; Wunder et al., 2008).

For AES to be effective and make a discernible and positive difference to biodiversity, programs have to achieve sufficient participation by farmers across a landscape (Merckx et al., 2009). It is often assumed that achieving sufficient area coverage is simply a question of available scheme funding, based on the neoclassical economic theory that farmers are profit maximisers and will therefore adopt a different land use practice or participate in an AES if

* Tel.: +418242156.
E-mail address: romy.greiner@riverconsulting.com.au
[1] This research was conducted while the author worked at Charles Darwin University, Darwin, NT, Australia.

http://dx.doi.org/10.1016/j.agsy.2015.04.005
0308-521X/© 2015 Published by Elsevier Ltd.

the conservation payment is sufficiently high to compensate for resulting opportunity and transaction costs, and deliver a financial advantage.

Analysis of participation in AES in the USA, Europe, Australia and South America has shown that the level of stewardship offered to landholders as part of a conservation contract is only one consideration influencing the participation decision (Bremer et al., 2014; Sorice et al., 2013). Other contract features also influence participation, including duration of contracts, whether and how they influence land tenure security and whether there is an option to exit the contract (Broch et al., 2013; Espinosa-Goded et al., 2010; Sorice et al., 2011).

Personal factors also influence participation. There have been reports of widespread 'cultural' resistance by farmers to participation in AES (Burton et al., 2008; Defrancesco et al., 2008) while research into AES participation across Europe found that conservation orientation was equally as important as financial motivation (Wilson and Hart, 2000). Personal factors include values, attitudes, motivations and perceptions and various social–psychological models and theories have been developed to explore and explain their influence on farmer behaviour (Beedell and Rehman, 2000; Burton, 2004; Greiner and Gregg, 2011; Johansson et al., 2013; Reimer and Prokopy, 2014).

In Australia, AES have been offered in some regions to deliver priority environmental outcomes such as biodiversity conservation and water quality protection. With some notable exceptions, in particular Victoria's BushTender program (Stoneham et al., 2003), they have proved both ineffective and inefficient as they have been unable to entice sufficiently high rates of adoption of conservation practices by private landholders (Hajkowicz, 2009). One explanation is that they ignored key adoption factors such as the influence of non-monetary contract attributes and the characteristics of the target audience.

There is a need for new AES to be implemented in northern Australia, which still holds vast natural assets, including a diverse endemic flora and fauna (Woinarski et al., 2007b). Here, land use practices associated with over-grazing, changed fire regimes and spread of exotic plant and animal species are causing widespread environmental degradation and biodiversity decline and the formal conservation estate is insufficient to safeguard the biodiversity into the future (Garnett et al., 2010; Woinarski et al., 2007b). The vast majority of land is managed by farmers – pastoralists and graziers – who could join the conservation effort by being incentivised to implement on-farm conservation actions and biodiversity-friendly farming practices (Greiner et al., 2009a). If AES-style conservation programs in northern Australia are to be effective, their design needs to be guided by a comprehensive understanding of relationship between land use practices and biodiversity, and the factors that influence farmers' participation in AES. Policy design that considers the personal dimensions of decision making is likely to be more effective than policy that ignores these factors (Manner & Gowdy, 2010; Ahnström et al., 2009; Ryan et al., 2003).

This paper contributes to the literature on a number of levels. It reports the results of empirical research to support an understanding of the personal dimensions governing northern Australian farmers' land use decisions. It tests theories about motivational and attitudinal influences on farmer behaviour. It also reports the results of a choice experiment and illustrates and quantifies the association between different types of farmer motivations and attitudes and willingness to participate in AES for biodiversity conservation.

In Section 2, the paper showcases the geographical setting of the research and farming systems, and provides a synopsis of the literature on the role of motivations and attitudes in decision making. Section 3 details the social survey and choice experiment conducted and data analytical methods employed. Section 4 details and interprets the research findings. Section 5 offers discussion of the findings and concludes with recommendations for AES design in the case study context and more generic sense.

2. Background

2.1. Geographical context: the tropical savannas of northern Australia

Tropical savannas are grassland ecosystems with or without tree/shrub cover and cover around 1.9 million km^2 of land right across the Australian continent. Australia has about one-third of remaining tropical savannas globally (Woinarski et al., 2007b). While they may appear relatively intact compared to landscapes in other parts of Australia, their ecological condition and some components of biodiversity have widely declined since European settlement (Lewis, 2002). Land use practices, in particular over-grazing, changed fire regimes and spread of exotic plant and animal species are causing widespread environmental degradation and biodiversity decline (Woinarski et al., 2007a, 2011).

The prevalent land use system is extensive cattle grazing. The combination of low soil productivity, seasonally restricted water availability, highly variable rainfall and hot summer temperatures restrict crop and horticulture production to small pockets of land. Grazing properties are very large, typically encompassing around 200–10,000 km^2 of land, and herds of 3000–30,000 head of cattle (DAFF, 2014). The majority of these stations are family owned but there are many corporation owned stations also, with some agglomerations holding millions of hectares of land. Stocking rates vary regionally between approximately 3 and 10 head of cattle per km^2 and income from cattle sales and transfers typically ranges from $5 to $12 per ha (DAFF, 2014; Gleeson et al., 2012).

The existing reserve system in the Australian tropical savannas occupies a relatively small proportion of the landscape, reserves are discontinuous (largely surrounded by pastoral lands) and geographically concentrated in wet tropical (northern) parts. There are some very large conservation reserves in Australia's tropical savannas (notably Kakadu National Park, at about 20,000 km^2). However, even large reserves are not large enough, on their own, to maintain viable populations of many endangered species and the ecological processes necessary to them in the long term and even the largest existing reserves in the area are losing some biodiversity (Parr et al., 2009; Woinarski et al., 2010).

The principal land management tool available to graziers is cattle and principally, two types of contributions to biodiversity conservation are possible. Firstly, the pursuit of the idea of a multi-tenure reserve systems (Fitzsimons and Wescott, 2008) would see land taken out of cattle production and managed by the pastoralist exclusively for biodiversity conservation. Secondly, conservation of many species of animals and plants is compatible with grazing to some extent provided grazing land management respects the needs of these species. Consequently, certain grazing systems could be eligible for inclusion in an AES (Woinarski and Ash, 2002).

This research focuses geographically on the dry tropical savannas, which are almost exclusively used as rangelands for cattle grazing (Fig. 1). It is an area of approximately one million km^2. A successful strategy for safeguarding north Australia's biodiversity relies on conservation contributions made by the graziers and pastoralists who manage these rangelands (Woinarski et al., 2007b).

2.2. The influence of personal factors on land use decisions

Farmers make land-use decisions not only in a business context but also in a personal context. Economic theory stresses the extrinsic drivers of decision making, in particular product prices and input costs. The personal context refers to intrinsic motivations for decision making (Ingram et al., 2013). The personal context relates

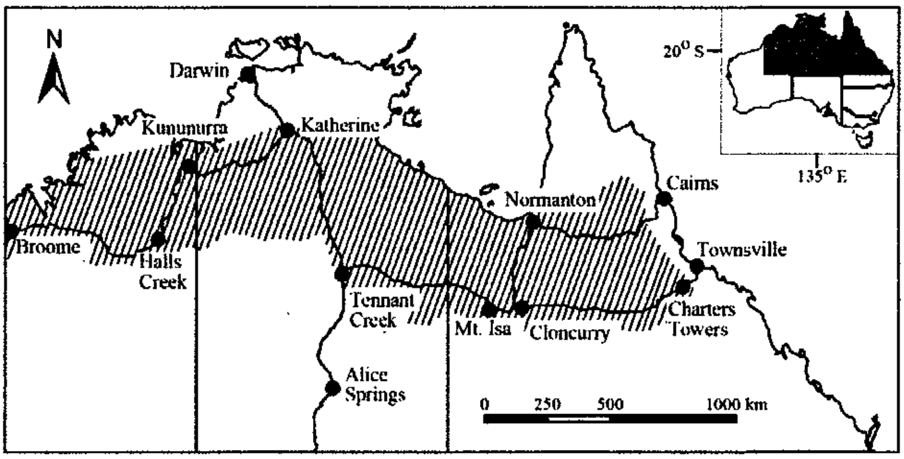

Fig. 1. The dry tropical rangelands of northern Australia.

to individual and social conditions in which the farmer operates, including personal capabilities such as knowledge, skills and power, and attitudinal and psychological dimensions.

A prevalent framework of decision making and behaviour change is the reasoned action approach (Fishbein and Ajzen, 2011) which builds on the theory of planned behaviour (Ajzen, 1991). This framework conceptualises a person's behavioural intentions, and ultimately their behaviour, a being driven by that person's attitudes, subjective norms and perceived behavioural control (Fig. 2). There is a body of empirical literature which illustrates that these factors indeed play out in the conservation behaviour of farmers (Ahnström et al., 2009; Beedell and Rehman, 2000; Hansson et al., 2012; Reimer et al., 2012).

In the context of land use and land management, alternative behavioural models account for extrinsic and intrinsic motivations by exploring more broadly how goals, motivations and attitudes influence adoption of conservation actions. Goals, such as making money, are usually only tools for achieving higher order aspirations such as securing family lifestyle (Pannell et al., 2006). Ultimately, these higher-order aspirations provide the motivation that drive farmers' decision making (Farmar-Bowers and Lane, 2009). These same motivations are likely driving many farmers to be farmers in the first place, as motivational factors strongly influence peoples' career choices (Watt and Richardson, 2007). Again, there is a body of empirical literature illustrating that these factors indeed play out in the conservation behaviour of farmers (Ahnström et al., 2009; Kancans et al., 2008; De Graaff et al., 2008; Pannell et al., 2006; Kessler, 2006; Maybery et al., 2005; Torkamani, 2005; Willock et al., 1999).

One study of particular relevance for this study is previous empirical research conducted with graziers in the Burdekin Dry Tropics region, which represents the most easterly part of Australia's tropical savannas. It established that farmers' motivation profile significantly explained the adoption of water conservation practices (Greiner et al., 2009b). It also established that many graziers are intrinsically motivated to look after their land and natural assets (Greiner and Gregg, 2011). The current research tests whether this relationship holds more broadly across the tropical savannas, and if and how motivations and attitudes can explain likely participation in AES.

3. Method

3.1. *Survey of pastoralists in Australia's tropical savannas*

During April–July 2013, a survey was conducted of pastoralists in the tropical savanna rangelands (Fig. 1). Key components of the survey instrument were a choice experiment and questions to establish social-psychological characteristics of pastoralists. The number of potential research participants was estimated to be less than 700 (Western Australia ≈35, Northern Territory ≈110, Queensland ≈550) due to the generally large size of stations and consolidation of stations into larger pastoral enterprises. A combination of participation formats was offered to maximise

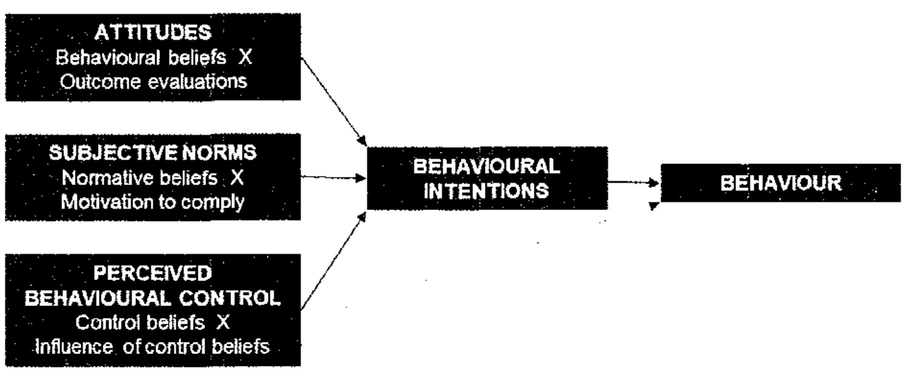

Fig. 2. Elements of the theory of planned behaviour (Ajzen, 1991).

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

opportunities for pastoralists to participate in the research and thereby maximise response rate and minimise participation bias of the sample (Wagner, 2012). This inculded face-to-face surveys of decision makers, research meetings, and mail-out mail-return.

3.2. Choice experimental design and analysis

Choice experiments are a stated preference method and are ideally suited to help the design of new agricultural markets such as AES which provides stewardship payments in return for private biodiversity conservation services by northern Australian pastoralists. Choice experiments have been used elsewhere to inform the design of agri-environmental and PES programs (Beharry-Borg et al., 2013; Broch et al., 2013; Christensen et al., 2011; Espinosa-Goded et al., 2010; Kaczan et al., 2013; Ruto and Garrod, 2009). Very few and only locality-specific choice experimental studies with pastoralists and graziers have been conducted in northern Australia (Adams et al., 2014; Rolfe and Windle, 2005) and consequently no comprehensive understanding exists of how the north Australian pastoralists may engage with such programs to assist landscape-scale biodiversity conservation efforts. To explore the behavioural intentions of pastoralists and fill this knowledge gap, a choice experiment was designed and implemented (Greiner et al., 2014).

There are a range of design decisions to be made, in particular relating to the expected make-up of the utility function, statistical properties of the experimental design, likely model to be used for data analysis and number of choice tasks, attributes and attribute levels defining an alternative, number of alternatives defining a choice, and response mechanism (Bliemer and Rose, 2011; Hoyos, 2010). All design decisions ultimately influence the results of choice experiments and resulting recommendations. A good design is able to explain more of the observed variance and minimises the stochastic element. A detailed deliberation of all choice design considerations and decisions relating to the discrete choice experiment for this study is given in Greiner et al. (2014). Table 1 offers a summary of other key choice design elements.

Attributes and attribute levels were determined in a multi-stage process involving literature review, expert and industry consultation, and pilot testing. The final experiment is summarised in Table 2. The range of stewardship payment levels was guided by historical data about the land productivity of the tropical savannas, in particular the value of cattle sales per hectare during 1992–2011 as derived from farm survey data (ABARES, 2012) and industry comment.

The experiment adopted a Bayesian D-efficient design (Sándor and Wedel, 2001; Bliemer et al., 2009; Bliemer and Rose, 2013). Priors were estimated from results of a pre-test of the DCE. The design was optimised for random parameter logit (RPL) modelling of choice data. A final panel design was generated with 24 choice tasks being blocked into four versions of six choice tasks. Each choice task consisted of three contract alternatives and a 'none' option to mimic the voluntary nature of conservation contracts. Respondents were asked to pick their preferred option ('1st preference') and subsequently indicate the least preferred then second preferred option in any given choice task. Table 3 provides an example of one discrete choice task with the 1st preference question only as the analysis shown here is restricted to the sub-set of 1st preference data, which has been shown to yield superior model results compared to the fully ranked data (Greiner, 2015).

3.3. Motivational and attitudinal constructs

To explore whether and how personal factors may influence the decision to participate in an AES, many choice experiments ask social and attitudinal questions and relate the answers to choice probability. Typically, ordinal scale responses to single attitude questions are chosen as psychological variables, as has been done in earlier analysis of this survey data (Greiner, 2015) to illustrate attitudinal influences on choice. However, a more systematic elicitation of psychological factors and elicitation of factors is preferable, which increases validity, reliability and precision of concept estimation (De Vaus, 2002; Francis et al., 2004).

To establish motivations, respondents were presented with a Likert scale of goals, or 'motivation items', which they rated on a five-point response scale in terms of their importance to them. The list was an extended list of items from Greiner and Gregg (2011). To establish attitudes towards biodiversity, respondents were presented with a Likert scale of statements capturing opinion on a range of matters relating to biodiversity, including matters of personal preference, knowledge of species, and perceived relationships between biodiversity and grazing, their ability to influence biodiversity and social norms about biodiversity conservation exerted by family and peers. Respondents were asked to rate their agreement with each statement on a five-point bi-polar response scale in terms of their level of agreement or disagreement with the statements 1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree.

Table 1
Summary description of the choice experimental design.

Design elements	Expression	Explanation
Conceptual construct	Willingness to accept	WTA provided construct validity as farmers have property rights over their land and contracts ask them to give up elements of those rights in return for recurring payments.
Response format	Best-worst scaling	Compared to 'pick one', best-worst scaling delivers a full ranking of all alternatives contained in the choice task. Ranking was achieved through sequential identification of 'best', 'worst', and 'second best' alternatives.
Number of alternatives	Three alternatives plus 'none' option	Three contract alternatives were offered plus a 'none' option to ensure conceptual validity of choice task given that participation in contractual biodiversity conservation was voluntary.
Labelling of alternatives	Unlabelled	Generic contract options were offered to focus respondents' attention on trading off contract attributes.
Number and types of attributes	Five	Attributes were developed in consultation with the pastoral industry and confirmed through pilot testing and pre-testing. Attributes defined the hypothetical conservation contracts in terms of the conservation requirement and its impact on cattle production, conservation payment, contract length, flexibility and monitoring arrangements. Attribute details are shown in Table 2.
Number of choice tasks per respondent	Six	The final design included 24 choice tasks, which were blocked into four versions of six choice tasks each. Each survey contained one block, i.e. each respondent answered six choice tasks. Blocks were assigned randomly. In the pre-test, respondents answered two blocks each.
Statistical properties	Bayesian d-efficient	Compared to orthogonal designs, efficient designs lead to smaller standard errors in model estimation at smaller sample sizes. Modified Federov algorithm was used, which does not force attribute-level balance. D-error criterion was used to optimise efficiency of the experimental design. The design was updated following pre-test of the survey with priors derived from pre-test choice data. The Bayesian D-error for the final design was 0.0716. Design was optimised for choice data analysis with RPL.

Table 2
Contract attributes, attribute levels and explanation.

Attributes	Levels	Definition and other relevant details
Conservation requirement	3 levels: Short spelling Long spelling Total exclusion	The conservation requirement expresses the environmental service to be remunerated. Focus is on broad-scale biodiversity conservation by removing cattle from the contract area either completely for the duration of the contract period or temporarily (i.e. 'spelling' the contract area every year) during times when biodiversity is particularly sensitive to grazing. Defined relative to cattle grazing and associated opportunity cost. SHORT SPELLING: Exclusion of cattle for short periods each year depending on biodiversity need, e.g. during nesting season of brolga (*Grus rubicunda*). There is no reduction in cattle production associated with short spelling. Short spelling is the base level for this contract attribute. LONG SPELLING: Prolonged spelling of contract area each year, e.g. wetlands or riparian areas are spelled during entire dry season, or grassland supporting Gouldian Finches (*Erythrura gouldiae*) is spelled during wet season and until after grasses have seeded. This may result in up to 50% reduction in cattle production from the contract land. TOTAL EXCLUSION: All cattle are removed from the contract area ('locking up country'), resulting in zero cattle production from that land. Fences need to be maintained. Weed and feral animal control need to be conducted. Stray cattle must be removed from contract area every year. A burning regime may have to be implemented to achieve desired biodiversity outcomes.
Annual conservation payment	6 levels: $1, $2, $4, $8, $16, $32 [$ per ha and year];	The contract stipulates and annual per-hectare conservation payment. The value shown is for year 2013 and the payment is indexed for the duration of the contract period, i.e. adjusted for inflation. The payment does not cover fixed costs; necessary infrastructure is paid separately and up-front. Note: To enhance respondents' ability to assess the conservation payment in the context of their cattle enterprise, their business situation was established and an indicative value of per-hectare income from cattle production was derived. Respondents were also prompted to consider the cost implications of each of the conservation requirements – e.g. cost savings associated with running a smaller herd or additional costs feral animal control action – and risk dimensions – e.g. accumulated biomass exacerbating fire risk and therefore requiring controlled burning.
Contract length	4 levels: 5, 10, 20, 40 years	No perpetual arrangement or covenants (when conservation requirements are registered on the land title) are considered. If property is sold, the contract transfers to new owner unless he/she chooses to discontinue.
Flexibility	2 levels: Flexibility/No flexibility	No flexibility: Standard contract with fixed contract conditions. Penalties may apply if conditions are violated. Base level. Flexibility: Farmer has the right to negotiate a 1-year suspension of the contract in 'exceptional circumstances' and, if suspension is granted, graze the contract area during specified exclusion periods without incurring a penalty. Maximum frequency 1 in 5 years. No conservation payment received during that year.
Monitoring (conducted by)	2 levels: External/Self	External monitoring: The administrating agency undertakes regular monitoring or contracts an independent provider for the task. Base level. Self: The pastoralist undertakes the monitoring but random spot-checks are conducted to validate results of self-monitoring. Each year the reports of 25% of program participants are validated.

Exploratory factor analysis was conducted of motivation Likert scales to uncover latent variables and constructs and to reduce the number of variables (Hair et al., 2010). Case-wise deletion of missing values was applied. Orthogonal rotation of factors was used. From the suite of orthogonal approaches VARIMAX rotation was used to achieve clear separation of factors ('varimax normalized'; STATSOFT, 2001). In addition, oblique rotation was performed to confirm the factor construct while allowing for the possibility of correlated factors. Factor loadings by items of 0.55 are deemed significant for a sample size of 100 respondents (Hair et al., 2010). An iterative process was adopted to determine the appropriate number of factors and the variables to retain in the factor model. This yielded a factor

Table 3
Illustration of a discrete choice task.

Block B Choice situation 2	Option A	Option B	Option C	None
Conservation requirements	Cattle exclusion for proLONGed periods; up to 50% loss of cattle production	TOTAL exclusion of cattle + active management for biodiversity outcomes	TOTAL exclusion of cattle + active management for biodiversity outcomes	
Annual payment ($/ha)	$8/ha	$32/ha	$ 16/ha	
Contract length (years)	10 years	40 years	5 years	
Flexibility of conditions	Flexibility	No flexibility	No flexibility	
Monitoring conducted by	Self (25% random spot-checks)	Self (25% random spot-checks)	External	
Which option would you choose?	○	○	○	○
Q2: Which is your least preferred option?	○	○	○	○
Q3: Which is your 2nd preferred option?	○	○	○	○
Q4: How certain are you of the choice you made in Q1? Please indicate % certainty on the scale.	0% 10 20 30 40 50 60 70 80 90 100% Level of certainty			
If you chose A, B or C in Q1, please continue to Q4. If you chose 'None', please go to next page.				
Q5: How much land would you offer to subscribe to the program? (minimum 400 ha/1000 acres) Q14	Hectares/Acres (Alternatively: % of property area)			
Q6: How did you determine the size of land area?				
Q7: What type of land is this?				
Q8: Indicatively, how much up-front infrastructure investment would be required to implement your proposal? Q15	km fencing Number of new watering points			

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

model and estimated factor scores for each respondent. Factors were scrutinised to ensure they met criteria of conceptual validity, consistency and reliability as per Hair et al. (2010). All factors had eigenvalues >1 to ensure the factor contributed to the explanation of variances in the variables.

Confirmatory factor analysis was also employed to verify factors where theory as to the latent structure of a Likert scale was available from the literature. For example, the Likert scale measuring the importance of a goals that graziers may want to achieve was tested against three motivations factors, which have been shown to influence adoption of conservation land-use practices in other studies (Greiner and Gregg, 2011; Kautonen et al., 2013). Chronbach's alpha is reported as an estimate of internal consistency of the factor construct and reliability of the scale. A value ≥0.7 indicates that the scale is reliable (De Vaus, 2002). Factors were labelled to (i) reflect constructs that had been previously identified in the literature or (ii) provide interpretation and meaning of the underlying construct defined by the grouping of variables.

For secondary data analysis including correlation, multiple regression analysis and econometric modelling, the factor scores were treated as independent variables. For the purpose of multiple regression analysis, factor scores were also treated as if they were continuous and normally distributed, consistent with Dieckhoff (1992), Clason and Dermody (1993) and Carifio and Perla (2007). The alpha level for interpretation of statistical significance was set at 0.1. Significance is reported at the $p < 0.1$ (*), $p < 0.05$ (**) and $p < 0.01$ (***) levels. Exploratory factor analysis and regression analysis were conducted in Statistica 7 (STATSOFT, 2001). Confirmatory factor analysis and correlation analysis were conducted in Free Statistics Software (Wessa, 2012).

3.4. Choice data analysis

Protest respondents were identified and eliminated from the analysis. As each survey contained multiple choice tasks (Greiner et al., 2014), panel specification of the choice models was necessary. Panels were unbalanced because some respondents did not complete all six choice tasks and respondents who participated in the pre-test and completed 12 choice tasks were included in the full sample. The analysis was done on the 1st preference data, which have been shown to yield superior models compared to the fully ranked choice data (Greiner, 2015). Missing covariate values were mean substituted to retain all choice observation in the analysis. Data analysis was conducted in NLOGIT® 5 software (Econometric_Software_Inc, 2012).

Random parameter logit (RPL) and latent class (LC) models are constructed as these are appropriate for situations with significant heterogeneity of preferences. RPL is a mixed multinomial logit model, which relaxes key assumptions constraining the interpretation of a multinomial logit model, namely (i) IID – i.e. that unobserved effects are 'extreme value 1' distributed, independent and identically distributed, (ii) independence of observed choices and (iii) homogeneity of preferences (Hensher et al., 2005). RPL models thus take into account heterogeneity of the parameter values among respondents. Compared to multinomial logit models, they are therefore behaviourally more appropriate and more policy relevant underpinned (Jaeck and Lifran, 2014; Mariel et al., 2013; Marsh, 2012; Schulz et al., 2014). Simulations are required in RPL models to approximate parameters as preference coefficients are not directly observable. Parameters were estimated using 1000 Halton draws. AES contract attributes were assumed to be normally distributed (other distributions were explored but not found to improve models), with the exception of the monetary attribute, which was fixed. Attitudinal and motivational factors were included as non-random covariates.

To profile different types of respondents in relation to heterogeneity of preferences in the context of motivations and attitudes, latent class (LC) models were also estimated. To that effect, attitudinal and motivational factors were included as class-defining variables (Lanza et al., 2013; Morey et al., 2008). LC models assign respondents into behavioural groups or latent classes, thus accounting for different preferences or different types of decision makers (Beck et al., 2011). Preference and covariate profiles are assumed to be homogenous within each latent class but differ between classes (Colombo et al., 2009). In terms of determining the best number of classes to report, model fit was considered on the basis of quantitative measures, in particular the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), both of which give measures of model parsimony (Magidson and Vermunt, 2004). Smaller values are preferred, along with qualitative aspects relating to parsimony and interpretability of the resulting class profiles (Beck et al., 2011; Nylund et al., 2007).

4. Results and interpretation

4.1. Descriptive summary of respondents

The survey yielded 104 valid responses. Responses captured approximately 15% of the estimated sample frame with good geographical coverage and representation of the pastoral industry (Table 4).

4.2. Motivational and attitudinal items and factors

Among motivation items, stewardship and lifestyle goals were consistently rated as being more important than economic/financial and social goals (Table 5). Scores for motivational items were tested for potential differences between respondents from family owned and corporation owned enterprises. Corporate respondents scored significantly higher for items "follow head office/owner directive" and "maximise company profit" ($p < 0.01$) and also for "be among the best in the industry" ($p < 0.05$), meaning these items were more important to them. They scored significantly lower for item "raise family on grazing property".

Exploratory factor analysis was conducted of the motivation items to find underlying motivational constructs. The hypothesis was that a 3-factor structure similar to Greiner and Gregg (2011) would be found. Indeed, an identical 3-factor model presented the most parsimonious factor solution. The model explained 53% of observed variance. The three factors were labelled 'lifestyle and stewardship motivation', 'financial/economic motivation' and 'social motivation'. Table 5 shows the factor loading matrix. Cronbach's alpha values confirm the reliability of the factors.

Exploratory factor analysis was conducted of the statements relating to biodiversity based on agreement scores. A 5-factor model provided the most parsimonious solution and explained 61.3% of variance (Table 6). The factors covered on intrinsic attitudes, normative beliefs about what caused biodiversity decline and the role of grazing. The model identified a separate factor (*Att-F3*) describing observations and perceived behavioural control – albeit with a low internal reliability score.

Additional attitude measures were also generated to complement this factor model. As a measure of normative influences exerted by family and peers, mean agreement score for the statements *"Other pastoralists tend to think that protecting biodiversity is important"* and *"People who are important to me think that protecting biodiversity is important"* was calculated. This construct was labelled *"Peer influences"*. The perceived effectiveness rating of *"payments for environmental services programs, such as that explored in this survey"* was taken to be a measure of attitude towards the policy instrument and labelled *"Attitude towards PES"*.

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Table 4
Summary statistics of research respondents.

Variable (unit)	Measure/Category label	Value
Property size (km²)	Mean	2411
	Median	775
	Minimum	18
	Maximum	16,116
	Total	250,750
Herd size (head)	Mean	15,925
	Median	7000
	Minimum	50
	Maximum	110,000
	Total	1,656,200
Stocking rate (head/km²)	Mean	8.9
	Median	8.1
	Standard deviation	4.9
	Minimum	0.8
	Maximum	22.8
Profit of the beef enterprise in 2011/12 (% of respondents)		
	Large profit	7%
	Small profit	36%
	Broke even	21%
	Small loss	17%
	Large loss	20%
Respondent's role on the property (% of respondents)		
	Owner-Manager	62.1%
	Employed manager	26.2%
	Other	11.7%
Gender of primary respondent (% of respondents)		
	Male	81.6%
Age of primary respondent (% of respondents)		
	<30 years	5.8%
	30–39 years	24.3%
	40–49 years	26.2%
	50–59 years	25.2%
	60 + years	18.5%
Business structure (% of respondents)		
	Family owned	80.8%
	Corporation owned	19.2%
Length of current property ownership (% of respondents)		
	<5 years	8.7%
	5–9 years	11.7%
	10–19 years	26.2%
	20–39 years	29.1%
	40 + years	24.3%
Membership of industry/NRM organisation(s) (% of respondents)		
	Yes	76.7%
Previous participation in a formal conservation program (%)		
	Yes	32.7%

Pairwise correlation analysis was conducted between all motivation and attitude factors and the normative score. *Mot-F1* was found to be positively correlated with *Att-F1* ($r = 0.468$, $p < 0.001$, $n = 92$) and negatively with *Att-F2* ($r = -0.1921$, $p = 0.067$, $n = 92$) indicating that respondents with higher stewardship motivation also attributed higher intrinsic value to biodiversity and were less inclined to blame biodiversity decline on causes other than grazing. *Mot-F2* was positively correlated with *Att-F2* ($r = 0.1949$, $p = 0.063$, $n = 92$) indicating that respondents for whom financial goals were more important tended to blame biodiversity decline on causes other than grazing. *Social motivation* was negatively correlated with *Att-F4* ($r = -0.3143$, $p = 0.002$, $n = 92$) indicating that respondents with higher social motivation thought they knew less about the biodiversity on their farms. The normative construct score was positively correlated with *Mot-F1* ($r = 0.3152$, $p = 0.0014$, $n = 100$) and *Att-F1* ($r = 0.2781$, $p = 0.0067$, $n = 94$) indicating that high intrinsic values of biodiversity and intrinsic motivation for biodiversity conservation were associated with a social setting that supported the notion that biodiversity was important.

4.3. Choice modelling results: influence of motivations and attitudes

A number of models were run to establish whether and how attitudinal, motivational and normative factors influenced stated participation in biodiversity contracts. To that effect, discrete choice models were run which included the factors as covariates. Factors were included provided they were relevant predictors of behaviour under the TBP and motivation frameworks. *Att-F1* was excluded because it measured the same construct as *Mot-F1*. Other correlations between factors were specified in the models.

The RPL found that all contract attributes other than *Monitoring* significantly influenced contract participation. It also confirmed that, as expected (Greiner et al., 2014), all contract attributes displayed significant heterogeneity of preferences (Table 7).

The significant heterogeneity of preferences means that average attribute parameter values, while giving an indication of the preferences of the industry as a whole, mask the significantly different heuristics that farmers apply when considering contract options. This finding vindicates the decision to use RPL instead of MNL modelling for discrete choice analysis.

Table 5
Three-factorial motivation model based on importance rating for motivation items.

	Mean item score	Motivation F1 (MOT-F1) Stewardship and lifestyle motivation	Motivation F2 (MOT-F1) Financial/economic motivation	Motivation F3 (MOT-F1) Social motivation
Look after the natural assets of the property	4.55	0.800		
Pass on land in good condition	4.58	0.795		
Enjoy life and work on the property	4.57	0.736		
Safeguard the property's natural assets	4.43	0.724		
Improve resource/land condition	4.29	0.706		
Look after cattle	4.65	0.647		
Protect the environment	4.31	0.645		
Get satisfaction from living and working on the land	4.60	0.642		
Produce high quality cattle	4.40	0.548		
Earn a high income	3.14		0.727	
Maximise company profit	4.04		0.696	
Maximise cattle production from the land	4.01		0.669	
Run a profitable business	4.43		0.616	
Build up land, wealth and assets	3.93		0.566	
Maximise land/property value for the time of sale	3.49		0.540	
Raise family on a grazing property	3.72			0.732
Step in ancestors' footsteps	2.25			0.692
Produce beef to 'help feed the world'	3.89			0.687
Eigenvalue of factors		5.85	2.02	1.66
% of total variance explained		32.5	11.2	9.2
Cronbach's alpha		0.876	0.688	0.56

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Table 6
Five-factorial attitude model.

Items: Statements relating to biodiversity	Mean item score	Attitude F1 (ATT-F1) Intrinsic motivation for biodiversity conservation	Attitude F2 (ATT-F2) Mental model: Other causes of decline and other solutions	Attitude F3 (ATT-F3) Personal observation and ease of on-farm biodiv. cons.	Attitude F4 (ATT-F4) Knowledge of species	Attitude F5 (ATT-F5) Acknowledgement that grazing contributes to biodiversity decline
As a landowner/land manager, I have an obligation to look after the native biodiversity and other natural assets on the property	4.52	0.827				
Caring for biodiversity is important to me personally	4.19	0.719				
I take pleasure from seeing native biodiversity around	4.35	0.650				
Every pastoralist has a moral responsibility to look after the biodiversity and other natural assets on his/her land. This includes corporate-owned stations	4.34	0.635				
Abundance of certain native animals is an indicator of the health of the country	4.12	0.614				
Grazing plays a minor role in biodiversity decline compared to other pressures	3.50		0.792			
Statutory duty of care is sufficient to protect biodiversity	2.89		0.685			
Feral animals and plants pose a greater threat to native biodiversity than grazing	4.06		0.685			
Current National Parks are sufficient to safeguard biodiversity of the savannas	2.86		0.554			
I have noticed a decline of native animals and plants on my property	1.92			0.662		
Protecting endangered species on my property is easy	2.81			−0.713		
It is relatively easy to safeguard native biodiversity on my property	3.35			−0.738		
I know the names of all the native animals and plants on my property	2.98				−0.867	
I accept that cattle grazing contributes to biodiversity decline	2.50					0.873
Eigenvalue		2.727	2.026	1.440	1.239	1.145
% Total (variance)		19.48	14.47	10.29	8.85	8.18
Cronbach's alpha		0.715	0.639	0.158	n/a	n/a

Direction of attribute influence was consistent with economic theory, which higher payments, shorter contracts and more flexibility significantly increasing the likelihood of participation while higher conservation requirements – and associated opportunity costs – reduced likely participation. There was a (non-significant) preference for external monitoring over self-monitoring, which of course generates additional transaction costs for farmers.

The ASC was positive and significant meaning that there were significant unexplained influences on choice and preferences towards the 'none' option, which could not be explained by the variables contained in the model – despite the inclusion of attitudinal variables. This was expected as the model did not include any business and social variables so as not to confuse the focus of this analysis on attitudinal and motivational influences. The influence of other factors is analysed elsewhere (Greiner, 2015).

WTA estimates for the choice attributes and ASC were calculated as the negative of the ratio of each attribute coefficient to the price coefficient. Confidence intervals were estimated using the Krinsky and Robb (1986) procedure based on the unconditional parameter estimates and applying 1000 simulations with the RPL model, based on Halton draws, to calculate the confidence intervals in this procedure.

Of attitudinal and motivational covariates, few showed significant influences. *Mot-F1* was significantly ($p < 0.05$) and positively associated with choice probability, meaning that respondents with higher factor scores for *Stewardship and lifestyle motivation* were significantly more likely to participate. Similarly, a favourable *Attitude towards PES* was associated with a higher likelihood to participate. On the other hand, *Peer influences* had a significant negative correlation coefficient ($p < 0.01$) meaning that social pro-biodiversity pressures were negatively associated with participation, pointing to a counter-intuitive influence.

Latent class models were subsequently run to explore and explain the preference heterogeneity and hopefully explain it in the context of attitudes and motivations. To that effect, covariates were included as class-defining variables. Two, three, four and five-class models were run, all of which resulted in valid models. The model fit for different class numbers was compared on the basis of various criteria of model fit (Table 8). On the basis of McFadden pseudo R-squared, AIC/N and BIC/N, the RPL performs better than the 2-class LC model, though its predictive power is much lower.

The AIC/N indicator suggests the 4-class model for best parsimony, the BIC/N indicator suggests the 3-class model. After consideration of the narrative provided by both models, the 3-class model was chosen (Table 9).

The three classes were of similar size, with class probabilities ranging from 30 to 36%. Among contract attributes, *Stewardship payment*, *Contract duration* and *Flexibility* were significant for all classes, indicating the central role of these attributes in respondents' utility function and decision making though they were traded off differently, e.g. *Class 1* had a much higher time preference ($1.42 per ha and year). *Classes 1 and 2* associated significant dis-utility with *Total exclusion* of cattle as a conservation requirement compared to the base level *Short spelling*. Only *Class 2* associated a significant level of dis-utility with *Long spelling*. In terms of the conservation requirements, this indicates that overall pastoralists do not seem to distinguish much between different lengths of cattle exclusion as long the as the contract area can be grazed for part of the year. This interpretation is also supported by the small monetary difference established in the RPL (Table 6).

The ASC parameter estimate was positive and significant for *Classes 1 and 3*, indicating that respondents with a high probability of affiliation with these classes had a significant tendency to choose the 'none' option over the contract alternatives and that choices could not be fully explained by the observable variables included in the model. The ASC was non-significant for *Class 2*, meaning

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Table 7
Results of the RPL model.

Variables	Coefficient	Sig	WTA mean	WTA 95% CI
Random parameters: attributes				
Requirement: Total exclusion (yes/no)	−2.818	***	$12.04	(8.08–15.78)
Requirement: Long spelling each year (yes/no)	−0.709	**	$3.03	(0.23–5.38)
Contract duration (years)	−0.091	***	$0.39	(0.28–0.49)
Flexibility in 'exceptional circumstances' (yes/no)	1.571	***	−$ 6.71	(−9.10– −4.44)
Monitoring arrangements (1 = self, 0 = external)	−0.165		$0.71	(−1.15–2.58)
Non-random parameters: attributes and covariates				
Stewardship payment ($ per ha and year)	0.234	***		
ASC	2.796	***	$ 11.95	(3.43–21.59)
Motivation F1 – stewardship and lifestyle	1.111	**		
Motivation F2 – financial/economic	0.450			
Motivation F3 – social	−0.094			
Attitude F2 – 'other causes of decline'	−0.071			
Attitude F3 – 'no problem on my property'	0.028			
Attitude F5 – 'grazing causes decline'	0.164			
Peer influences	−1.001	***		
Attitude towards PES	0.844	***		
Distribution of random parameters				
Requirement: Total exclusion (yes/no)	2.893	***		
Requirement: Long spelling each year (yes/no)	1.594	***		
Contract duration (years)	0.072	***		
Flexibility in 'exceptional circumstances' (yes/no)	1.313	***		
Monitoring arrangements (1 = self, 0 = external)	0.947	***		
Model statistics				
Number of observations	548			
Degrees of freedom	20			
Log likelihood function	−530			
McFadden pseudo R-squared	0.301			
Chi squared	458			
AIC/N	2.010			
BIC/N	2.167			

Casewise deletion of missing values, all random distributions assumed to be normal.
Note: ASC = alternative specific constant ("None" = 1). SE = standard error.
Sig: ***, **, * denotes significance at 1%, 5%, 10% levels.

that choice behaviour for *Class 2* could be fully explained with by the model variables. It was the only class that considered all contract attributes. *Class 1* also considered *Monitoring*, expressing a significant preference of external monitoring over self-monitoring, while *Class 2* had a preference for self-monitoring.

Attitudes and motivations influenced choice behaviour quite differently for different classes and different attitudinal and motivational factors were brought to bear in explaining decision making. A favourable *Attitude towards PES* was a significant predictor of choice for *Classes 1 and 3*, illustrating the importance of understanding this type of policy mechanism for the adoption of conservation contracts. *Stewardship motivation* was significant only for *Class 3*, which also attributed biodiversity decline more strongly to *Other causes (Att-F3)*, and showed a stronger *Social motivation*. At the same time, participation was significantly negatively associated with *Peer influences*. In comparison, participation decisions by *Class 2* were significantly positively associated with *Financial motivation* and negatively associated with *Social motivation*, and *Control belief (Att-F3)*. It was the class with the highest WTA for *Total exclusion* ($23.47 per ha and year). *Class 1* displayed a significant negative association of decisions with *Financial motivation*, did not believe that *Grazing causes biodiversity decline* but had a strong *Control belief (Att-F3)*.

5. Discussion and Conclusions

This research confirms that pastoralists and graziers in northern Australia share the same general attribute preferences for conservation contracts with farmers elsewhere in the world. They require a greater monetary incentive to sign up to longer contract periods or contracts that require cattle to be removed for the duration from the area under contract, and they have a strong preference for any type of flexibility in contractual arrangements (Windle and Rolfe, 2005; Ruto and Garrod, 2009; Espinosa-Goded et al., 2010; Christensen et al., 2011; Peterson et al., 2011; Yu and Belcher, 2011; Broch and Vedel, 2012; Jaeck and Lifran, 2014).

The research establishes that there is significant heterogeneity of preferences across all contract attributes – even for monitoring

Table 8
Comparison of statistics of fit for RPL and LC models.

Descriptors and indicators of model fit	RPL	Latent class models: number of classes			
		2	3	4	5
Number of observations	548	548	548	548	548
Degrees of freedom	20	31	47	62	79
Log likelihood function	−530	−553	−501	−461	−446
McFadden pseudo R-squared	0.301	0.272	0.341	0.394	0.413
Chi squared	458	414	518	598	628
AIC/N	2.010	2.131	1.999	1.911	1.916
BIC/N	2.167	2.374	2.369	2.406	2.536
Correct predictions (%)	38.1%	52.6%	66.8%	76.1%	84.1%

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Table 9
Results of the 3-class LC model.

	Class 1			Class 2			Class 3		
	Coefficient	Sig	SE	Coefficient	Sig	SE	Coefficient	Sig	SE
Attributes									
Requirement: Total exclusion (yes/no)	−2.420	***	0.655	−4.049	***	0.935	−0.586		0.689
Requirement: Long spelling each year (yes/no)	−0.348		0.452	−0.673	*	0.384	−0.192		0.549
Stewardship payment ($ per ha and year)	0.156	***	0.037	0.173	***	0.034	0.263	***	0.043
Contract duration (years)	−0.222	***	0.044	−0.025	**	0.010	−0.056	***	0.016
Flexibility in 'exceptional circumstances' (yes/no)	1.837	***	0.478	1.432	***	0.355	1.108	***	0.295
Monitoring arrangements (1 = self, 0 = external)	−1.161	***	0.339	0.477	*	0.282	−0.034		0.270
ASC	2.653	**	1.178	5.312		3.469	3.503	***	1.162
Covariates									
Motivation F1 – stewardship and lifestyle	−0.470		0.601	0.482		0.966	1.178	*	0.612
Motivation F2 – financial/economic	−1.236	***	0.431	1.673	***	0.573	0.003		0.485
Motivation F3 – social	0.198		0.202	−1.877	***	0.572	0.752	*	0.396
Attitude F2 – 'other causes of decline'	−0.031		0.140	0.081		0.119	0.629	***	0.188
Attitude F3 – 'no problem on my property'	0.575	**	0.286	−0.851	**	0.362	0.255		0.346
Attitude F5 – 'grazing causes decline'	−0.636	***	0.231	0.654		0.607	0.457	*	0.261
Peer influences	0.405		0.361	−0.941		0.673	−1.927	***	0.540
Attitude towards PES	0.832	***	0.275	1.518		0.934	1.003	***	0.272
Membership probability (%)	33.6%	***	5.4%	30.1%	***	5.4%	36.3%	***	5.5%
Model statistics									
Observations	548								
Degrees of freedom	47								
Log likelihood function	−501								
McFadden pseudo R-squared	0.341								
Chi squared	518								
AIC/N	1.999								
BIC/N	2.369								

Note: SE = standard error, ***, **, * denotes significance at 1%, 5%, 10% levels.

arrangements, where no clear industry-level preferences could be established due to the small sample size. This is important to consider in the design of any future PES-style conservation program as programs tailored to an average set of preferences will appeal to few and are destined to be ineffective and inefficient because they will have little uptake. Tailoring is critical for maximising farmer participation in agri-environmental schemes as well as scheme efficiency (Falconer and Saunders, 2002). Tailoring refers to the fit of a scheme to the needs of the target biodiversity as well as farming situations and farmer preferences.

This research shows that the fit and predictive capacity of discrete choice models can be enhanced when psychological constructs such as motivations and attitudes are included as covariates. It demonstrates how LC models can develop decision making narratives based on a combination of attribute preferences, motivations and attitudes. For example, farmers who are strongly financially motivated appear to more comprehensively consider contract attributes and demand a higher stewardship payment for total exclusion of cattle from contract areas. These typologies reflect the different ways in which pastoralists and graziers in northern Australia are likely to view and engage with conservation contracts, and illustrates that a 'one contract fits all' approach is unlikely to succeed. The research provides important guidance for policy and program design that offers contractual diversity and supports contract negotiations and administration.

The research illustrates that stated intentions by northern Australian pastoralists to participate in contractual biodiversity conservation are influenced by their motivations and attitudes, which have been shown to similarly influence the adoption of conservation land management practices (Greiner and Gregg, 2011; Greiner et al., 2009b). It confirms that most pastoralists and graziers in northern Australia derive intrinsic value from the presence of native biodiversity and are consequently intrinsically motivated to look after their land and the natural assets contained on their very large farms (Greiner and Gregg, 2011). The whole-of-industry analysis shows that stewardship and lifestyle motivation drives stated participation in voluntary conservation programs. This type of motivation is in fact the key reason why many newcomers buy and/or manage grazing properties in Australia's tropical savannas (Holmes, 2008).

The research also shows that many farmers lack a clear understanding of the impact of grazing practices on biodiversity, and how changes in grazing regimes can help to restore and safeguard biodiversity. The attitudinal profiles arising from the LC models show that such knowledge, or the lack of it, can influence intentions of undertaking conservation action. It has been shown elsewhere that farmers require a much better understanding of biodiversity in general and as it relates to their farm. Lüscher et al. (2014) suggested two complementary metrics particularly helpful in a Swiss context: richness – i.e. number of species found on the farm and uniqueness – thereby encapsulating the contribution of the farm to total species richness of the region.

The key message arising from this research is that 'neo-liberal' PES-style programs may be a valuable part of a policy mix directed at safeguarding the unique biodiversity of Australia's tropical savannas (Cooke and Moon, 2015; Higgins et al., 2014; Lockie, 2010; Stock et al., 2014). It is also worth highlighting the social co-benefits that accrue to participating farms and regional communities (Greiner and Stanley, 2013). However, as experiences elsewhere have shown, they need to be part of a policy bundle to ensure participation of farmers with different property situations, cost structures, and needs and motivations (Reimer and Prokopy, 2014). In particular, information and extension efforts should focus on increasing awareness of biodiversity and grazing impacts, thus changing attitudes relating to biodiversity, increasing acceptance of AES and PES-style policies and programmes, and fostering stewardship motivation and consequently participation in conservation (Johansson et al., 2013). In addition, the policy mix needs to include regulatory measures that clearly define the biodiversity conservation standards expected of farmers as part of their operations so that a baseline can be established (Greiner, 2014; Greiner et al., 2009a) and concepts of additionality be defined, which underpin the legitimacy of PES.

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Acknowledgements

This research was jointly funded by the Australian Government's National Environmental Research Program – North Australia Hub and Charles Darwin University. The research would not have been possible without the support of the North Australian Beef Research Council, Northern Territory Cattlemen's Association, Pastoralists and Graziers Association of Western Australia, north Australian natural resource management groups, Landcare groups and officers of the Queensland Department of Agriculture Fisheries and Forestry. Thanks go to Michelle Franklin and Leanne Fernandes for assistance with data collection, Eddie Webber for the map, and to Jill Windle, John Rolfe, Daniel Gregg, Matthew Beck and Michiel Bliemer for discussions on aspects of choice experimental design and analysis. Two anonymous reviewers have provided helpful comments on an earlier version of the manuscript.

References

ABARES, 2012. AGSURF Data. Australian Government, Department of Agriculture, Fisheries and Forestry, ABARES, Canberra.

Adams, V.M., Pressey, R.L., Stoeckl, N., 2014. Estimating landholders' probability of participating in a stewardship program, and the implications for spatial conservation priorities. PLoS ONE 9.

Ahnström, J., Höckert, J., Bergeå, H.L., Francis, C.A., Skelton, P., Hallgren, L., 2009. Farmers and nature conservation: what is known about attitudes, context factors and actions affecting conservation? Renew. Agric. Food Syst. 24, 38–47.

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50, 179–211.

Baylis, K., Peplow, S., Rausser, G., Simon, L., 2008. Agri-environmental policies in the EU and United States: a comparison. Ecol. Econ. 65, 753–764.

Beck, M.J., Rose, J.M., Hensher, D.A., 2011. Behavioural responses to vehicle emissions charging. Transportation 38, 445–463.

Beedell, J., Rehman, T., 2000. Using social-psychology models to understand farmers' conservation behaviour. J. Rural Stud. 16, 117–127.

Beharry-Borg, N., Smart, J.C.R., Termansen, M., Hubacek, K., 2013. Evaluating farmers' likely participation in a payment programme for water quality protection in the UK uplands. Reg. Environ. Change 13, 633–647.

Bliemer, M.C.J., Rose, J.M., 2011. Experimental design influences on stated choice outputs: an empirical study in air travel choice. Transport. Res. Part A Policy Pract. 45, 63–79.

Bremer, L.L., Farley, K.A., Lopez-Carr, D., 2014. What factors influence participation in payment for ecosystem services programs? An evaluation of Ecuador's SocioPáramo program. Land Use Policy 36, 122–133.

Broch, S.W., Strange, N., Jacobsen, J.B., Wilson, K.A., 2013. Farmers' willingness to provide ecosystem services and effects of their spatial distribution. Ecol. Econom. 92, 78–86.

Burton, R.J.F., 2004. Reconceptualising the 'behavioural approach' in agricultural studies: a socio-psychological perspective. J. Rural Stud. 20, 359–371.

Burton, R.J.F., Kuczera, C., Schwarz, G., 2008. Exploring farmers' cultural resistance to voluntary agri-environmental schemes. Sociol. Ruralis 48, 16–37.

Carifio, J., Perla, R., 2007. Ten common misunderstandings, misconceptions, persistent myths and urban legends about Likert scales and Likert response formats and their antidotes. J. Soc. Sci. 3, 106–116.

Christensen, T., Pedersen, A.B., Nielsen, H.O., Mørkbak, M.R., Hasler, B., Denver, S., 2011. Determinants of farmers' willingness to participate in subsidy schemes for pesticide-free buffer zones – a choice experiment study. Ecol. Econom. 70, 1558–1564.

Cooke, B., Moon, K., 2015. Aligning 'public good' environmental stewardship with the landscape-scale: adapting MBIs for private land conservation policy. Ecol. Econom. 114, 152–158.

DAFF, 2014. AGSURF Data. Australian Government Department of Agriculture, Canberra.

De Vaus, D.A., 2002. Surveys in Social Research, fifth ed. Allen & Urwin, Crows Nest, NSW.

Defrancesco, E., Gatto, P., Runge, F., Trestini, S., 2008. Factors affecting farmers' participation in agri-environmental measures: a northern Italian perspective. J. Agric. Econom. 59, 114–131.

Econometric_Software_Inc, 2012. NLOGIT 5, Australia.

Espinosa-Goded, M., Barreiro-Hurlé, J., Ruto, E., 2010. What do farmers want from agri-environmental scheme design? A choice experiment approach. J. Agric. Econom. 61, 259–273.

Falconer, K., Saunders, C., 2002. Transaction costs for SSSIs and policy design. Land Use Policy 19, 157–166.

Farmar-Bowers, Q., Lane, R., 2009. Understanding farmers' strategic decision-making processes and the implications for biodiversity conservation policy. J. Environ. Manage. 90, 1135–1144.

Fishbein, M., Ajzen, I., 2011. Predicting and Changing Behavior: The Reasoned Action Approach. Taylor & Francis.

Fitzsimons, J.A., Wescott, G., 2008. The role of multi-tenure reserve networks in improving reserve design and connectivity. Landsc. Urban Plan. 85, 163–173.

Francis, J.J., Eccles, M.P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., et al., 2004. Constructing Questionnaires Based on the Theory of Planned Behaviour: A Manual for Health Services Researchers. Centre for Health Services Research. University of Newcastle upon Tyne, Newcastle upon Tyne, UK.

Garnett, S.T., Woinarski, J.C.Z., Crowley, G.M., Kutt, A.S., 2010. Biodiversity conservation in Australian tropical rangelands. In: Du Toit, J.T., Kock, R., Deutsch, J.C. (Eds.), Wild Rangelands: Conserving Wildlife While Maintaining Livestock in Semi-arid Ecosystems. Wiley-Blackwell, Chichester, pp. 191–234.

Gleeson, T., Martin, P., Mifsud, C., 2012. North Australian Beef Industry: Assessment of Risks and Opportunities. Australian Government Department of Agriculture, Fisheries and Foresty; ABARES, Canberra.

Greiner, R., 2014. Environmental duty of care: from ethical principle towards a code of practice for the grazing industry in Queensland (Australia). J. Agric. Environ. Ethics 27, 527–547.

Greiner, R., 2015. Factors influencing farmers' participation in contractual biodiversity conservation: a choice experiment with north Australian pastoralists. Aust. J. Agric. Resour. Econom. 58, 1–28.

Greiner, R., Gregg, D., 2011. Farmers' intrinsic motivations, barriers to the adoption of conservation practices and effectiveness of policy instruments: empirical evidence from northern Australia. Land Use Policy 28, 257–265.

Greiner, R., Stanley, O., 2013. More than money for conservation: exploring social co-benefits from PES schemes. Land Use Policy 31, 4–10.

Greiner, R., Gordon, I., Cocklin, C., 2009a. Ecosystem services from tropical savannas: economic opportunities through payments for environmental services. Rangel. J. 31, 51–59.

Greiner, R., Patterson, L., Miller, O., 2009b. Motivations, risk perceptions and adoption of conservation practices by farmers. Agric. Syst. 99, 86–104.

Greiner, R., Bliemer, M.C.J., Ballweg, J., 2014. Design considerations of a choice experiment to estimate likely participation by north Australian pastoralists in contractual on-farm biodiversity conservation. J. Choice Model. 10, 34–45.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2010. Multivariate Data Analysis: A Global Perspective, seventh ed. Pearson, Upper Saddle River, NJ.

Hajkowicz, S., 2009. The evolution of Australia's natural resource management programs: towards improved targeting and evaluation of investments. Land Use Policy 26, 471–478.

Hansson, H., Ferguson, R., Olofsson, C., 2012. Psychological constructs underlying farmers' decisions to diversify or specialise their businesses – an application of theory of planned behaviour. J. Agric. Econom. 63, 465–482.

Hensher, D.A., Rose, J.M., Greene, W.H., 2005. Applied Choice Analysis: A Primer. Cambridge University Press, Cambridge, UK.

Higgins, V., Dibden, J., Potter, C., Moon, K., Cocklin, C., 2014. Payments for ecosystem services, neoliberalisation, and the hybrid governance of land management in Australia. J. Rural Stud. 36, 463–474.

Holmes, J., 2008. Impulses towards a multifunctional transition in rural Australia: interpreting regional dynamics in landscapes, lifestyles and livelihoods. Landscape Res. 33, 211–223.

Hoyos, D., 2010. The state of the art of environmental valuation with discrete choice experiments. Ecol. Econom. 69, 1595–1603.

Ingram, J., Gaskell, P., Mills, J., Short, C., 2013. Incorporating agri-environment schemes into farm development pathways: a temporal analysis of farmer motivations. Land Use Policy 31, 267–279.

Jaeck, M., Lifran, R., 2014. Farmers' preferences for production practices: a choice experiment study in the Rhone river delta. J. Agric. Econom. 65, 112–130.

Johansson, M., Rahm, J., Gyllin, M., 2013. Landowners' participation in biodiversity conservation examined through the value-belief-norm theory. Landscape Res. 38, 295–311.

Kaczan, D., Swallow, B.M., Adamowicz, W.L.V., 2013. Designing payments for ecosystem services (PES) program to reduce deforestation in Tanzania: an assessment of payment approaches. Ecol. Econom. 95, 20–30.

Kautonen, T., van Gelderen, M., Tornikoski, E.T., 2013. Predicting entrepreneurial behaviour: a test of the theory of planned behaviour. Appl. Econ. 45, 697–707.

Lanza, S.T., Bray, B.C., Collins, L.M., 2013. An introduction to latent class and latent transition analysis. In: Weiner, I.B., Schinka, J.A., Velicer, W. (Eds.), Handbook of Psychology, Volume 2: Research Methods in Psychology, second ed. John Wiley & Sons, Hoboken, NJ, pp. 691–716.

Lewis, D., 2002. Slower than the Eye can See: Environmental Change in Northern Australia's Cattle Lands. Tropical Savannas CRC, Darwin.

Lockie, S., 2010. Neoliberal regimes of environmental governance: climate change, biodiversity and agriculture in Australia. In: Redclift, M.R., Woodgate, G. (Eds.), The International Handbook of Environmental Sociology. Edward Elgar, Cheltenham, UK, pp. 364–377.

Lüscher, G., Schneider, M.K., Turnbull, L.A., Arndorfer, M., Bailey, D., Herzog, F., et al., 2014. Appropriate metrics to inform farmers about species diversity. Environ. Sci. Policy 41, 52–62.

Magidson, J., Vermunt, J.K., 2004. Latent class models. In: Kaplan, D.W. (Ed.), The SAGE Handbook of Quantitative Methodology for the Social Sciences. Sage, Thousand Oaks, CA, pp. 175–198.

Margules, C.R., Pressey, R.L., 2000. Systematic conservation planning. Nature 405, 243–253.

Mariel, P., De Ayala, A., Hoyos, D., Abdullah, S., 2013. Selecting random parameters in discrete choice experiment for environmental valuation: a simulation experiment. J. Choice Model. 7, 44–57.

Marsh, D., 2012. Water resource management in New Zealand: jobs or algal blooms? J. Environ. Manage. 109, 33–42.

Please cite this article in press as: Romy Greiner, Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts, Agricultural Systems (2015), doi: 10.1016/j.agsy.2015.04.005

Merckx, T., Feber, R.E., Riordan, P., Townsend, M.C., Bourn, N.A.D., Parsons, M.S., et al., 2009. Optimizing the biodiversity gain from agri-environment schemes. Agric. Ecosyst. Environ. 130, 177–182.

Mora, C., Sale, P.F., 2011. Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. Mar. Ecol. Prog. Ser. 434, 251–266.

Morey, E., Thiene, M., De Salvo, M., Signorello, G., 2008. Using attitudinal data to identify latent classes that vary in their preference for landscape preservation. Ecol. Econom. 68, 536–546.

Morris, C., Potter, C., 1995. Recruiting the new conservationists: farmers' adoption of agri-environmental schemes in the UK. J. Rural Stud. 11, 51–63.

Nylund, K.L., Asparouhov, T., Muthén, B.O., 2007. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. Struct. Equat. Model. 14, 535–569.

Pannell, D.J., Marshall, G.R., Barr, N., Curtis, A., Vanclay, F., Wilkinson, R., 2006. Understanding and promoting adoption of conservation technologies by rural landholders. Aust. J. Exper. Agric. 46, 1407–1424.

Parr, C.L., Woinarski, J.C.Z., Pienaar, D.J., 2009. Cornerstones of biodiversity conservation? Comparing the management effectiveness of Kruger and Kakadu National Parks, two key savanna reserves. Biodiver. Conserv. 18, 3643–3662.

Pattanayak, S.K., Wunder, S., Ferraro, P.J., 2010. Show me the money: do payments supply environmental services in developing countries? Rev. Environ. Econom. Policy req006.

Primdahl, J., Peco, B., Schramek, J., Andersen, E., Onate, J., 2003. Environmental effects of agri-environmental schemes in Western Europe. J. Environ. Manage. 67, 129–138.

Rands, M.R., Adams, W.M., Bennun, L., Butchart, S.H., Clements, A., Coomes, D., et al., 2010. Biodiversity conservation: challenges beyond 2010. Science 329, 1298–1303.

Reimer, A.P., Prokopy, L.S., 2014. Farmer participation in U.S. Farm bill conservation programs. Environ. Manage. 53, 318–332.

Reimer, A.P., Thompson, A.W., Prokopy, L.S., 2012. The multi-dimensional nature of environmental attitudes among farmers in Indiana: implications for conservation adoption. Agric. Human Values 29, 29–40.

Rolfe, J., Windle, J., 2005. Establishing the potential for offset trading in the Lower Fitzroy River. Research Report No. 6. Final report for MBI project 53. Central Queensland University, Emerald, Qld.

Ruto, E., Garrod, G., 2009. Investigating farmers' preferences for the design of agri-environment schemes: a choice experiment approach. J. Environ. Plan. Manage. 52, 631–647.

Schulz, N., Breustedt, G., Latacz-Lohmann, U., 2014. Assessing farmers' willingness to accept "greening": insights from a discrete choice experiment in Germany. J. Agric. Econom. 65, 26–48.

Sorice, M.G., Haider, W., Conner, J.R., Ditton, R.B., 2011. Incentive structure of and private landowner participation in an endangered species conservation program. Conserv. Biol. 25, 587–596.

Sorice, M.G., Oh, C.-O., Gartner, T., Snieckus, M., Johnson, R., Donlan, C.J., 2013. Increasing participation in incentive programs for biodiversity conservation. Ecol. Appl. 23, 1146–1155.

Stock, P.V., Forney, J., Emery, S.B., Wittman, H., 2014. Neoliberal natures on the farm: farmer autonomy and cooperation in comparative perspective. J. Rural Stud. 36, 411–422.

Stoneham, G., Chaudhri, V., Ha, A., Strappazzon, L., 2003. Auctions for conservation contracts: an empirical examination of Victoria's BushTender trial. Aust. J. Agric. Resour. Econom. 47, 477–500.

STATSOFT, 2001. STATISTICA System Reference. StatSoft, Tulsa, OK.

Wagner, J., 2012. A comparison of alternative indicators for the risk of nonresponse bias. Public Opin. Q. 76, 555–575.

Watt, H.M., Richardson, P.W., 2007. Motivational factors influencing teaching as a career choice: development and validation of the FIT-Choice Scale. J. Exper. Educ. 75, 167–202.

Wessa, P., 2012. Free statistics and forecasting software version 1.1.23-r7. Office for Research and Education. <http://www.wessa.net>.

Willock, J., Deary, I.J., Edwards-Jones, G., Gibson, G.J., McGregor, M.J., Sutherland, A., et al., 1999. The role of attitudes and objectives in farmer decision making: business and environmentally-oriented behaviour in Scotland. J. Agric. Econom. 50, 286–303.

Wilson, G.A., Hart, K., 2000. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Environ. Plan. A 32, 2161–2186.

Woinarski, J., Mackey, B., Nix, H., Traill, B., 2007a. The Nature of Northern Australia: Natural Values, Ecological Processes and Future prospects. ANU E Press, Canberra.

Woinarski, J.C.Z., Ash, A.J., 2002. Responses of vertebrates to pastoralism, military land use and landscape position in an Australian tropical savanna. Austral Ecol. 27, 311–323.

Woinarski, J.C.Z., Mackey, B., Nix, H., Traill, B., 2007b. The Nature of Northern Australia: Natural Values, Ecological Processes and Future Prospects. ANU E Press, Canberra.

Woinarski, J.C.Z., Armstrong, M., Brennan, K., Fisher, A., Griffiths, A.D., Hill, B., et al., 2010. Monitoring indicates rapid and severe decline of native small mammals in Kakadu National Park, northern Australia. Wildl. Res. 37, 116–126.

Woinarski, J.C.Z., Legge, S., Fitzsimons, J.A., Traill, B.J., Burbidge, A.A., Fisher, A., et al., 2011. The disappearing mammal fauna of northern Australia: context, cause, and response. Conserv. Lett. 4, 192–201.

Wood, A., Stedman-Edwards, P., Mang, J., 2000. The Root Causes of Biodiversity Loss. Earthscan, New York.

Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. Ecol. Econom. 65, 834–852.

Uncited references

Clason, D.L., Dormody, T.J., 1993. Analyzing data measured by individual Likert-type items. J. Agric. Educ. 35, 31–35.

Diekhoff, G., 1992. Statistics for the Social and Behavioral Sciences: Univariate, Bivariate, Multivariate. C. Brown Publishers, Dubuque, IA.