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Analysis

Landowner preferences for agri-environmental agreements to conserve the *montado* ecosystem in Portugal

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ABSTRACT

Landowner preferences are elicited for different contractual agri-environmental agreements (AEA) using choice experiments in the Portuguese *montados*, an agro-forestry ecosystem with high conservation value. The choice experiment is developed with the help of biologists from local environmental authorities and builds upon existing AEA in the Portuguese Rural Development Program ProDeR implemented at Natura 2000 conservation sites. Current uptake rates of AEA for *montado* conservation are very low. The study's main objective is to assess how varying the institutional–economic terms and conditions underlying current contract design can increase this uptake. We find demand for AEA inside and outside the currently designated protection areas, but there exist clear trade-offs between willingness to accept financial compensation and opportunity costs measured through varying cattle and oak tree density levels. Also contract duration plays a significant role. Minimum willingness to accept financial compensation for a hypothetical scenario representing the current contract conditions in the region is more than six times higher than the actual payment levels under the existing agri-environmental agreements.

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1. Introduction

The *montado* is an agro-silvo pastoral system specific to the region of Alentejo in South Portugal, consisting of an open formation of cork and holm oaks in varying densities, combined with a rotation system of crops, fallow and pastures (Pinto-Correia and Mascarenhas, 1999). The conservation value of *montados* relies on the maintenance of the shrub–grassland matrix through human management (Santos-Reis and Correia, 1999; Delgado and Moreira, 2000; Pereira et al., 2004, 2005). In recent decades intensification of human activities resulted in a disturbance of the equilibrium of this ecosystem. Poor agricultural and grazing practices are increasing the spread of diseases and preventing *montados*' natural regeneration, which threatens their sustainability in the long-run (Pinto-Correia and Mascarenhas, 1999; Pinto-Correia, 2000; Plieninger and Wilbrand, 2001; Plieninger, 2007).

Agri-environmental schemes (AES) have been introduced in the EU Common Agriculture Policy (CAP) as a response to the increasing concern over the environmental impacts associated with modern-day agriculture in Europe (COM, 2005). They intend to encourage farmers to protect and enhance the environment on their farmland through specific agri-environmental measures (AEM) (Farmer et al., 2008). Under the Portuguese Rural Development (ProDeR) Program (2007–2013), Integrated Territorial Interventions (ITI) are a specific type of AEM addressing site-specific environmental issues, in particular conserving rural landscapes and biodiversity in areas such as Natura 2000 sites and Natural Parks (Santos et al., 2015). Financial support for ITI concerns (1) agri-environmental activities, which aim to conserve cultivated areas of high ecological value, maintain landscape features, and preserve habitats and species under threat; (2) silvo-environmental measures, which aim to conserve or enhance forest areas of high biodiversity, including native forest species, and preserve endangered forest habitats; and (3) non-productive investments, which are necessary to fulfill agri-environment and silvo-environment objectives (ProDer Program, 2010).

Current uptake rates of ITI for *montado* conservation are very low (Domingos et al., 2011). The main objective of the research presented in this paper therefore is to assess how varying the institutional–economic terms and conditions underlying current contract design can increase this uptake. To this end, a choice experiment is developed to assess how farmers value the different components in a contractual agreement to maintain and enhance the *montados* on their land. The choice experiment focuses on one specific measure, grazing extensification and *montado* regeneration (GEMR), which is included in the list of AEM applied in ITI Alentejo Natura 2000 sites. This measure is highly relevant due to the recent trend of livestock intensification, which has led farmers to convert non-productive natural areas into forage land to meet the increasing needs of their livestock. The

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negative impacts of livestock in *montado* forests are significant, as they damage young trees thus hindering natural regeneration. Limiting the size of livestock and protecting the natural regeneration of holm and cork oak trees contribute to the conservation of *montado* habitats.

The main requirements to implement GEMR include submission of a multi-annual intervention plan, limiting cattle density, keeping records of changes in cattle stock and cattle movements, avoid soil mobilization and install and maintain tree fences to enhance forest regeneration. So, the trade-off consists of giving up productive agricultural farmland through extensification of grazing and *montado* protection, for which farmers receive financial compensation. Limitations on cattle density have been argued by farmers to pose a serious constraint on farm productivity and profitability. They furthermore consider the financial compensation in the existing ITI too low compared to the revenue losses resulting from these limitations. The experiment is therefore designed to test the impact of different contract conditions, including financial compensation levels, to increase the uptake of GEMR, and provide relevant information for the design of new contracts.

In the next sections we first present the choice experiment design and the adopted choice model (Section 2), followed by a description of the case study area and survey data collection strategy in Section 3. We then present the results of our study in Section 4 and discuss their relevance for the design of effective AES in Section 5.

2. Methodology

2.1. The Choice Experiment

Choice experiments are increasingly applied to explore the conditions that enhance farmers' motivations to enroll in AES and elicit stakeholders' preferences for biodiversity conservation (e.g. Broch and Vedel, 2012; Rogers et al., 2013; Lienhoop and Brouwer, 2015). A small-scale farm household survey preceded the main survey to identify the reasons for the current low uptake of ITI-AEM related to *montado* conservation in the study area, while interviews with representatives from the Institute for Nature Conservation and Forests (ICNF) and other local experts in *montado* ecosystem management were used to identify the relevant contract attributes and corresponding levels to be considered in the choice experiment. The contract characteristics include:

- Area size: the share (%) of the eligible area of the property under contract;
- Cattle density: the number of livestock units allowed per hectare of forage area on the farm;
- Tree density: the number of cork and holm oak trees per hectare on the contracted land by the end of the contract period;
- Contract duration: the lifetime of the contract (years), corresponding to the period during which the farmer must comply with the contract terms and conditions;
- Compensation: the compensation in euros per hectare per year to manage and maintain the land according to the contract specification over the contract lifetime.

The contract features and their levels are summarized in Table 1.

Table 1
Features and levels of the contractual agreements in the choice experiment.

	Attributes	Units	Levels		
1	Area size	% of eligible farm land area	25	50	75
2	Cattle density	Livestock units per ha of forage area	0.2	0.5	0.7
3	Tree density	Number of trees per ha	20	30	40
4	Contract duration	Years	5	10	20
5	Compensation	€/ha/year	100	250	450

The financial compensation to manage the land according to the contract terms and conditions over the contract life-time has a minimum of 100 and a maximum of 450 euros per ha per year, aiming to cover income losses due the application of the nature conservation measures. Compensation levels are based on prior estimations of the range of opportunity costs for the different land use types in the case study area, obtained with the support of local farmer associations.

Combining the five contract features and their levels results in 243 (3^5) possible combinations making up the contractual designs. Showing all these possible combinations to farmers results in a too high cognitive burden. For this reason the number of combinations is reduced to 64, divided across 8 sets of 8 choice tasks each, based on a D-efficient main effects statistical design generation procedure in the software Sawtooth. A balanced overlap method was used to generate the design to approximate orthogonality conditions.

Each surveyed farmer was randomly shown one of these 8 sets and answered 8 choice cards. Each choice card depicts two alternatives describing two different contractual agreements along with the option to choose none of the two. The latter 'opt-out' alternative, as it was explained to farmers, implies choosing not to enter into any of the two presented contractual agreements. On the card it was shown that the pay-out of this baseline alternative is zero. Farmers who systematically choose this 'opt-out' are asked in a follow-up question for their underlying reasons. In order to make sure farmers have a clear understanding of the choice task, they were first asked to make their choice using an instruction card, allowing them to ask questions about the task before the experiment started. An example of a choice card is presented in Fig. 1. Each choice card was printed on a separate sheet of paper, laminated, and bound together with other choice cards into a spiral binder for multiple use. Interviewers were trained to deliver the same standard introduction and explanation of the choice tasks to the survey participants.

2.2. Econometric Model

The choice model that informs this study has its roots in random utility theory (e.g. Ben-Akiva and Lerman, 1985) and Lancaster's attribute based utility theory (Lancaster, 1991). The random utility approach describes the utility of respondent i's choice for alternative j U_{ij} as consisting of an observable component V_{ij} and an unobservable error component ε_{ij} (Eq. (1)). V_{ij} is usually specified as a linear function, additive in utility, where X is a vector of k attributes associated with alternative j (in this case the terms and conditions of the contract design) and β is the corresponding coefficient vector.

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta X_{ij} + \varepsilon_{ij}. \quad (1)$$

The standard choice model is the multinomial logit (MNL) model (McFadden, 1974), which assumes that the random component of the utility of the alternatives is independently and identically (Gumbel) distributed (*i.i.d.*) with a type I extreme value distribution. In the MNL model, the preferences for attributes of different alternatives are assumed to be homogeneous across individuals. This assumption leads to a closed-form mathematical model that enables estimation through maximum likelihood (ML) procedures (e.g. Greene, 2003).

Over the past decades alternative modeling approaches have been developed relaxing this assumption, such as mixed logit models, including random parameter logit (RPL) models. Mixed logit models account for respondent differences and repeated choices (Train, 2003). In order to account for preference heterogeneity, a vector of random coefficients of the attributes X_k for individual i can be included in Eq. (1) representing individual preference variation (Eq. (2)). The utility coefficients β vary according to individual i (hence β_i) with density function $f(\beta)$. This density can be a function of any set of parameters, and represents in this case the mean and covariance of β in the sample population. By enabling coefficients to vary randomly, the model is able to

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