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Farmers' willingness to provide ecosystem services and effects of their spatial distribution

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ABSTRACT

The supply of ecosystem goods and services is spatially heterogeneous and the provision of such goods and services is also influenced by landowners' willingness to provide. This is particularly the case in countries such as Denmark where many properties are privately owned. However, little attention has previously been given to the relationship between farmers' willingness to provide a good or service and the spatial heterogeneity associated with their demand. In this study farmers' willingness to participate in afforestation contracts are investigated using a choice experiment of various contracts with the purpose to provide: groundwater protection, biodiversity conservation or recreation. We employ a random parameter logit model to analyse the relationship between farmers' preferences for afforestation purposes and the spatial variables; groundwater interests, species richness, human population density, forest cover and hunting. The results show that increasing human population density significantly increases farmers' required compensation with respect to recreational activities. Furthermore, there is a significant effect of hunting which decreases compensation required by the farmers to enter an afforestation project. The share of groundwater and forest cover does not significantly influence preferences. We conclude that spatial variations should be considered when designing conservation policies

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1. Introduction

In a horizon scanning exercise of priority areas for conservation and ecological research, Sutherland et al. (2009) argue that future intensification of agriculture as a result of climate change and increased wealth and population will be a major conservation challenge. Thus the conservation of biodiversity and the provision of ecosystem services will be embedded in an increasingly complex social, economic, and institutional context (Balmford and Cowling, 2006; Pannell et al., 2006) and the consideration of the human and social factors that drive conservation success will require greater attention (Dutton et al., 2008; Pannell et al., 2006; Tenge et al., 2004).

Conservation opportunities and the probability of success of conservation investments are influenced by numerous socio-political factors, including political stability and corruption; budget continuity; governance; and stakeholder willingness to be involved in conservation initiatives (Barrett et al., 2001; Knight and Cowling, 2007; Noss et al., 2002; Smith et al., 2003). In this paper we focus on the latter as there are documented incidences of the implementation of conservation initiatives being constrained by inadequate consideration of the needs and desires of landholders (Hiedanpaa, 2002). In addition, a large proportion of agricultural and forested land is privately-owned, further emphasising the need for analysing the drivers of landholder participation in conservation initiatives. In particular an improved understanding of the relationships between farmer preferences and the spatial distribution of environmental services may provide insights into 'where' conservation initiatives can effectively be implemented.

Previous studies on farmer participation in voluntary agri-environmental schemes (Morris and Potter, 1995; Polman and Slangen, 2008; Vanslembrouck et al., 2002; Wilson, 1997; Wilson and Hart, 2000) have analysed farmers' contingent behaviour by applying survey data and qualitative interviews. In such studies decision-maker characteristics (e.g. farm production and size, environmental attitude, age, education, experience) are found to be important drivers of farmer participation and their motivation to provide ecosystem services. Much less attention has been given to how preferences are influenced by spatial variation in the supply of ecosystem goods and services (Brouwer et al., 2010) and the potential implications of this for the design of conservation contracts.

Since environmental non-market goods and services are themselves spatially arranged, it is hypothesised that respondents' compensation needs (especially in the case of use values) will reflect the presence of the good or service in the particular spatial context (Campbell et al., 2008, 2009). Values are often assumed to decrease by distance (Bateman et al., 2006; Cuncu, 2009; Hanley et al., 2003).

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Johnston and Duke (2009) found that the willingness to pay depends on the size and scale of jurisdictions. Barton and Bergland (2010) used a choice experiment (CE) to evaluate a hypothetical irrigation water pricing regime and found that farmers' willingness to pay for water irrigation related to water availability on the farm. Johnston et al. (2002) found the spatial distribution of attributes to greatly influence their values, even when the spatial pattern is not communicated. These studies prove that incorporating spatial aspects in environmental valuation may explain variation in preferences and may improve the usefulness of data for benefit transfer.

The objective of this study is to investigate the relationship between geographical data on the potential supply of environmental goods and services and farmers' compensation needed for providing such goods and services. This will also add to the debate surrounding the extent to which conservation priorities coincide with conservation opportunities exemplified by farmers' willingness to become involved.

In order to investigate the relationship between supply and farmer preferences we have selected afforestation projects as a case study. Since the late 1980s, a range of European Union and Member State policies have been designed to increase the area of woodland across Europe. The Danish Parliament approved a national afforestation programme in 1989 and since 1991 it has been possible for farmers to apply for afforestation grants within this programme. The afforestation programme is not restricted to native species, but can also cover exotics. More than 90% of Danish farms are private and each owned by a single owner, 8% are owned by a private company, and 2% by the municipality or the Danish Government (Danish Statistics, 2009a; Landbrugsraadet, 2008).

This case study investigates the hypothesis that farmers' preferences for attributes of afforestation contracts affect the size of compensation they would need to participate in the scheme. Moreover we assume that the preferences depend on the spatial distribution of the goods and services associated with the attributes. CE is used to elicit farmers' preferences for improving conditions for biodiversity, recreation and groundwater through afforestation. We explicitly test for the spatial link between farmer preferences elicited in the CE with spatial data on attributes we believe could influence these choices, including species richness, the proportion of the area with special groundwater interests, hunting, forest cover and the potential recreational use of the area exemplified by human population density. Compared to the CE literature on spatial aspects, we thus focus on the abundance or presence/absence of spatially distributed attributes (e.g., Campbell et al., 2008) rather than the distance itself (e.g., Bateman et al., 2006; Hanley et al., 2003). As we are looking at attributes on privately owned land it would make little sense to include distance per se. In addition to combining spatial attributes with CE data on farmer preferences we discuss the potential implications of the results for increasing farmer participation and to potentially design and inform more effective conservation contracts and policies. We will start by describing in more detail the spatial aspects that will be considered in this case study and why they were chosen.

1.1. Motivation for Expected Spatial Interactions

The over-arching goals of afforestation projects as described by The Danish Ministry of the Environment (2002) are to protect groundwater resources, to secure urban recreation needs and to support and enhance biodiversity. In the following we investigate potential expected relations (hypotheses) regarding farmers' attitudes towards the purposes (i.e. groundwater protection, biodiversity protection, or recreational opportunities) of an afforestation project. The expected relations are based on existing literature on such relationships and policy relevant interactions that seem reasonable. Finally they are limited by available indicator data.

From a policy perspective it is relevant to know whether the spatial distributions of attributes such as biodiversity richness, groundwater availability and recreational opportunities are spatially correlated with farmer's willingness to provide such public goods. If farmers' willingness to accept (WTA) a contract is linked to the actual level of these attributes in a given area, this could potentially be relevant for the framing and design of afforestation contracts and related nature restoration projects. Previous research (Wilson and Hart, 2000) has shown that although financial rewards are an important reason for farmers to participate in nature restoration, there is a recent tendency for farmers to express more conservation-oriented motivations (Lokhorst et al., 2011). Such pro-environmental behaviour could be guided by personal norms and self-identity and to do the ‘right thing’ (Fielding et al., 2008). The question is whether the farmers' willingness to undertake pro-environmental behaviour is linked to environmental attributes of the landscape. This could be the case if lower WTA for afforestation projects correlate with the abundance or presence of the attributes (in this case study biodiversity, areas with high groundwater interest or recreational opportunities). For example, Campbell et al. (2009) find a decline in willingness to pay for preservation of ‘mountain land’, ‘stonewalls’, ‘farm tidiness’, and ‘cultural heritage’ from the rural west of Ireland (where such features are generally present) to the urbanised and modern farm landscapes of the east (where they are generally absent). Recognising that Campbell et al. studied the demand for landscape attributes, and this case study is concerned with the suppliers of landscape attributes, i.e. the farmers, we assume that farmers are driven by the same belief and norm values as the general public.

Based on this we expect that farmers' private utility of providing public goods increases with availability of environmental attributes in the local landscape. We expect that farmers' WTA for afforestation projects with the main aim of biodiversity protection increases with increasing species richness in the landscape. Similar we expect the farmers' private utility of establishing afforestation areas with the main aim of groundwater protection or increasing recreational opportunities to increase with the share of areas with special groundwater interests or human population density, respectively. Furthermore, we expect that farmers living in areas with high population density may be more aware of the importance of groundwater protection and of a secure drinking water supply than farmers living in more rural and less human populated areas.

However, other studies indicate that the direction of such spatial relationships could be influenced by other factors. Church and Ravenscroft (2008) suggest that woodland owners' sense of ownership and perceived property rights are central in determining their decisions regarding recreation and public access. Allowing or denying access is connected to a strong sense of ownership, identity with the land and need for control and personal use (Boon et al., 2004; Slee, 2006; Urquhart et al., 2010). Public access is allowed on afforestated land and increased public recreational opportunities on the farm may decrease a farmer's utility (Church and Ravenscroft, 2008). We expect that such sensitivity would increase with increasing human population density in the local landscape. Conflicts between recreational users are usually more frequent in densely populated areas (Manning and Valliere, 2001). From a policy perspective such patterns are also interesting since afforestation near urban areas are likely to have a higher recreational value. We thus assume that the expected relationship between farmers' WTA for afforestation projects with the main aim of increasing recreational opportunities and population density could be either positively or negatively correlated.

Broch and Vedel (2011) showed in a study based on the same data as this one, that farmers owning forest land are more motivated towards afforestation projects. One reason could be that such farmers are more familiar with forestry and the potential benefits of forest use and non-use. Farmers living in areas with high forest cover may be more likely to accept an afforestation contract compared to farmers living in areas with low forest cover. On the other hand, they may also see a smaller need for establishing more forest in that area. We assume that the dominante relationship between WTA for afforestation projects in general and forest cover is negatively correlated.

Many farmers attach importance to the forest as a place for personal use and hunting (Boon et al., 2004). Lundhede et al. (2009) showed that the hunting value of farm land increases when forests are present on the land. One important reason could be the increase in habitat and game diversity (Munn et al., 2011) including the presence of high value hunting game such as roe deer and red deer. Therefore, we expect that WTA are likely to be smaller in areas with higher game populations as farmers can earn more from selling hunting licences in these areas.

Agricultural land near cities and in more densely populated areas usually has higher land development possibilities and higher land prices (Plantinga et al., 2002). Afforestation can however reduce land development opportunities, and therefore farmers may be more cautious about afforestating their land. It is likely that opportunities and WTA to decrease with increasing human population density (Plantinga et al., 2002).

2. Methods and Materials

2.1. The Choice Experiment and Statistical Model

In this study we use the stated preference technique CE to elicit farmer preferences. CE, is useful in facilitating an analysis of tradeoffs and interactions among attributes at various levels. In this study CE is applied to simulate a real life situation where farmers choose whether or not to join a voluntary agri-environmental contract for afforestation. For a general description of CE, see Louviere et al. (2000). In the following the methodological approach is described briefly. The CE method is based on Lancaster's theory which assumes that the utility from a good comes from the value of the attributes of the good (Lancaster, 1966). It is also based on the random utility theory according to which observation of utility can only be made imperfectly, so the utility from a good consists of deterministic and stochastic elements (McFadden, 1973).

Thus an individual i, will choose an alternative k from a specific choice set, n, given the utility, U, of k is greater than the utility of any other choice j *in the choice set*:

$$U_{kn} > U_{jn} \Rightarrow V_{kn} + \varepsilon_{kn} > V_{jn} + \varepsilon_{jn} \forall j \neq \mathrm{k}; \mathrm{k}, j \in J \quad (1)$$

V is the deterministic part of the utility, depending on the alternatives' attributes x_k, income, and the individual's characteristics. Income and other individual characteristics are not analysed further here and are thus omitted from the analysis. We assume that U is linear in its arguments and that ε_{in} is IID extreme value distributed. We apply the random parameter logit (RPL) model (mixed logit) with panel specification which takes into account heterogeneity in the population of the parameter values (Train, 1998). We also use a panel specification so that the model utilizes the information from each respondent by making taste (response) parameters constant over choices within individuals but not between individuals. Thus the probability of individual i choosing alternative k in choice set n over a set of alternatives J becomes:

$$\Pr(kin) = \int \left(\prod_{n=1}^{N} \left[\frac{\exp\left(\beta'_i x_{kin}\right)}{\sum_j^J \exp\left(\beta'_i x_{jin}\right)} \right] \right) f(\beta) d\beta \quad (3)$$

Where $f(\beta)$ is the distribution function for β, with mean b and covariance W (Train, 2003). Finally we include an error component, σ, related to choosing one of the two non-status quo choices instead of the status-quo. This error component reflects that there may be additional variance related to the two non-status quo alternatives, because it is cognitively more demanding for respondents to evaluate two complex alternatives in each choice set as opposed to the status quo (Ferrini and Scarpa, 2007; Greene and Hensher, 2007; Scarpa et al., 2007, 2008).

2.2. Design of the Choice Experiment

The choice experiment had four attributes as described in Table 1. The purpose of afforestation was included as an attribute in the CE where farmers were asked to choose between afforestation contracts with different purposes. Thus the purpose of the contract was the first attribute and we assumed only one purpose. Afforestation projects where the main purpose is groundwater protection involve minimal ground preparation and no pesticides/herbicides can be used. The recreational purpose implies that there has to be established paths and parking areas. Where the main purpose is biodiversity the afforested area mainly consists of broadleaved trees. In addition to the purpose of the contract, the contracts where described by three other attributes; level of monitoring, option of cancelling and the amount of compensation. In this paper we focus on the purpose of the contract and the amount of compensation. For details of the other attributes, see Broch and Vedel (2011).

The CE applied a fractional factorial design consisting of 36 choice sets separated into six blocks. The design was optimised in order to minimise the d-error for a multinomial model with main effects for the two alternatives. Each attribute was coded on a continuous scale from 1 to 3 and from 1 to 6 for the price. Priors were assumed to be equal to zero. The resulting design had an *ex ante* d-error of 0.04, whereas its d-error is 0.0008 *ex-post* when evaluated as a conditional logit model but with actual attribute levels. When evaluated for the final model (Table 4) the *ex-post* d-error was 0.00133. See Scarpa and Rose (2008) for a discussion of these efficiency measures. Each

Table 1
Description of choice experiment attributes.

Attribute	Description	Levels and name of variable
Purpose of the afforestation	Groundwater protection implies that the ground preparation is minimal and no pesticides/herbicides can be used	Groundwater *(reference)*
	Recreation implies that there has to be established paths and parking areas.	Recreation
	Biodiversity implies that the afforested area mainly consists of broadleaved trees.	Biodiversity
Option of cancelling the contract	The contract is either binding or may be cancelled within 5 or 10 years. If the contract is cancelled, the compensation has to be paid back to the state (with a specified interest rate) and the farmer is then free to return the area to arable land.	Cancellation within 5 years Cancellation within 10 years
	A binding contract means that the area will be forest reserve.	Binding contract *(reference)*
Monitoring (visit) by authorities	A fraction of the farmers who accept an afforestation contract will receive a visit by the authorities in order to check that the area has been afforested.	1% will be checked 10% will be checked 25% will be checked *(0% is reference)*
Compensation	The compensation is the amount of Euro the farmer receives as a one-time compensation per hectare.	€ 3600–5600 per ha (in steps of € 400) *(€ 0 is the reference)*

respondent was randomly assigned to one of six blocks and they each completed six choice sets (see e.g. Bech et al., 2011 and Caussade et al., 2005 for a discussion of numbers of choice sets). A choice set consisted of two alternative afforestation contracts and an option to decline both contracts (i.e. to choose the *status quo*). Prior to the CE the respondents were informed about the attributes and the levels of each, with the exception of the possible compensation levels as this may have resulted in the respondents choosing only the highest offer. A brief scenario description presented before each choice set aimed to create a common frame for making the choice. It described a situation where 1 ha of land had a current contribution margin of €130–170 and expected cost of afforestation at €4000. Respondents were told that additional costs related to establishing forest for the different purposes of the contract were covered. An example of a choice set is included in Appendix A.

2.3. Data on Farmer Preferences

Data on farmers' preferences for afforestation schemes were collected from an online, e-mail distributed questionnaire. The questionnaire was distributed among Danish farmers in January to February 2009. Before the final distribution, the questionnaire was discussed with experts (consultants, researchers etc. within the agricultural field) and a focus group consisting of farmers. Furthermore, a pilot test of 61 farmers was conducted.

Eighteen out of 46 local Danish Agriculture associations agreed to send the questionnaire to their members as a link in an e-mail. Possible concerns regarding the questionnaire e.g. that answers would be kept confidential were addressed in the e-mail. Furthermore, a prize of three prizes of €135 was offered to encourage farmers to respond. The questionnaire was distributed to 3609 e-mail addresses and of these 1027 farmers answered the questionnaire. This gave a response rate of 29%. Of these 174 were excluded, either for not having answered any of the choice sets (146), for answering status quo in the first choice and nothing else in the rest (25), or for stating that they did not consider and/or understand the six questions (3). The final sample used for analysis in this paper consisted of 842 farmers as only 853 had answered the CE satisfactorily and 11 of these added their postal codes incorrectly. A total of 4988 choice sets were included as not all farmers answered six choice sets. The sample was compared with population data using age, farm size, and geographical location of the farm. Other socio-economic or demographic data were not available. With respect to age there was no significant difference between the sample and the population of Danish farmers (χ^2 test, p = 0.33). There is a significant difference between the sample and population concerning farm size (χ^2 test, p = 0.000). Larger farms were slightly overrepresented as compared to smaller farms. We also found that the representativeness of farmers in Northern Jutland and Southern Jutland were lower and higher, respectively, in the sample compared to the population (χ^2 test, p = 0.000).

The questionnaire included the CE, in addition to questions about characteristics of the farmer and the property, objective for ownership, and attitude towards and experience with agri-environmental schemes and afforestation. Furthermore, the questionnaire investigated farmers' considerations of private and public utility derived from the three environmental goods; biodiversity, groundwater and recreation.

2.4. Spatial Data

We applied spatial data to test a number of stated hypotheses on farmer's need for compensation and spatial characteristics of the landscape within the postal code where each respondent has his farm.

The five chosen spatial variables are presented in Table 2. Since every farmer reported their postal codes, we used this as the spatial resolution. As some farmers have a property belonging to more than one postal code, all the farmers were assigned to the first postal code they reported. Postal codes from the centre of Copenhagen were excluded from the analysis as no respondents were from this area. The postal codes vary in size from 2.4 to 460 km^2, the smaller ones mainly in larger cities and the bigger ones in more remote areas. The average size is 73 km^2. The respondents belonged to 221 of the 594 postal codes or 47% of the land area of Denmark.

2.4.1. Species Richness Data

We used distributional data (presence or absence) for various species groups in Denmark and geographically related this data to each of the 594 postal codes (Fig. 1a). The data set constituted a further development of an existing data set that has already been used for quantitative biodiversity analyses in Denmark (Lund, 2002). (For more detailed information on the data and collection procedures see Larsen et al. (2008)). Because the data were originally compiled for 10 × 10-km Universal Transverse Mercator (UTM) quadrates (= 100 km^2, n = 622), the species richness from each grid cell was assigned to the postal code that occupies the greatest proportion of that grid cell using ARCGIS. It is assumed that species in a grid cell overlapping several postal code areas can only belong to one postal code area and not populate all of them at the same time. This simplification was implemented to avoid sampling bias and overestimating the number of species occurring within the postal code areas. The specific geographic location of species within each quadrate is unknown. Therefore the likelihood of species occurring in a specific area increases with the included area share of each quadrate. Choosing the quadrate with the highest area share should hopefully also result in a conservative but likely species richness index in the postal code area. The dataset included 1008 species: reptiles, amphibians, birds, mammals, insects and flora. We included only species that breed in Denmark, and excluded vagrant, casual, and exotic species

Table 2
Overview of spatial variables.

Variable (description)	Analysis performed to create variable	Unit	Source
Species richness (Biodiversity data on presence/absence of 1008 species)	Species richness data from each 10 × 10 km grid cell was assigned to the postal code that occupies the greatest proportion of that grid cell.	Number of species	Larsen et al. (2008)
Human population density (Human population density)	Point data on population was aggregated to postal code level and density calculated.	People/km^2	Danish Statistics (2009b)
Groundwater interests (Share of area with special groundwater interests)	Data on land areas with groundwater interests was overlaid with data on postal code and share of groundwater interest calculated.	% special interests	Danish Ministry of Environment and Energy (2000)
Forest cover (Share of forest area)	Data on forest land was overlaid with data on postal code and share of forest cover calculated.	% forest cover	Danish Ministry of Environment and Energy (2000)
Hunting (Number of animals shot)	Hunting data at the municipality level was linked to GIS data on postal codes by assigning unique municipality names to postal codes.	Number of animals	Danish National Environmental Research Institute (2009)

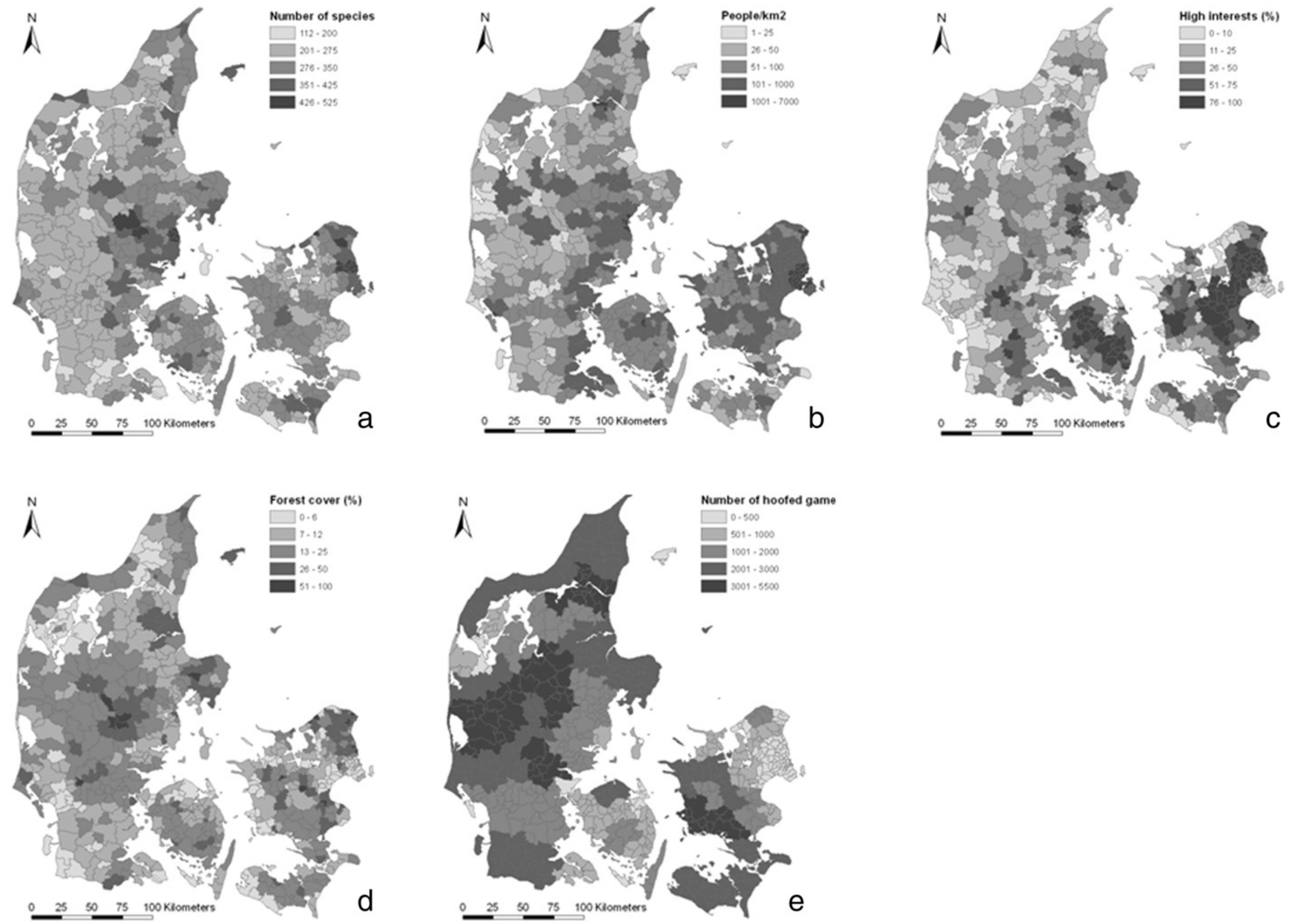

Fig. 1. Maps of the five spatial variables. a (upper left): Species richness. b (upper middle): Human population density. c (upper right): Groundwater interests. d (lower left): Forest cover. e (lower right): Hunting, hoofed game.

from the dataset to avoid bias toward those species. The data cited include the majority of Danish species within each taxonomic group.

2.4.2. Human Population Density Data

Models of the demand for forest recreation in Denmark has been developed for a smaller geographical area in Denmark (Zandersen et al., 2007a), but national wide data is missing. Instead we used national data on the human population size (Danish Statistics, 2009b) within each postal code as a proxy for the potential for public recreation demand. The number of people per km^2 was generated per postal code by aggregating point data on human population size for each postal code, and then dividing by the area of the postal code using ARCGIS (Fig. 1b). This variable was used as a proxy for recreational demand. Most visits to forests in Denmark take the form of everyday recreation. Some 80% of forest visitors spent less than 30 min travelling to the forest and the average travelling distance is 8.5 km from the visitor's home (Jensen and Koch, 2004). The distance is often assumed linear (see e.g. Zandersen et al., 2007b).

2.4.3. Groundwater Interests Data

Danish land areas holding groundwater resources have been classified into two categories: i) areas of importance, and ii) areas of special interest. The latter one is of particular interest since it has a high quality and provides important drinking water to households and the industry. For each postal code we calculated the share of the area designated as special interest for groundwater using ARCGIS (Danish Ministry of Environment and Energy, 2000) (Fig. 1c).

2.4.4. Forest Cover Data

We calculated the percentage of forest area per postal code using data on forest areas larger than 2500 m^2 and more than 10 m wide (Danish Ministry of Environment and Energy, 2000). The total forest area per postal code was calculated using ARCGIS and then divided by the area of the postal code in order calculate the percentage of forest cover (Fig. 1d).

2.4.5. Hunting Data

In the questionnaire the respondents could state their beliefs about each of the three purposes of the afforestation project. Analysing the data, some of the respondents stated that they would like to be involved in afforestation projects because they believed increasing the forest area would increase the possibilities of hunting game on their property. In order to create a variable for hunting, the number of animals shot in 2009 at a municipality level was obtained (Danish National Environmental Research Institute, 2009). Each postal code was assigned a unique municipality name according to that which overlaps the central point of the postal code. Four different aggregates of hunting data were added. These were; (1) hoofed game (red deer, fallow deer, sika deer, roe deer) (see Fig. 1e), (2) other mammals (fox, rabbit, hare), birds (partridges, pheasant, wood pigeon, woodcock) and (3) both hoofed game and other mammals combined. We would have liked to include data on the hunting activity at estate level, since an aggregate measure at municipality level is estimated as a mix of available animals and hunting intensity. Unfortunately such data is not available. This may produce lower end

Table 3
How attributes from the choice experiment (column 1) are combined with the spatial variables (column 2). Each row presents a cross-product and the expected sign related to the cross-product (column 3).

Choice experiment attribute interacting with the spatial variable	Spatial variables	Expected sign
Biodiversity	Species richness	+
Groundwater	Groundwater interest	+
Groundwater	Human population density	+
Recreation	Human population density	−/+
Recreation	Hunting	−
ASC	Forest cover	+
Compensation	Hunting	−
Compensation	Human population density	−

estimates in postal codes where a large share of the area is owned by the municipality or the Government as hunting activity is lower in these areas compared to privately owned land. However, most of the respondents belonged to postal codes with predominately privately owned land and thus was considered a minor problem.

2.5. Specification of Attributes and Interactions

Based on the expected relations described in Section 1.1, we investigated eight interaction effects, see Table 3. The expected signs are also presented.

For testing these hypotheses we run the RPL model with interaction effects between some of the attributes from the stated preferences of the farmers and the geographical distribution of species richness, groundwater interests, forest cover, hunting and human population density.

Biodiversity, groundwater and recreation are all dummy variables taking the value 1 if the contract is implying that specific purpose. The alternative specific constant (ASC) is a dummy variable taking the value 1 for the two contracts and 0 for no contract. Also the cancelling attribute was dummy coded (with two dummies), whereas the monitoring attribute was continuously coded. All main variables except the compensation were assumed to be normally distributed within the population. The compensation was kept constant, even though it implies that the marginal utility of money is fixed over the population. This however avoids a number of potentially severe problems associated with specifying a random price parameter for the following calculation of WTA (see e.g. Hensher et al., 2005; Train and Sonnier, 2005). We did run a model where it was log-normally distributed and found the standard deviation to be significant and that the resulting log-likelihood improved only slightly (to −3407). But it does not change the mean parameter estimates and thus had no impact on the conclusions.

The attributes from the CE were multiplied with the spatial variables in order to analyse interaction effects, see Table 3. Spatial variables were modelled as constants as the expected heterogeneity is captured by the main effect and the spatial effect.

3. Results

The five spatial variables were interacted with the main effects (biodiversity, groundwater, recreation, compensation level and the constant), according to the hypotheses, resulting in eight interaction effects, see Table 3. A model with all interaction effects found that only human population density interacts with recreation and hoofed game hunting interacts with compensation at the 20% significance level.[1] When tested one parameter at a time, these two spatial effects were also the only ones significant at the 10% level.

[1] The full model can be requested by sending an e-mail to the authors.

Table 4
RPL model of contract preferences combining choice experiment and spatial variables.

	Coefficient (s. e.)	P-value
Constant (ASC[a,b])	−4.600 (0.366)	0.0000
Recreation	−0.686 (0.180)	0.0001
–Std. deviation	1.938 (0.162)	0.0000
Biodiversity	0.285 (0.103)	0.0058
–Std. deviation	1.525 (0.133)	0.0000
Cancellation within 5 years	1.236 (0.093)	0.0000
–Std. deviation	0.542 (0.214)	0.0116
Cancellation within 10 years	1.244 (0.100)	0.0000
–Std. deviation	0.980 (0.150)	0.0000
Monitoring (per percentage)	−0.036 (0.004)	0.0000
–Std. deviation	0.051 (0.006)	0.0000
Compensation	0.908 (0.100)	0.0000
Recreation × Human population density	−0.002 (0.001)	0.0571
Compensation × Hunting (hoofed game)	0.0001 (0.00004)	0.0038
Sigma × 10	5.985 (0.359)	0.0000
No. of choices	4988	
Log likelihood/Restricted Log likelihood	−3421/−5480	
McFadden Pseudo-R^2	0.375	
Number of draws	2000	
No. of parameters/χ^2	15/4119	

[a] ASC is an alternative specific constant taking the value 1 if one of the scenarios is chosen and zero otherwise. ASC is a project for groundwater purposes, with no monitoring and no cancellation option.

The estimates of the resulting model are presented in Table 4. It shows that all main variables from the CE are significant at least at the 1% level (Table 4). The variables for cancelling the contract and for monitoring have the expected relationships and are discussed in more detail in Broch and Vedel (2011). The interaction between recreation and human population density is negative and significant at the 6% level, and the interaction between hunting and compensation is positive and significant at the 1% level.

The explanatory power of the model was high with an estimated McFadden Pseudo-$R^2 = 0.38$ (cf. Hensher et al., 2005). The standard deviations in Table 4 show that there is heterogeneity among respondents around the main effect of biodiversity and recreation and for some of the respondents the parameter estimates are likely to change signs.

Table 5 shows the calculated marginal rate of substitution (MRS) based on parameter estimates from Table 4. Groundwater is chosen as the purpose for comparison (so the parameter for ASC can be interpreted as a contract with groundwater as the purpose). Compared to this recreational purposes increases compensation (approx. €1000), whereas biodiversity purposes decrease compensation (approx. €400). These results indicate that the preferences of the farmers are sensitive to the type of purpose and service delivered by the afforestation project. We aimed to identify any statistical pattern when comparing the preference for recreation, biodiversity and clean groundwater with human population density, species richness and the share of areas with groundwater interests, respectively. Interestingly, we find a significant and

Table 5
Marginal rate of substitution[a] (Euro[b]) when no hunting.

	MRS (s.e.)	P-value
Constant (ASC[c])	6810 (673)	0.000
Recreation	1016 (286)	0.000
Biodiversity	−423 (160)	0.084
Cancellation within 5 years	−1830 (221)	0.000
Cancellation within 10 years	−1842 (235)	0.000
Monitoring	53 (8)	0.000
Human population density × recreation (per person)	4 (2)	0.059

[a] Estimated by the Delta method Simulations are based on 1000 Halton draws.
[b] DKK are converted to Euro using €1 equals DKK 7.44.
[c] All other values should be added or subtracted from the ASC value, corresponding to the purpose being groundwater preservation.

positive dependency between the level of compensation needed for recreational afforestation projects and the human population density at the postal code level. It is estimated that the farmer would require an additional €4 compensation if the population per square kilometre increased by one person (Table 5).

There is a significant spatial relationship between the compensation level and the number of hoofed animals shot in the municipality. Hunting opportunities decreased the required compensation level.

The compensation per hectare stated by the farmers was estimated by adding or subtracting the MRS values depending on the purpose of the contract and the spatial characteristics of postal code where the farm is located. For example, if a recreational project is to take place in an area with a population density of 100 people/km^2, then the total compensation cost will be the general price of contracting (ASC = approx. €6800) plus the extra cost of recreational projects (recreation = approx. €1000) plus the cost of human population density interacted with recreation (human population density: €4/person/km$^2 *$ 100 people/km^2 = €400) giving a total compensation cost of approx. €8200. This is under the assumption of no hunted animals. An increase in the amount of hunted animals will reduce the required compensation.

4. Discussion

This study investigated how spatial variation of potential supply and demand for environmental goods may relate to farmers' willingness to supply these goods and services. CE data on farmer preferences are combined with spatial data on selected goods and services. Analysing the congruence between the spatial variation of farmer preferences and the supply of or demand for environmental goods and services is of general interest as it adds to the discussion of to what extent it should be expected that conservation priority coincide with conservation opportunity. Furthermore, combining preferences and spatial variation is interesting in relation to environmental valuation as it provides insight into attributes which may influence farmers' perceptions and preferences for the provision of private or public goods.

4.1. Linking Farmer Preferences with Spatial Characteristics

The study shows that spatial variables, which are 'external' to the questionnaire, may be linked with farmer preferences. The RPL model shows that of the eight interaction effects, the interaction between human population density and recreation had a significantly negative effect on the preference for recreational purposes ($p = 0.057$), and a greater number of hunted animals had a positive effect on the compensation level required for entering a contract ($p < 0.01$). The other spatial variables, namely forest cover × ASC, species richness × biodiversity, groundwater interests × groundwater, human population density × groundwater, hunting × hunting and compensation × human population density seem to not exhibit a significant relationship with the contract attributes.

The RPL model shows that if recreation is the aim of afforestation then the amount of required compensation compared to biodiversity and groundwater protection is greater. Furthermore, the results from the model support that the compensation needed for recreation purpose increases by increasing human population density in the area of the afforestation project, and this is not attributed to the opportunity cost of land being higher in more densely populated areas (compensation × human population density is insignificant). Interestingly nor is it only linked to any potential effects on the hunting quality as the hunting interacted with recreation was not significant. This finding may indicate that farmers experience a disutility from providing recreational opportunities and that they are sensitive also to the quantity of potential recreational activity measured by the proxy population density. This may be one reason why farmers would hesitate to provide public goods which may induce a cost on themselves. Previous studies confirm that private farmers may experience problems related to public recreational access, e.g. illegal vehicular access, visitors accessing prohibited areas, litter and vandalism (Church and Ravenscroft, 2008). Similarly, the questionnaire includes statements like: "visitors are very disturbing for the wildlife", "people do not show respect. I have to walk around and collect litter…" and "we do not want lots of visitors. It results in too much disturbance, litter, loose dogs and lack of respect for private property rights" which support experiences of disutility from recreation. All these problems are likely to increase as more people use the area and the increased disutility could explain the higher compensation requirements. This could be overcome by authorities regulating the negative impacts of recreation on private land (e.g. paying for garbage bins and cleaning or providing information to visitors about behavioural rules). Urquhart et al. (2010) found in a qualitative study conducted in the UK that many farmers are reluctant to allow increased public access due to concerns about health of the woodland and wildlife. This pattern may depend on the history of public access and farmers' dependency on recreational business. Buckley et al. (2009) found that increased contact with walkers in more remote areas increased the likelihood of owners providing access for free whereas owners in regions with high tourism were more likely to require compensation. In this study it is less likely that higher compensation requirements are caused by farmers' perception of recreation as a way to earn money from tourism because there is no tradition of access fees in Denmark.

The interaction between the amount of compensation and the number of hoofed animals hunted in the area was significant and positive ($p = 0.01$). The result indicates that increased hunting opportunities decrease the required compensation for afforestation per se. This indicates that owners living in areas with more hunting are more likely to join an afforestation scheme at a given compensation.[2] Urquhart et al. (2010) also found that a majority of forest owners have conservation, wildlife conservation or recreational shooting as part of their main motivations for forest management. Furthermore, they found that concerns for wildlife are one of the main reasons for being reluctant to provide public access to their land, a reason also used by some respondents in this study.

There may be several explanations as to why the three spatial variables; forest cover, species richness and groundwater interests were insignificant. First, the spatial variables may not be a part of the farmers preference function. Qualitative statements revealed as part of the questionnaire as open ended questions with respect to attitudes towards groundwater protection show a diversity of responses in relation to the importance of groundwater protection. Some respondents state that it is important whereas others state e.g. that "ordinary agricultural production is equally good for groundwater protection as forests" indicating a neutral or negative perception of the groundwater purpose.

Second, even if the variables were topically relevant there still needs to be a causal link between the spatial proxies used to exemplify groundwater and biodiversity and how the farmers value groundwater and biodiversity. Farmers' perceptions of biodiversity may not relate to species richness but rather to landscape characteristics or specific species. Farmers may lack knowledge of the importance of their land for groundwater protection even if they are located in an area of high protection interest. Unless farmers have been directly informed, such values are not visible. Qualitative interviews or group discussions could reveal whether this is the case.

Third, spatial variables and farmer preferences are linked based on postal code. This kind of aggregation over a larger area unit may simplify data collection but hide important patterns within a postal code. It is interesting to see that there are significant patterns for both

[2] Notice that as we do not have data on hunting at property level, we only conclude on a basis of hunting activity in a larger area.

hunting and recreation as these are both variables which are likely to be generally high or low across an entire postal code. The three other variables are more likely to vary within a postal code. In order to analyse farmer behaviour and such landscape characteristics higher resolution data at a parcel level is required (Grout et al., 2011).

Fourth, the preferences and values for these spatially distributed variables may depend on both supply and demand; a farmer may not want more forest in an area that is already forested; hunting interests may be high if wildlife populations are high due to little hunting activity in neighbouring areas or if demand is very high. In order to investigate such issues further, more complete measures of both supply and demand would be needed.

Linking spatial attributes with stated preferences is rarely done in the environmental literature. In a recent study Brouwer et al. (2010) use a CE to assess the preference heterogeneity related to the spatial distribution of water quality improvements throughout a river basin. Changes in water quality throughout the river basin were visualized with maps and modelled simultaneously in relation to where respondents live allowing for the effect of preferences for local and more regional water quality improvements to be revealed. In this way the location is endogenous and implicitly accounted for in the questionnaire and experimental design. We suggest a model where the preferences and spatial attributes are linked explicitly. Of course there could be a self-selection bias—farmers choose where to live depending on their preferences. But we would expect this issue to be of minor importance given that a possibility of afforestation is only a minor attribute of a farm. The advantages of the approach used in this study is that we use the spatial perception that is inherent in the respondents' understanding of the attributes and not other attributes which could be included if the spatial aspect was included directly, cf. also discussion in Johnston et al. (2002). It is interesting that we find a pattern even though we combine data collected without any relation between the spatial data and preference data. This indicates that human population density and hunting is something that matters to farmers even though we do not mention the spatial variability in the CE.

Together these results indicate that farmers may be reluctant to deliver services which are exclusively a public good or have a negative impact on their private welfare (e.g., public access and recreational opportunities) and rather prefer project purposes which are composed of attributes contributing not only to public welfare but also their private welfare (e.g., wildlife protection and hunting opportunities). Ignoring these aspects when designing incentives may result in reduced participation and cost-effectiveness. This suggests that the efficiency of incentives related to enhancing public benefits (e.g. public access) may increase if they simultaneously offer private benefits to the farmer (Church and Ravenscroft, 2008).

5. Concluding Remarks

This study has analysed the relationship between geographical data on farmers' willingness to provide ecosystem services (measured by WTA) and spatial data on such services. We combined attributes from a CE for afforestation contracts with data on the spatial distribution of groundwater interests, species richness, human population density, forest cover and hunting. We find that increasing population density significantly increases farmers' required compensation with respect to recreational afforestation activities. There is a significant and negative spatial relation between the amount of hoofed game hunted and farmers' required compensation level. We find no spatial effects with respect to groundwater interests, species richness or forest cover. Spatial variations should be taken into account when designing conservation policies, either by targeting specific groups of farmers or focusing the schemes in different areas on specific purposes and thereby facilitating the design of more efficient afforestation schemes.

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Appendix A. Example of a choice set

Imagine that you have an area of 1 ha which gives an annual net income of €135–270 and that you have a possibility of planting a forest on this area. It will cost you €4030 per ha in establishment cost, regardless the purpose. The compensation is a one time payment.

Choice 1 out of 6

Which contract would you choose?

(Mark one)

	Contract 1	Contract 2	
Purpose of afforestation	Groundwater	Recreation	
Possibility of cancelling the contract	Can be cancelled until year 10	Cannot be cancelled	
Visits by authorities[a]	10% are visited	25% are visited	
Compensation (Euro/ha)	4839	5645	
	Contract 1	Contract 2	I do not want any of the contracts
	❑	❑	❑

[a]In the choice sets send to the farmers monitoring is referred to as “visits by authorities”.

References

Balmford, A., Cowling, R.M., 2006. Fusion or failure? The future of conservation biology. Conservation Biology 20, 692–695.

Barrett, C.B., Brandon, K., Gibson, C., Gjertsen, H., 2001. Conserving tropical biodiversity amid weak institutions. Bioscience 51, 497–502.

Barton, D.N., Bergland, O., 2010. Valuing irrigation water using a choice experiment: an ‘individual status quo’ modelling of farm specific water scarcity. Environment and Development Economics 15, 321–340.

Bateman, I.J., Day, B.H., Georgiou, S., Lake, I., 2006. The aggregation of environmental benefit values: welfare measures, distance decay and total WTP. Ecological Economics 60, 450–460.

Bech, M., Kjaer, T., Lauridsen, J., 2011. Does the number of choice sets matter? Results from a web survey applying a discrete choice experiment. Health Economics 20, 273–286.

Boon, T.E., Meilby, H., Thorsen, B.J., 2004. An empirically based typology of private forest owners in Denmark: improving communication between authorities and owners. Scandinavian Journal of Forest Research 19 (S4), 45–55.

Broch, S.W., Vedel, S.E., 2011. Using choice experiments to investigate the policy relevance of heterogeneity in farmer agri-environmental contract preferences. Environmental and Resource Economics. DOI 10.1007/s10640-011-9512-8.

Brouwer, R., Martin-Ortega, J., Berbel, J., 2010. Spatial preference heterogeneity: a choice experiment. Land Economics 86, 552–568.

Buckley, C., Hynes, S., van Rensburg, T.M., Doherty, E., 2009. Walking in the Irish countryside: landowner preferences and attitudes to improved public access provision. Journal of Environmental Planning and Management 52, 1053–1070.

Campbell, D., Scarpa, R., Hutchinson, W., 2008. Assessing the spatial dependence of welfare estimates obtained from discrete choice experiments. Letters in Spatial and Resource Sciences 1, 117–126.

Campbell, D., Hutchinson, W., Scarpa, R., 2009. Using choice experiments to explore the spatial distribution of willingness to pay for rural landscape improvements. Environment and Planning A 41, 97–111.

Caussade, S., Ortúzar, J.de D., Rizzi, L., Hensher, D.A., 2005. Assessing the influence of design dimensions on stated choice experiment estimates. Transportation Research Part B 39, 621–640.

Church, A., Ravenscroft, N., 2008. Landowner responses to financial incentive schemes for recreational access to woodlands in South East England. Land Use Policy 25, 1–16.

Cuncu, G.B., 2009. Measuring environmental externality spillovers through choice modelling. Environment and Planning A 41, 199–212.

Danish Ministry of Environment and Energy, 2000. Area Information System—AIS. Danish National Environmental Research Institute, Ministry of Environment and Energy.

Danish Ministry of the Environment, 2002. Danish National Forest Programme. Danish Forest and Nature Agency, Ministry of the Environment. (83 pp.).

Danish National Environmental Research Institute, 2009. Jagt statistik 2009 ([Hunting Statistics 2009]).

Danish Statistics, 2009a. Danish Statistical Bank—Landowner information.

Danish Statistics, 2009b. Danish Statistical Bank—Population density.

Dutton, A., Edwards-Jones, G., Strachan, R., MacDonald, D.W., 2008. Ecological and social challenges to biodiversity conservation on farmland: reconnecting habitats on a landscape scale. Mammal Review 38, 205–219.

Ferrini, S., Scarpa, R., 2007. Designs with a priori information for nonmarket valuation with choice experiments: a Monte Carlo study. Journal of Environmental Economics and Management 53, 342–363.

Fielding, K.S., Terry, D.J., Masser, B.M., Hogg, M.A., 2008. Integrating social identity theory and the theory of planned behaviour to explain decisions to engage in nature conservation practices. British Journal of Social Psychology 47, 23–48.

Greene, W.H., Hensher, D.A., 2007. Heteroscedastic control for random coefficients and error components in mixed logit. Transportation Research Part E-Logistics and Transportation Review 43, 610–623.

Grout, C.A., Jaeger, W.K., Plantinga, A.J., 2011. Land-use regulations and property values in Portland, Oregon: a regression discontinuity design approach. Regional Science and Urban Economics 41 (29), 98–107.

Hanley, N., Schläpfer, F., Spurgeon, J., 2003. Aggregating the benefits of environmental improvements: distance-decay functions for use and non-use values. Journal of Environmental Management 68, 297–304.

Hensher, D.A., Jones, J.M., Greene, W.H., 2005. Applied choice analysis—a primer. Cambridge University Press, United Kingdom.

Hiedanpaa, J., 2002. European-wide conservation versus local well-being: the reception of the Natura 2000 Reserve Network in Karvia, SW-Finland. Landscape and Urban Planning 61, 113–123.

Jensen, F.S., Koch, N.E., 2004. Twenty-five years of forest recreation research in Denmark and its influence on forest policy. Scandinavian Journal of Forest Research 19 (Suppl. 4), 93–102.

Johnston, R.J., Duke, J.M., 2009. Willingness to pay for land preservation across states and jurisdictional scale: implications for benefit transfer. Land Economics 85 (2), 217–237.

Johnston, R.J., Swallow, S.K., Bauer, D.M., 2002. Spatial factors and stated preference values for public goods: considerations for rural land use. Land Economics 78, 481–500.

Knight, A.T., Cowling, R.M., 2007. Embracing opportunism in the selection of priority conservation areas. Conservation Biology 21, 1124–1126.

Lancaster, K.J., 1966. New approach to consumer theory. Journal of Political Economy 74, 132–157.

Landbrugsraadet, 2008. Landbruget i tal 2008 ([Danish agriculture in numbers]). Landbrugsraadet, Copenhagen, Denmark. (21 pp.).

Larsen, F.W., Petersen, A.H., Strange, N., Lund, M.P., Rahbek, C., 2008. A quantitative analysis of biodiversity and the recreational value of potential national parks in Denmark. Environmental Management 41, 685–695.

Lokhorst, A.M., Staats, H., van Dijk, J., van Dijk, E., de Snoo, G., 2011. What's in it for me? motivational differences between farmers' subsidised and non-subsidised conservation practices. Applied Psychology: An International Review 60, 337–353.

Louviere, J.J., Hensher, D.D., Swait, J.D., 2000. Stated choice methods. Analysis and applications. University of Cambridge, United Kingdom.

Lund, M.P., 2002. Performance of the species listed in the European Community "Habitats" Directive as indicators of species richness in Denmark. Environmental Science and Policy 5, 105–112.

Lundhede, T.H., Jacobsen, J.B., Thorsen, B.J., 2009. Hunting is more than shooting: a hedonic pricing model of the complex hunting experience. Paper presented at the 17th Annual conference of EAERE, Amsterdam, June 24–27, 2009 (30 pp.).

Manning, R.E., Valliere, W.A., 2001. Coping in outdoor recreation: causes and consequences of crowding and conflict among community residents. Journal of Leisure Research 33, 410–426.

McFadden, D., 1973. Conditional logit analysis of qualitative choice behaviour. In: Zarembka, P. (Ed.), Frontiers in Econometrics, pp. 105–142.

Morris, C., Potter, C., 1995. Recruiting the new conservationists—farmers adoption of agri-environmental schemes in the UK. Journal of Rural Studies 11, 51–63.

Munn, I., Hussain, A., Hudson, D., West, B.C., 2011. Hunter preferences and willingness to pay for hunting leases. Forest Science 57, 189–200.

Noss, R.F., Carroll, C., Vance-Borland, K., Wuerthner, G., 2002. A multicriteria assessment of the irreplaceability and vulnerability of sites in the Greater Yellowstone Ecosystem. Conservation Biology 16, 895–908.

Pannell, D.J., Marshall, G.R., Barr, N., Curtis, A., Vanclay, F., Wilkinson, R., 2006. Understanding and promoting adoption of conservation practices by rural landholders. Australian Journal of Experimental Agriculture 46, 1407–1424.

Plantinga, A.J., Lubowski, R.N., Stavins, R.N., 2002. The effects of potential land development on agricultural land prices. Journal of Urban Economics 52, 561–581.

Polman, N.B.P., Slangen, L.H.G., 2008. Institutional design of agri-environmental contracts in the European Union: the role of trust and social capital. Njas-Wageningen Journal of Life Sciences 55, 413–430.

Scarpa, R., Rose, J.M., 2008. Designs efficiency for nonmarket valuation with choice modelling: how to measure it, what to report and why. The Australian Journal of Agricultural and Resource Economics 52, 253–282.

Scarpa, R., Thiene, M., Tempesta, T., 2007. Latent class count models of total visitation demand: days out hiking in the eastern Alps. Environmental and Resource Economics 38, 447–460.

Scarpa, R., Thiene, M., Marangon, F., 2008. Using flexible taste distributions to value collective reputation for environmentally-friendly production methods. Canadian Journal of Agricultural Economics-Revue Canadienne D Agroeconomie 56, 145.

Slee, B., 2006. The scope for reconciling public good and private forestry in the UK. Small-Scale Forest Economics, Management and Policy 5, 1–18.

Smith, R.J., Muir, R.D.J., Walpole, M.J., Balmford, A., Leader-Williams, N., 2003. Governance and the loss of biodiversity. Nature 426, 67–70.

Sutherland, W.J., Adams, W.M., Aronson, R.B., Aveling, R., Blackburn, T.M., Broad, S., Ceballos, G., Cote, I.M., Cowling, R.M., Da Fonseca, G.A.B., Dinerstein, E., Ferraro, P.J., Fleishman, E., Gascon, C., Hunter, M., Hutton, J., Kareiva, P., Kuria, A., MacDonald, D.W., MacKinnon, K., Madgwick, F.J., Mascia, M.B., McNeely, J., Milner-Gulland, E.J., Moon, S., Morley, C.G., Nelson, S., Osborn, D., Pai, M., Parsons, E.C.M., Peck, L.S., Possingham, H., Prior, S.V., Pullin, A.S., Rands, M.R.W., Ranganathan, J., Redford, K.H., Rodriguez, J.P., Seymour, F., Sobel, J., Sodhi, N.S., Stott, A., Vance-Borland, K., Watkinson, A.R., 2009. One hundred questions of importance to the conservation of global biological diversity. Conservation Biology 23, 557–567.

Tenge, A.J., De Graaff, J., Hella, J.P., 2004. Social and economic factors affecting the adoption of soil and water conservation in West Usambara highlands, Tanzania. Land Degradation & Development 15, 99–114.

Train, K.E., 1998. Recreation demand models with taste differences over people. Land Economics 74, 230–239.

Train, K., 2003. Discrete Choice Methods with Simulation. Cambridge University Press, Cambridge.

Train, K., Sonnier, G., 2005. Mixed logit with bounded distributions of correlated partworths. In: Scarpa, R., Alberini, A. (Eds.), Applications of Simulation Methods in Environmental and Resource Economics. The Economics of Non-Market Goods and Resources 6. Springer, Dordrecht, The Netherlands, pp. 117–134.

Urquhart, J., Courtney, P., Slee, B., 2010. Private ownership and public good provision in English woodlands. Small-Scale Forestry 9, 1–20.

Vanslembrouck, I., Van Huylenbroeck, G., Verbeke, W., 2002. Determinants of the willingness of Belgian farmers to participate in agri-environmental measures. Journal of Agricultural Economics 53, 489–511.

Wilson, G.A., 1997. Factors influencing farmer participation in the environmentally sensitive areas scheme. Journal of Environmental Management 50, 67–93.

Wilson, G.A., Hart, K., 2000. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Environment and Planning A 32, 2161–2185.

Zandersen, M., Termansen, M., Jensen, F.S., 2007a. Evaluating approaches to predict recreation values of new forest sites. Journal of Forest Economics 13, 103–128.

Zandersen, M., Termansen, M., Jensen, F.S., 2007b. Testing benefit transfer of forest recreation values over a twenty-year time horizon. Land Economics 83, 412–440.