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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

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