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How spatial variation influences landowner willingness to provide ecosystem services

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Abstract
Within conservation literature increasing attention is on conservation opportunity valuing actual implementation. Previously focus has been on conservation priority among areas with the highest biological value or lowest cost. However, when nature management has to take place on private land through voluntary agreement it becomes important to know landowner preferences for such agreements. This study combines data from a choice experiment on landowner preferences with spatial data on the need for biodiversity conservation, groundwater protection and recreation. The aim is to discuss if spatial variation influences landowner preferences and the possibility of including preferences when prioritizing Preliminary results show a negative impact of increasing population density on willingness to provide recreation.

Keywords: Landowners, preference modeling, choice experiments, biodiversity, groundwater, recreation.

1. Introduction

In a recent horizon scanning on the research needs for conservation (Sutherland, 2009; Sutherland et al., 2009) it is argued that future intensification of agriculture as a result of climate change and increased wealth and population will be one of the major conservation challenges. Pressures, responses and impacts will be complex and may result in intensification of agricultural production and destruction of important habitat. If conservation is to become a societal priority, conservation science must be more engaged in the real world and incorporate analyses from the social sciences and humanities, and address conservation in a human-dominated landscape (Robinson, 2006). In this human-dominated landscape

landowners are key actors implying a need for understanding their conservation preferences. Knowing more about how spatial presence of goods influence landowners' preferences may be beneficial when conservation projects are to be implemented.

The aim of this study is to investigate how spatial variation of potential supply of environmental goods influence landowners' willingness to supply these goods and services. Linking landowners' preferences for providing different goods (e.g. biodiversity, groundwater protection and recreation) to geographical data on potential supply and demand for these goods has not previously achieved much attention.

Recent studies (e.g., Knight and Cowling, 2007; Knight et al., 2010) investigate the link between farmer characteristics and conservation opportunities. They add significant insight to the conservation planning literature, which has mostly focused on identifying conservation priorities rather than conservation opportunities. They find that greater efficiency may be added to the decision on 'where' and 'when' to allocate the conservation if conservation research also achieves to map 'how' specific actions can effectively be implemented with a high likelihood of effectiveness. We link farmers' willingness to join conservation projects with the type of ecosystem service provided by the project and socio-economic determinants and discuss the potential implications for the design and targeting of conservation contracts for nature management on private land. Although this approach proves suitable for conservation planning, we argue that lacking investigations of land owner preferences may face the risk of implementation failure, which at the end could lead to a reduced delivery of conservation outcomes (Guerro et al., In Press).

2. Data and Methods

Two sets of data are combined in this study. Landowners' preferences are investigated using a choice experiment of landowners' preferences for afforestation contracts with the purpose to provide different goods; groundwater protection, biodiversity conservation or recreation. The spatial demand for goods is identified using GIS. Preferences and spatial demand for goods are linked by postal code.

2.1 Survey data on land owner preferences

The data were collected using an online, e-mail distributed questionnaire among Danish landowners in January and February of 2009. SurveyXact was used as software. The questionnaire was discussed with a focus group consisting of farmers and experts which resulted in a redesign of parts of the questionnaire. Before the final distribution of the questionnaire a pilot test with 61 landowners was conducted.

Eighteen out of 46 local Danish Agriculture associations agreed to distribute the questionnaire to their members as a link in an e-mail. The e-mail aimed at encouraging the landowner to answer the questionnaire by giving the opportunity to win a prize of 3 X 135 € and addressed possible concerns regarding the questionnaire as e.g. that answers would be kept confidential. The questionnaire was distributed to a total of 3,609 landowners and of these 1,027 landowners answered the questionnaire which equals a response rate of 28.5 %. Respondents who answered less than four questions are not included in the sample (Broch & Vedel, upubl).

2.2 Biodiversity, ground water and recreational proxies

Atlas data (10x10 km grid cells) on 1008 species (Petersen et al. 2005) were spatially designated to zip code levels. Because the data were originally compiled for 10 x 10–km Universal Transverse Mercator (UTM) quadrates (= 100 km2, n = 622), the species richness from each grid cell was assigned to the post code that occupies the greatest proportion of that grid cell using ARCGIS (ESRI). The data include the majority of Danish species within species groups. Similarly the Danish Area Information System was applied to identify the proportional share of area within a zip code with drinking water interests. We applied Danish National Statistic (2010, www.dst.dk) data on the population size within each zip code as a proxy of recreational demand. (Fig 1.).

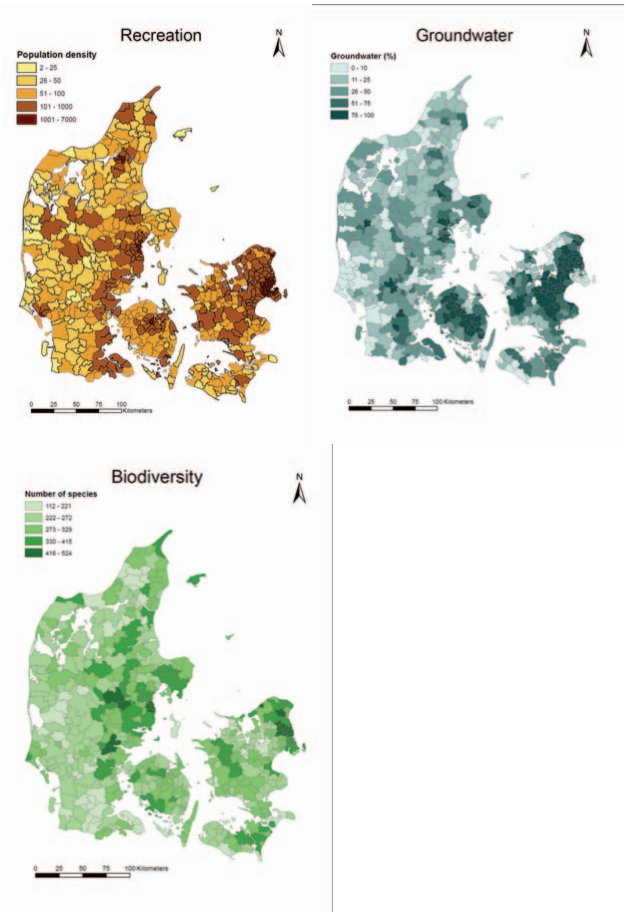

Fig. 1. Proxies for recreational demand, groundwater interests and biodiversity.

2.3 Spatial econometric analysis

The current study applies a choice experiment (CE) to elicit farmers stated preferences towards conservation objectives. The CE method has previously been applied to valuation of environmental goods and services (e.g. Boxall et al., 1996; Christie et al., 2007), and landowners' agri-environmental scheme preferences (Horne, 2006; Ruto & Garrod, 2009; Espinosa-Goded et al., 2010).

The CE utilises the information that each respondent have answered in several choice sets in the survey. In the random parameter logit model with a vector β of parameters, the probability of choosing alternative k becomes:

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

where $f(\beta)$ is the distribution function for β , with mean b and covariance W.

3. Preliminary results

This study shows some preliminary results from the statistical analysis of the combination of spatial data and landowner preferences. It is found that compared to recreational projects land owners require less compensation if the purpose is groundwater, and even less if the purpose is biodiversity. We applied cross products to estimate spatial links between population density, species richness, and the area share of groundwater interests. There is no significant link between the area with high groundwater interests and landowners' willingness to protect groundwater. Interestingly, increasing population density significantly increase landowners' required compensation. This result indicates farmers' disutility from public recreation on their property. Further analysis will investigate the effect of existing forests, hunting data and similar proxies related to the three different purposes of afforestation, on landowners' willingness to provide the different environmental goods. We find no significant spatial effect of species richness on landowners' willingness to afforest for biodiversity purposes. These findings may be used for improving the future targeting of conservation policies and what can be learned about landowners' willingness to contribute to public goods.

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