ELSEVIER

Journal of Environmental Management 85 (2007) 1076–1087

Journal of Environmental Management

www.elsevier.com/locate/jenvman

Assessing the efficiency gains of improved spatial targeting of policy interventions; the example of an agri-environmental scheme

Dan van der Horst*

School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK

Received 27 December 2005; received in revised form 25 July 2006; accepted 11 November 2006
Available online 9 March 2007

Abstract

GIS-based spatial targeting is increasingly recognised as a potentially useful tool to design more efficient policy interventions. The use of this tool has also been advocated in the context of incentive-based agri-environmental schemes, but there has been little work to date to estimate the level of efficiency gains which it may help to achieve. This paper investigates the requirements to arrive at such estimates, using a Scottish farm woodland scheme as a case study. This agri-environmental scheme aims to provide visual amenity and biodiversity. Maps of these two benefits are used to develop improved spatial targeting scenarios that deliver significant efficiency gains in comparison to the existing scheme design. The paper discusses the nature of the spatial distribution of the relevant benefits at the landscape scale and the data requirements for the realistic estimation of efficiency gains. It concludes that although much work needs to be done, the methods available today could and should play a much greater role in improving the landscape-scale design of existing land use schemes focused on the delivery of non-market benefits.

Keywords: Spatial targeting; Value map; Agri-environment; Woodland; Value for money

1. Introduction

There are a growing number of studies that demonstrate how a broad range of different policies can be made to work more equitably, effectively and/or efficiently by using (GIS-based) spatial analysis as an analytical tool to define the most suitable or relevant geographical target areas for policy intervention. Examples of studies that promote the geographical or spatial targeting of environmental policies include Walpole and Sinden (1997) on sub-farm level erosion abatement; Cook and Norman (1996) on agri-environmental policy regarding water pollution, soil erosion and habitat degradation, Apan et al. (2004) on the revegetation of areas affected by dryland salinity problems and Lee et al. (2001, 2002) for the creation and restoration of chalk grasslands and native woodlands, respectively.

The concept of spatial targeting is not new as many established environmental and conservation policies and schemes already apply to specific geographical areas. However, the efficiency of many existing policy interventions can be questioned as the delineation of the target areas, assuming that the choice of boundaries is at all transparent, may be heavily influenced by administrative considerations rather than being based on rigorous spatial analysis of potential costs *and* benefits, and the target areas are treated as internally homogeneous with regards to potential benefit provision. Criticism of such ineffectively delineated designated areas for conservation or pollution prevention in the UK can for example be found in Hutchinson et al. (1995), Wilson (1997), Osborn and Cook (1997) and Thompson et al. (1999).

To date, there have been only a limited number of economic evaluation studies that have attempted to measure the relative efficiency of environmental policy interventions by looking at the design of the intervention with regards to the spatial heterogeneity of costs and

*Tel.: +44 121 4145525; fax: +44 121 4145528.
E-mail address: d.vanderhorst@bham.ac.uk.

0301-4797/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jenvman.2006.11.034

benefits. Bateman et al. (2003) have been at the forefront in demonstrating the usefulness of GIS in environmental economics but the wider applicability of their approach has been limited by their strict focus on those non-market values that could be monetised. A few others have recognised that monetisation is not a strict prerequisite for cost–benefit thinking, and have used quantified non-monetary estimates of such benefits to assess the efficiency of policy interventions. Macmillan et al. (1998) demonstrated that the costs and benefits of a UK scheme to regenerate native woodlands are negatively correlated, partially because the design of the grant scheme does not take into account the importance of the locational determinants of benefit such as the size of the woodland or distance to other woodlands. In an early US case study, Babcock et al. (1997), demonstrated that enrolling land into a conservation programme on the basis of the lowest cost of purchasing the land, is a far less efficient use of taxpayers' money than targeting land on the basis of the benefit–cost ratio of that land. These two *ex-post* studies related to discrete parcels of land that were already enrolled into the scheme, and did not consider the wider, continuous landscape around these parcels where spatial analysis could be used to identify (*ex ante* or *ex post*) other areas that may have much higher (environmental) benefit–cost ratios.

In addition to policy interventions on land already owned by the state or on land which is specifically purchased by the state as part of the intervention, there are policy interventions on private land. These interventions may be based on command-and-control measures in which land-owners face specific restrictions in their usage of the land, or they may be based on a market-oriented approach of incentives. As an example of the latter, various agri-environmental schemes under the EU's Common Agricultural Policy offer subsidies to entice farmers to manage their land in ways that increase the provision of non-market benefits such as recreation, the conservation of biodiversity or the maintenance of historic landscape features. Since the early 1990s, methods have been developed to map many of these benefits across the landscape. This research trend has been particularly notable in forestry where GIS-based potential benefit maps have been developed for estimating timber yield (Macmillan and Chalmers, 1992; Allison et al., 1994), woodland recreation (Brainard et al., 1999), carbon sequestration (Bateman and Lovett, 2000), biodiversity (van der Horst and Gimona, 2005) and visual amenity (van der Horst, 2006a). These studies invariably show that these benefits are highly spatially heterogeneous at the landscape or regional scale.

This trend in benefit mapping studies is linked to the increased research interest in multifunctional land use and ecosystem services, and the increased availability and accessibility of computers, modelling software and (geo-referenced) data. These developments also explain why in more recent years there has been a strong increase in the number and diversity of studies looking at the efficiency of spatial targeting of land use policy interventions for the provision of non-market goods (Yang et al., 2003; Park et al., 2004; Groeneveld et al., 2005; Lant et al., 2005; Lee and Thompson, 2005; Messer, 2006; Bailey et al., 2006; Saroinsong et al., 2007). These studies demonstrate time and again that better spatial targeting can in principle result in better value for money.[1] In the case of voluntary agri-environmental schemes, however, there have been very few efforts to date to estimate the level of efficiency gains, which could potentially be achieved.

The main aim of this paper is to explore the requirements of assessing such efficiency gains. This exploration will be based on a regional case study of an existing voluntary agri-environmental scheme. The Farm Woodland Premium Scheme (FWPS) is a voluntary scheme that offers farmers in Scotland annual incentive payments for the conversion of farmland to woodlands. The FWPS succeeded its predecessor the Farm Woodland Scheme in 1992 and was in turn superseded in 2003 by a broadly similar scheme called the Scottish Forestry Grants Scheme; Farmland Premium. Since existing contracts provide participating farmers with annual payments for the first 15 years after planting, from a financial perspective the FWPS will continue to be a live scheme until 2018.

Biodiversity and visual amenity are the two most important public benefits that the woodlands planted under the FWPS were expected to deliver (MLURI, 1996). However, the payment levels for this scheme are based on land use classifications, which reflect the opportunity cost of the land, i.e., farmers are compensated for the forgone income from the most lucrative agricultural activities possible on that piece of land. This scheme is thus designed to provide an equal encouragement for planting across the landscape and there is no effort to target plantings towards areas where potential benefits are likely to be higher.

A relatively conventional mid-term evaluation of the FWPS (MLURI, 1996) showed appreciation of the importance of spatial characteristics at the site-level only, which was assessed through site visits by experts. They scored the landscape impacts in terms of contributions to landscape character, aesthetic impact, visibility and local conformity, while biodiversity impacts were assessed by scoring a range of site and planting attributes against fauna, flora, naturalness and structural diversity. "*Overall, the survey showed that new woodlands enhanced the local landscape character and were of aesthetically pleasing design*" (MLURI, 1996, p. IV) while biodiversity was found to be substantially increased.

An evaluation of the plantings at the landscape or regional scale (as opposed to site-level) would require knowledge of the spatial variability of the benefits that the

[1] Some questions have been raised about the practicalities of implementation and the potential transaction costs but that debate lies outside the scope of this study.