Ian J. BATEMAN, Andrew A. LOVETT and *Julii S. BRAINARD*, **Applied Environmental Economics: A GIS approach to Cost-Benefit Analysis.**

Cambridge (UK), Cambridge University Press, 2003, 335 p.

The authors aim to assess the expected social benefits and costs on the conversion of agricultural land into woodland. For this cost-benefits analysis (CBA), the authors make extensive use of a Geographical Information System (GIS) to accommodate the spatially distributed biophysical and economic data but also to present the results in colourful maps.

The book is centred around a policy application for Wales (UK) concerning a CBA that evaluates the optimal geographical sites for conversion of agricultural land into woodland. The analysis requires that both the environmental and economic characteristics of woodlands are properly appreciated and the main problem is that woodland clearly has both monetary and 'non-monetary' values. Hence, the authors organize their book for this ambitious quest mainly around three types of woodland valuation, viz timber yields (market based use value), recreational aspects (non-market use value) and future carbon sequestration (bequest value). The introduction identifies the objectives, motivates the GIS approach and describes the organization of the book. Hereafter, three chapters deal with the non-market valuation of recreation in woodlands. The next two chapters concentrate on the market-based valuation of timber production, while the subsequent chapter is devoted to the valuation of carbon sequestration. Having established the economic value of woodlands, its opportunity costs in terms of market-based agricultural output are estimated. A concluding chapter provides a synthesis in which the accumulated information of the previous exercises was used for a cost-benefit appraisal of converting agricultural land into woodland, depicting the results of this GIS-based CBA in illustrative maps.

The authors make clear that any assessment of the appreciation for recreational purposes of woodlands should rely upon individual preferences. Since environmental goods typically do not have a market price, it is impossible to apply standard revealed preference techniques. The authors, after an extensive and thorough discussion, choose therefore to use surrogate market approaches such as the travel costs (TC) on an individual and zonal basis. The negative relationship between travel costs and the number of visits maps out a spatially represented demand curve for recreational services with the drawback that the substitution effect cannot be separated from an ambiguous income effect. To overcome this problem, the authors rely on the much-criticized contingent valuation (CV) method, but they also include the relevant critical references. Chapter 2 is entirely devoted to discussion of the CV and TC methods. The estimations are carried out in chapter 3 in several steps. First, a cross-study meta-analysis of recreational values in the UK is performed that establishes consistency among estimation results throughout the country. Second, the recreational valuation for Thetford Forest in East Anglia is estimated from two extensive surveys performed by the authors and these estimates are taken as being valid for valuation of woodlands in Wales. Finally, the valuations are used in a spatial regression with travel distance as one of the variables to fill

the GIS database with local valuations. In chapter 4, the arrival function is estimated for Thetford Forest and the results are translated to a GIS data base for Wales, which allow to predict the number of visits in Wales as a function of the distribution of woodlands, the roadmap and population distribution. The end result is a spatial distribution of woodland recreation benefit values for Wales. The subsequent two chapters are devoted to the market valuation and mapping on the GIS of timber production. Chapter 6 deals with assessing the net present value of costs and benefits of planting two divergent species of timber, *e.g.* spruce and beech, that was performed by estimating each species growth curve, its optimal rotation cycle and the different discount rates for policy makers and farmers. The analytical and data logistic properties of the GIS are fully exploited in chapter 6, where the obtained valuations are distributed on the GIS map. A nice example of the GIS facilities is the incorporation of the spatial data set from the Soil Survey and Land Research Centre, which allows accounting for the soil and climate influences on wood production. Chapter 7 extends the analysis by incorporating carbon sequestration for the tree species. The valuation is based upon the shadow price of carbon emissions in society and is related to the carbon storage by each species, the rotation cycle with carbon liberation from wood products and forest management practices that influence the carbon uptake. The estimations make use of expert data from other agronomics. Finally, these estimations are mapped into the GIS by making use of soil and other maps. Chapter 8 calculates the farmgate income for two different farm types : sheep and dairy production. Rather than working at parish level, the GIS allowed to present farm level utilities and inclusion of biophysical information as explanatory variables in the surplus functions. A shadow-pricing exercise provided comparisons with estimated levels of farmgate income. The CBA in chapter 9 uses the information of the previous chapters the compared net benefits of woodland to the two alternative agricultural production systems. These alternative uses provide the shadow prices or opportunity costs of woodlands. Farm surpluses for each type of farming are estimated taking into account agricultural inputs and soil characteristics, which produced the spatial distribution over the GIS. Based upon these shadow prices the CBA with respect to conversion of agricultural land into woodlands could be conducted.

The book is well structured and pleasant to read. Throughout the book the authors discuss the approach followed as well as alternative routes not taken without knocking out the reader. The use of GIS does not only capitalize on the visual display capabilities, which makes the results appealing for decision makers and the general public, it also addresses the aggregation problem, which so often blurs non-spatial analysis in resource economics, thereby significantly improving the quality of the CBA. For example, the GIS analysis shows that the optimal location of converting agricultural land is near heavily populated areas and not, as now is common practice, in remote uphill areas. A table where the numerous abbreviations are explained would benefit this nice academic work that shows how spatial resource economics can contribute to analyse the difficult and often times confronting environmental policy questions. The book is especially interesting for environmental economists ; however, it also shows geographers and soil scientists how their information can be accommodated in a decision support tool that addresses socially relevant questions. Finally, the subject is also important in the light of the discussion

on eco-services that are now part of the Common Agricultural Policy in the EU. In the June 2003-reform of the CAP, it is announced that price support is to be replaced by direct income support and payments for eco-services. Clearly, to be acceptable within WTO, and not be denounced as hidden subsidies in upcoming panels, the pricing services will have to be standardized in the most objective way possible. Contingent valuation is unlikely to win this contest.

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