

Science for Environment Policy

Trade-offs in ecosystem services in Central and Eastern Europe

Researchers have developed a new approach for identifying regions that are most suitable for expanding ecosystem services. This could be used to help inform spatial planning decisions. By modelling ecosystem services' opportunity costs in relation to agricultural revenue, the study provides a map of suitable areas of ecosystem service expansion in Eastern Europe.

Understanding where particular ecosystem services are weak or strong and how they might complement or counteract each other is important for making decisions about [land use](#). However, little research on this has been conducted. The study aimed to address this knowledge gap and provide a way to assess which regions' ecosystem services can be increased cost-effectively, and whether it is better to jointly generate ecosystem services or to specialise in one of them. This would allow decision makers to improve ecosystem services in a cost-effective way and to identify which regions to target for ecosystem service enhancing measures.

The study focused on assessing the trade-offs of four ecosystem services: provisioning of agricultural goods, carbon sequestration, cultural services (e.g. tourism and recreation) and enhancing biodiversity. This was done by estimating the opportunity costs of expanding the ecosystem services in terms of the gross agricultural revenue foregone from the required land use change. The study used data on these services in 18 Central and Eastern European countries and calculated the amount of carbon sequestration as: the carbon produced by plants minus the carbon lost via soil respiration and from harvesting crops.

The results indicate that, in general, higher levels of biodiversity, cultural services or carbon sequestration result in lower levels of agriculture revenue, implying there are trade-offs between the three former ecosystem services and provisioning of agricultural goods. However, this picture varies between regions.

To investigate this further, the study examined the opportunity costs in terms of the agricultural revenues that would be lost if other ecosystem services were expanded. There was a great variation in these costs between countries. For example, the opportunity cost of expanding carbon sequestration in Estonia was \$62 (€47.81) per tonne of carbon, whereas in Macedonia it was \$1169 (€901.41). This indicates that targeting areas which already have high sequestration levels is cost-effective.

In general, it appeared that regions suitable for carbon sequestration had greater percentages of grassland or forest and lower agricultural production. This, for instance, makes Estonia, on average, a more suitable location to increase carbon sequestration.

For biodiversity and cultural services, the pattern seemed less clear. Interestingly, it appeared that areas suitable for improving biodiversity were those where biodiversity was either very poor or very rich. A likely explanation for this is that small land use changes can have large impacts in areas with little biodiversity, by providing better habitat for species. Small land use changes in areas high in biodiversity can have large effects by improving connectivity between those areas already rich in biodiversity.

Moreover, many of the areas considered suitable for improving biodiversity, carbon sequestration or cultural services overlap, for example, some areas of Slovakia, Slovenia and Estonia. This implies that multiple ecosystem services can be improved simultaneously if areas for conservation are carefully targeted.

The approach provides informative insights into interactions between ecosystem services for proposed land use changes. However, there is a need to consider other ecosystem services, particularly those providing protection against the impacts of climate change. For effective decision making, more detailed, localised data and a better understanding of community values on ecosystem services for an area may also be needed.



25 July 2013

Issue 338

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Source: Ruijs, A., Wossink, A., Kortelainen, M., Alkemade, R. & Schulp, C.J.E. (2013) Trade-off analysis of ecosystem services in Eastern Europe. *Ecosystem Services* Doi: 10.1016/j.ecoser.2013.04.002.

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To cite this article/service: "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.