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Levin, Gregor; Brandt, Jesper; Olsen, Martin; Holmes, Esbern

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Discrepancies in scale between stratified sampling based landscape monitoring and CORINE land cover registration.

G. Levin¹, J. Brandt¹, M. Olsen¹, E. Holmes¹

¹ Department of Environmental, Social and Spatial Change, Roskilde University, P.O. box 260, DK-4000 Roskilde, Denmark. e-mail: gplevin@ruc.dk

Introduction

As recent agricultural change profoundly affects landscape patterns, a need to measure changes in agricultural landscapes exists. Important changes are the establishment and removal of small uncultivated and semi-cultural landscape elements, dynamics in field structure as well as extension and abandonment of agricultural land use. These changes are considerable, but generally characterised by small spatial scales. Detailed landscape monitoring like the Danish small biotope programme (SBMP) (Agger and Brandt, 1988; Brandt *et al.*, 2001; Levin *et al.*, 2006) is adequate to measure these changes. However, the SBMP is limited to 32 sample areas, covering < 0.4% of all agricultural land in Denmark, from which it can be difficult to generalise to the national level. The CORINE land cover (CLC) database is a covering land cover registration for 1990 and 2000 embracing all countries in the EU 25. However, the minimum mappable unit is 25 ha, which is too small to capture most changes in Danish agricultural landscapes. This paper aims at analysing relationships and discrepancies in scale between the two databases.

Land cover changes between 1990 and 2000

According to the CLC registration, between 1990 and 2000 only 1.3% of the Danish land area has been subject to change in land cover. Only about 1/3 of all changes involved agricultural land. The major changes involving agricultural land use were agriculture to urban use and agriculture to forest. Changes between different kinds of agricultural land cover accounted for less than 7% of all changes.

In comparison, analyses of land cover changes within 12 sample areas in eastern Denmark show that between 1991 and 2001 more than 15% of the agricultural landscapes were subject to change in land cover. This means that the much lower spatial resolution of CLC limits the registration of most changes in Danish agricultural landscapes.

Separating CORINE classes with monitoring data

For 31 sample areas, Table 1 shows how the three major CLC classes urban, agriculture and forest are characterised by the monitoring data from SBMP. The three classes clearly differ from each other in terms of area in agricultural rotation, area with tree cover and area with urban use.

Table 1. Characteristics from landscape monitoring data from 1991 for 3 major CORINE land cover classes in 1990 within 31 sample areas in Denmark (average area percentage for CORINE classes calculated for squares of 25ha – 500m X 500m)

CORINE land cover class	% under agricultural rotation	% tree cover	% urban use and built up
Urban	21.6%	0.3%	76.3%
Agriculture	90.7%	2.6%	1.3%
Forest	14.4%	29.1%	0.3%

The same analysis was performed for the three different agricultural classes within CORINE (lowest level), which exist within the 31 sample areas. Furthermore, a larger number of variables from the SBMP monitoring were applied. The analysis showed that the three CLC classes differ highly from each other:

- Non irrigated arable land is characterised by the largest average field size and the highest area percentage of land in rotation.
- Land with complex cultivation patterns is characterised by the highest land cover heterogeneity and the highest density of line elements, such as hedgerows, field divides and water courses.
- Agricultural land use with larger nature areas is characterised by the highest area percentage of land outside rotation and of tree cover

In spite of the very different scales, this analysis thus points at a clear relationship between the two different datasets. However, with respect to land cover changes between 1990 and 2000 only few relationships between CLC and SBMP could be found. With 12 SBMP sample areas in east Denmark land cover changes were registered for 1991 and 2001. Within these 12 areas no changes in the CLC registration appeared. However, within the two CLC classes, which exist within the 12 areas, following tendencies were observed:

- Non irrigated arable land is characterised by a larger increase in heterogeneity, an increase in mean field size and a larger decrease in land in rotation.
- Agricultural land use with larger nature areas is characterised by a slight fall in mean field size, a larger increase in tree cover and a larger increase in the density of hedgerows and field divides.

Conclusions

The strength of the CLC registration is that it provides a total coverage for the whole EU. However, the registration is too broad to capture most relevant changes in the Danish agricultural landscape. Still, our analyses show that in spite of very different resolutions, the CLC and the SBMP databases are related to each other. We therefore propose a system, where information from other data sources, e.g. from landscape monitoring, is added to the CLC-database in the form of additional attributes to the existing CLC classes. These attributes or "tessera" specifications, add information on densities and spatial properties of different landscape elements and on indicators for spatial heterogeneity. Such system would hopefully enable the CLC-database to capture more changes in the agricultural landscape, without altering the general CLC classification system.

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