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Does demographic change affect land use patterns? A case study from Germany

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ABSTRACT

Recent demographic change, mainly characterised by a decreasing and ageing population, is seen as one of the main factors for future land use development in Europe. However, there is still insufficient evidence about the relationship between demographic changes and land use changes since quantitative studies dealing with these interactions are still rare. We aim to fill that gap by presenting the first comprehensive study that investigates statistical relationships and spatial differentiations between demographic and land use change for the whole of Germany. Our study is based on data for the period from 1995/1996 to 2003/2004. The results clearly show that in most growing regions in the West of Germany a correlation was found between land use, natural population growth and net-migration, whereas for land use change in the shrinking regions in the East of Germany economic variables are of noticeable importance. A cluster analysis reveals "gaining" and "shrinking" regions concerning both urbanisation and demographic change. Neither a decreasing nor an ageing population imply reduced land consumption for housing and transportation. Furthermore we found a decreasing settlement population density for almost all German districts regardless of population growth or shrinkage.

Introduction

Demographic change is becoming increasingly more important in political and planning discussions, given that it is considered to be an important factor for future land use development and urbanisation throughout the whole of Europe (UN, 2007; UNPF, 2007). The Millennium Ecosystem Assessment states that demographic development is an essential driver for ecosystem and land use change (Nelson et al., 2006; EEA, 2006). As in most European countries, demographic development in Germany is mainly characterised by a declining and rapidly ageing population due to a fertility that is below replacement and an increasing life expectancy (Edmonston, 2006). Another important aspect of demographic change is the decline of the average household size in line with what demographers describe as the Second Demographic Transition (SDT; Lesthaeghe and Neels, 2002; Steinführer and Haase, 2007). However, long-term data sets on household dynamics and household types put into relation with land use dynamics are still rare (Haase and Haase, 2007).

In addition to a decrease in fertility, migration can be an even more determining factor that influences population size and age structure (Flöthmann, 2003). Ever since the German reunification in 1990, migration fluxes from eastern to western Germany and from the core cities to the suburban regions have been observed (Nuissl and Rink, 2005). Rural regions in eastern Germany have particularly suffered from population decline and a growing proportion of elderly people whereas most suburban and rural regions in the western part of the country are still experiencing population growth (Müller and Kilper, 2005). Demographic processes, of which the migration rate is of prime importance, are having significant impacts on urbanisation. Marginalisation and land abandonment in rural areas are becoming more and more observable. However, ongoing construction activities in the suburban areas of eastern Germany's shrinking cities are creating an urban-sprawl and resulting in the perforation of residential areas, and a decreasing settlement population density (Nuissl and Rink, 2005).

Currently, population decline is regarded as an opportunity to increase the sustainability of land use by decreasing the further sealing of open areas for housing and transport (Haase and Nuissl, 2007), although there is still almost no evidence on the accuracy of this relationship. Through its national sustainability strategy the German Federal Government (German Federal Statistical Office, 2007) hopes to limit new land consumption for housing and transport purposes to 30 ha/day up until 2020. This target, however,

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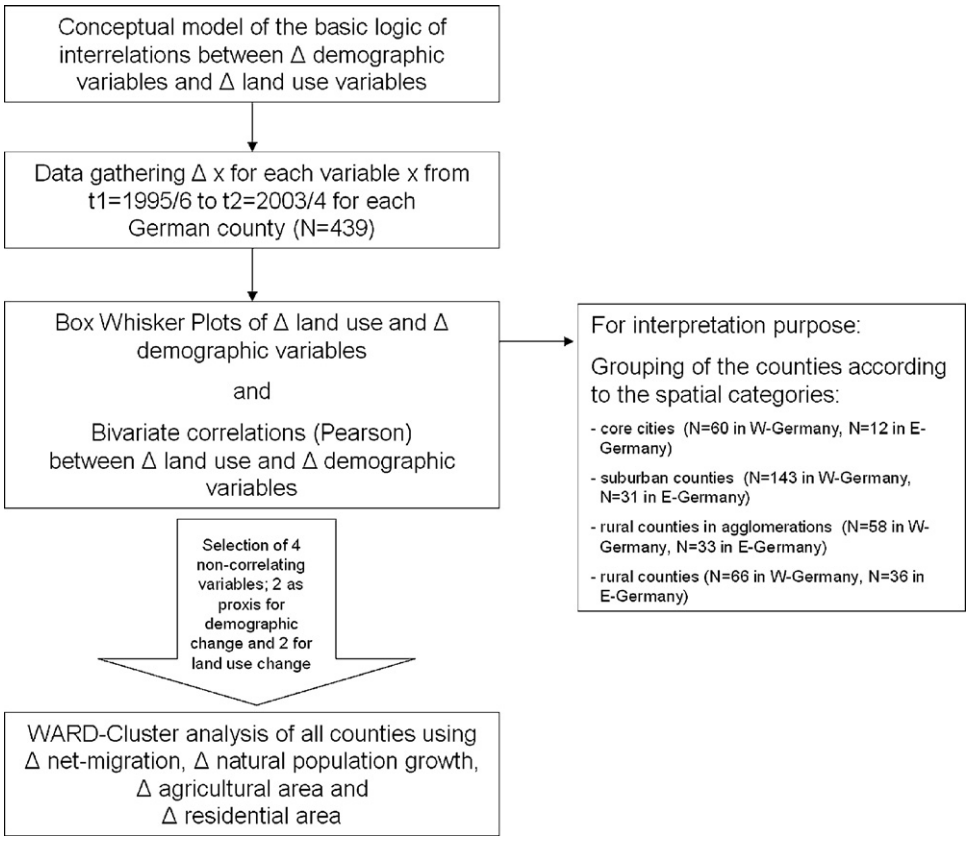

Fig. 1. Main components and sequence of the methodical approach.

still seems to be well out of reach, as a noticeable trend towards a decreasing amount of land consumed for housing and transport is not yet visible. Thus, the effects of a declining and ageing population on the development of residential and transport areas are of particular interest to national and regional policy makers.

In the current literature, contradictory assumptions about the relationship between demographic change and land use have been found. A declining population is not necessarily followed by a decline in development or even a decrease in urban land (German Federal Environment Agency, 2003; Couch et al., 2005). The reasons for this can be attributed to a decreasing household size and a rise in housing demand regardless of population decline. In contrast, Wolf et al. (2004) expect a future decline in urban area growth in regions with a decreasing population. In addition, abandoned agricultural land and the growth of forest and natural land following the depopulation of rural areas are considered to be a likely scenario (Bruns et al., 2000).

However, a quantitative analysis of the relationship between demographic and land use change at the regional scale is still missing.

Objectives and case study

We aim to fill that gap by using Germany as an example and looking for, firstly, statistical relationships between demographic and land use changes and, secondly, the spatial differentiation and heterogeneity of demographic and land use change variables.

Germany is extremely well suited as it is the most populous country of the EU and has shown significant demographic changes since 1990. At the same time, Germany has one of the highest rates of daily land consumption (a current average of 113 ha in 2006; German Federal Statistical Office, 2008). Therefore, we looked for correlations among the most significant demographic, socio-economic and land use variables since 1990 in order to depict statistical relationships, which identify possible causalities. We focused on both the entire country and its urban, suburban and rural regions. This enabled us to explore varying relationships depending on regional specifics as major differences between eastern and western Germany were expected. Such quantitative knowledge of statistical relationships between demography and land use can be used to support policy makers and help them to cope with population growth and decline when "planning" sustainable spatial development.

The paper is organised as follows: in the first part, after an introduction, the components of the methodical approach are presented, followed by the results of the statistical analyses. In the subsequent part the results are discussed and in the final part the final conclusions are drawn.

Data and methods

In order to build a statistical model including land use and socio-demographic processes, we identified key land use and socio-demographic variables. The respective variable selection was restricted by data availability at the district level. We chose the spatial level of the 439 German districts as a compromise between a high spatial resolution and the availability of comparable data for all entities. After collecting the data, the changes for 1995/1996–2003/2004 were computed before conducting a variance, correlation and cluster analysis. Fig. 1 summarises the main components of the methodical approach.